Catalog No. CHC-11

OPERATOR'S MANUAL

KEARNEY & TRECKER
MILWAUKEE

3hp 18"-24"

MODEL AC

Plain and Swivel Head Vertical Milling Machines

with mono-lever and automatic cycle table control

3hp No. 1

MODEL CH

Plain-Universal-Swivel Head Vertical Milling Machines

with standard directional table control

3hp No. 2

MODEL CHL

Plain-Universal-Swivel Head Vertical Milling Machines

with standard directional table control

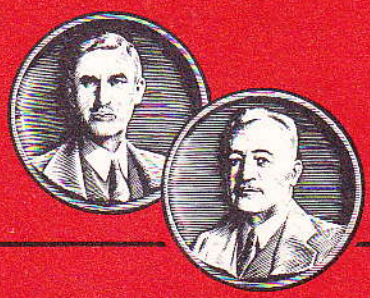
5hp No. 2

MODEL CH

Plain-Universal-Vertical Milling Machines

with mono-lever and automatic cycle table control

with standard directional table control



KEARNEY & TRECKER CORPORATION

MILWAUKEE 14, WISCONSIN, U.S.A.

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KEARNEY & TRECKER MILWAUKEE

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

Kearney & Trecker Corporation

Milwaukee 14, Wisconsin

U. S. A.

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LIST OF ILLUSTRATIONS

FOREWORD

This manual contains instructions for operating the plain, universal and swivel head vertical styles of the following Kearney & Trecker - Milwaukee milling machines:

3 hp No. 1 Model CH
3 hp No. 2 Model CHL
3 hp 18" - 24" Model AC
5 hp No. 2 Model CH

This manual has been prepared to familiarize you with these machines and to help you operate them properly. The first three sections of the manual briefly describe the electrical, coolant and lubrication systems. Section IV describes conventional operation in which table travel is manually controlled by the table feed lever. Section V describes automatic cycle operation (on 18" - 24" AC and 2CH machines only) in which table travel is automatically controlled by trip dogs and the hydraulic system.

NOTE

THIS IS AN OPERATOR'S MANUAL ONLY. For installation instructions refer to the Installation Manual No.CHI-11. For replacement parts information refer to Catalog CHR-31 for 1CH, 2CHL and 18" - 24" AC machines and to Catalog CHR-33 for 2CH machines.

IMPORTANT Read before Studying Manual

Figures 1 through 8 identify the units with which the operator should be familiar. Refer to these illustrations when studying the manual. Check the figure title to be sure that the picture illustrates the machine you are operating.

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

It is our intention to continually improve the service you receive from Kearney & Trecker - Milwaukee milling machines and to make their operation as simple as possible. In accordance with this policy, we invite you to bring any questions and problems to the attention of the Service Department, Kearney & Trecker Corporation, Milwaukee 14, Wisconsin, U.S.A. For service by telephone, call GReenfield 6-8300.

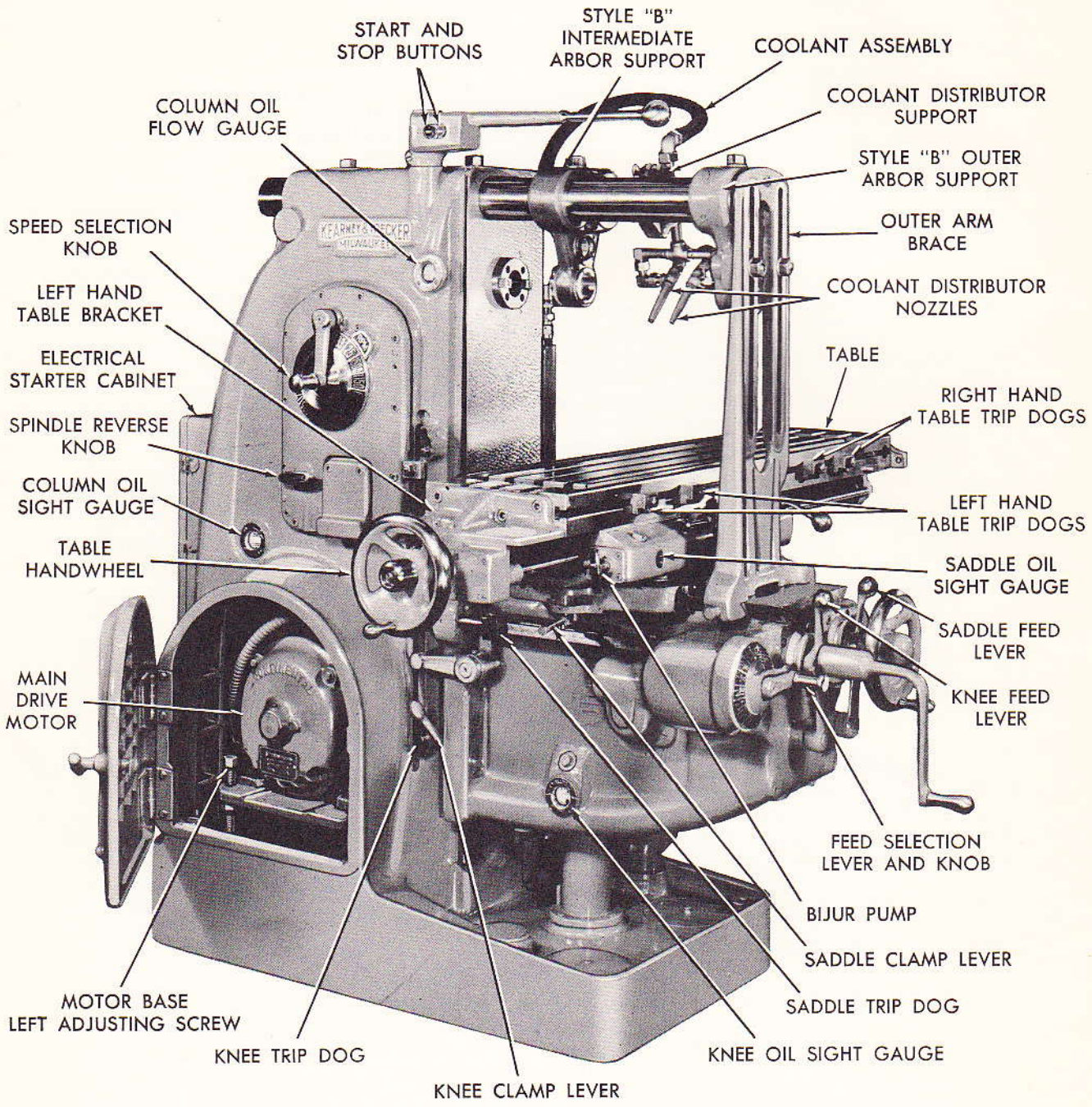


Fig. 1. 1CH and 2CHL Universal Machines—
Left Front View

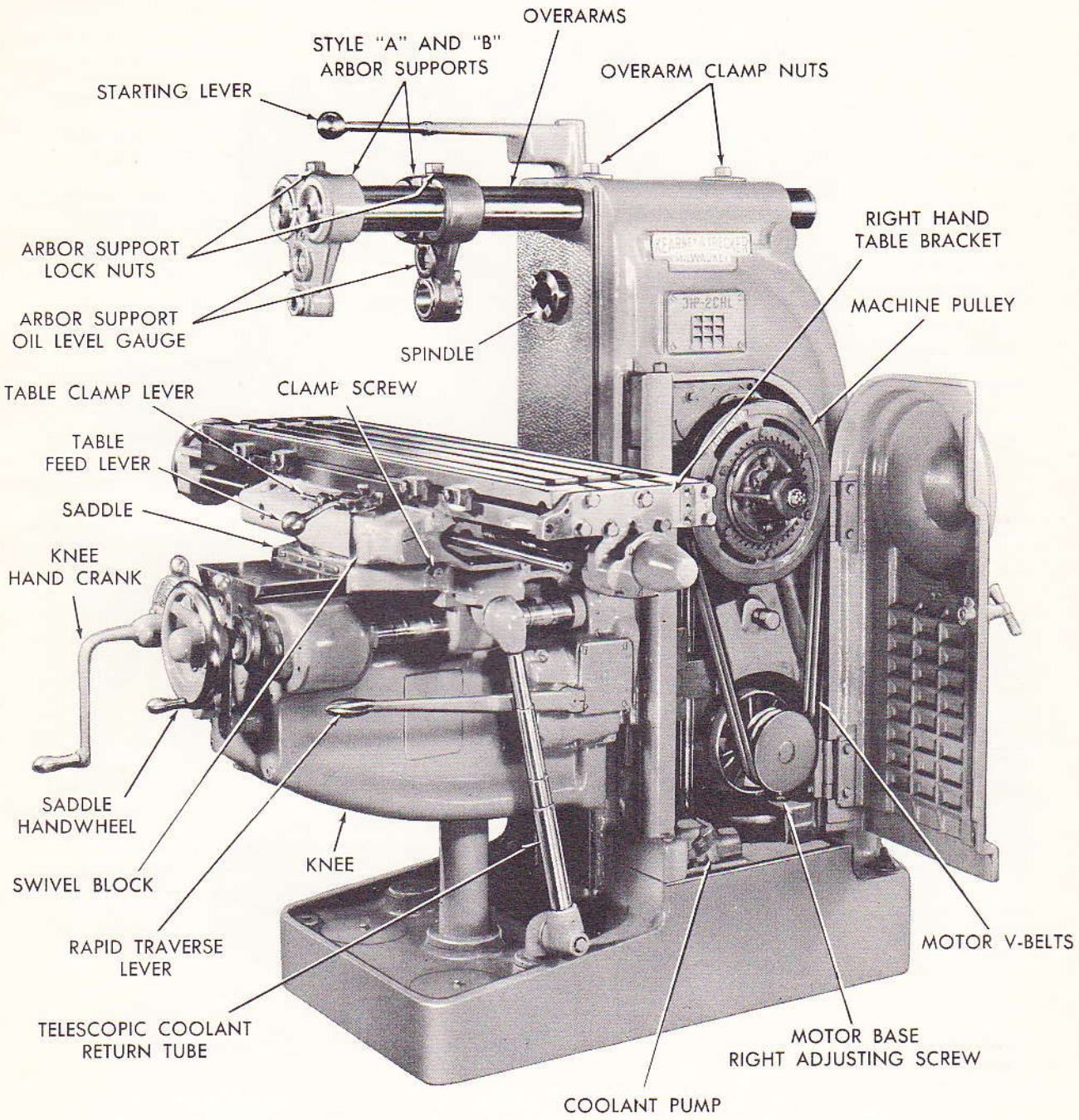


Fig. 2. 1CH and 2CHL Universal Machines—
Right Front View

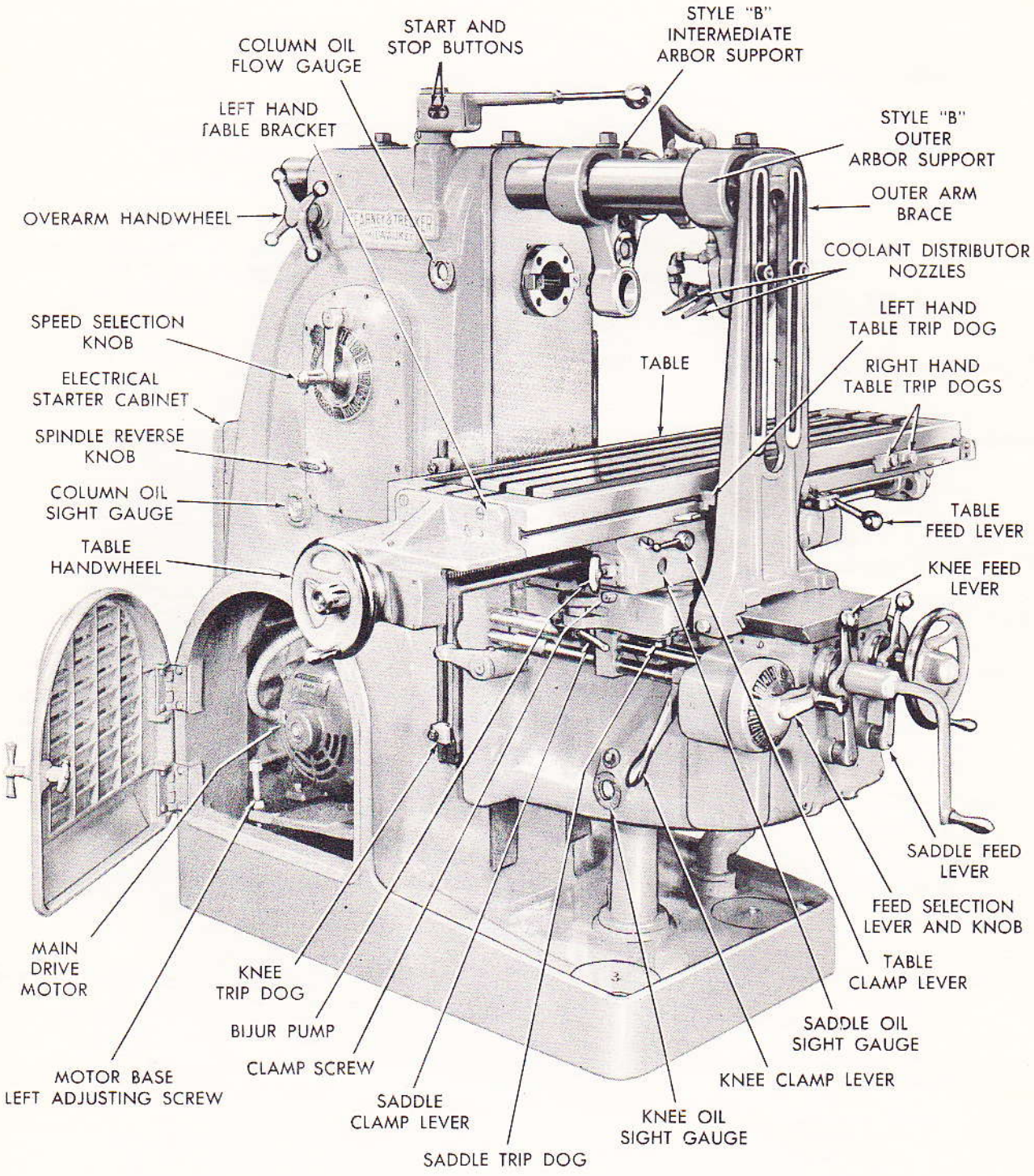


Fig. 3. 2CH Universal Machine—Left Front View

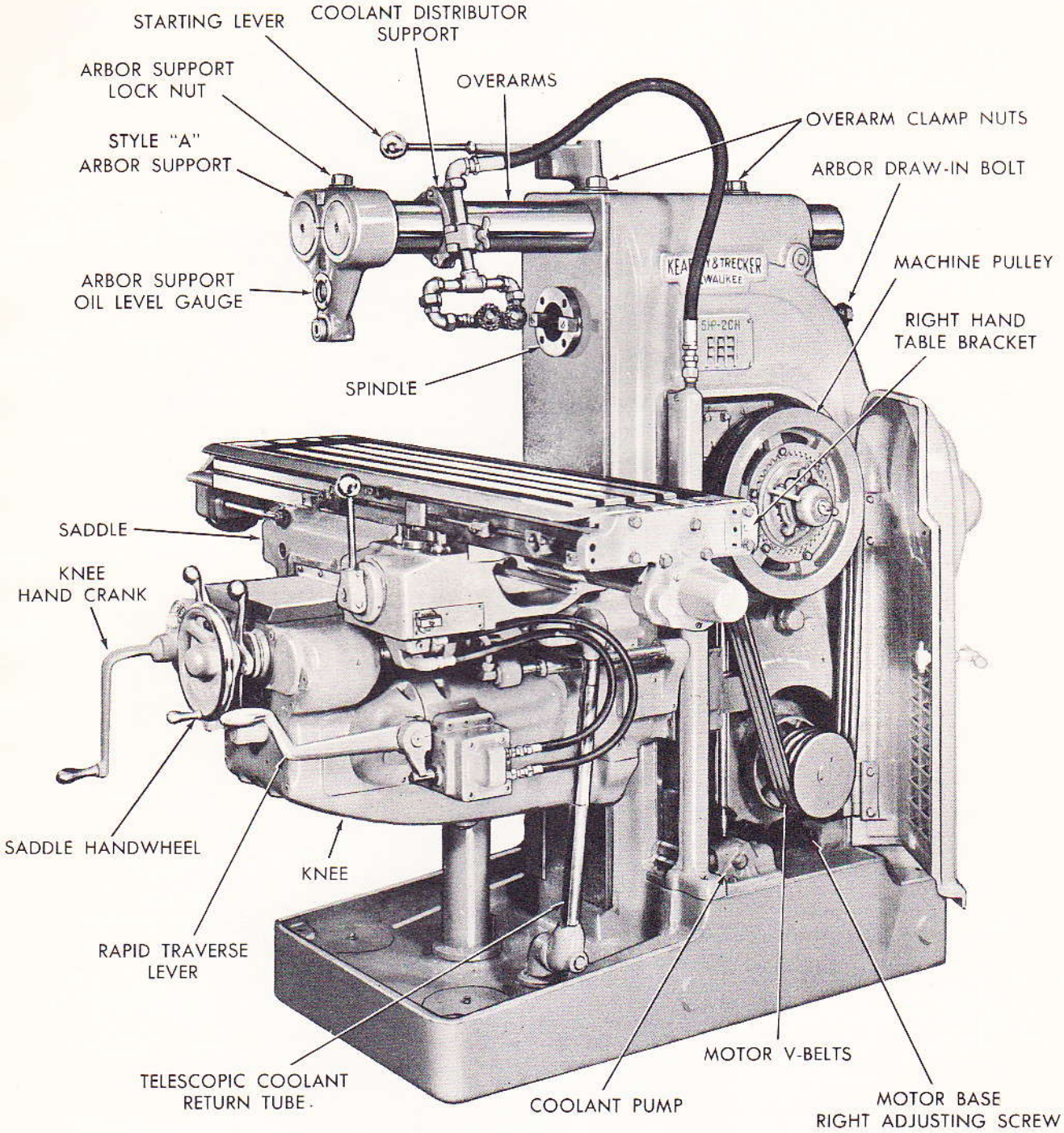


Fig. 4. 2CH Plain Machine — With Mono-Lever and Automatic Cycle Table Control — Right Front View

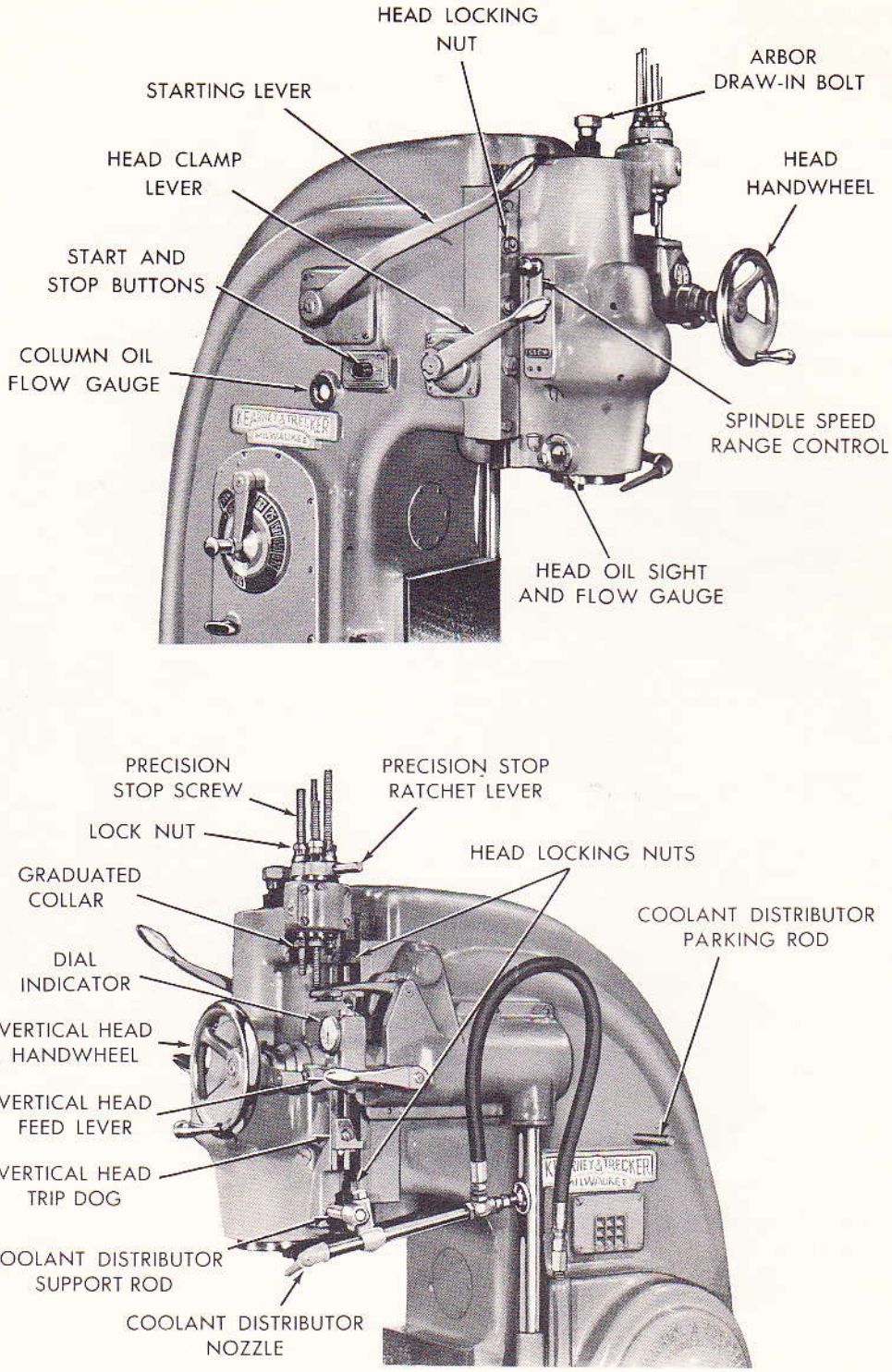
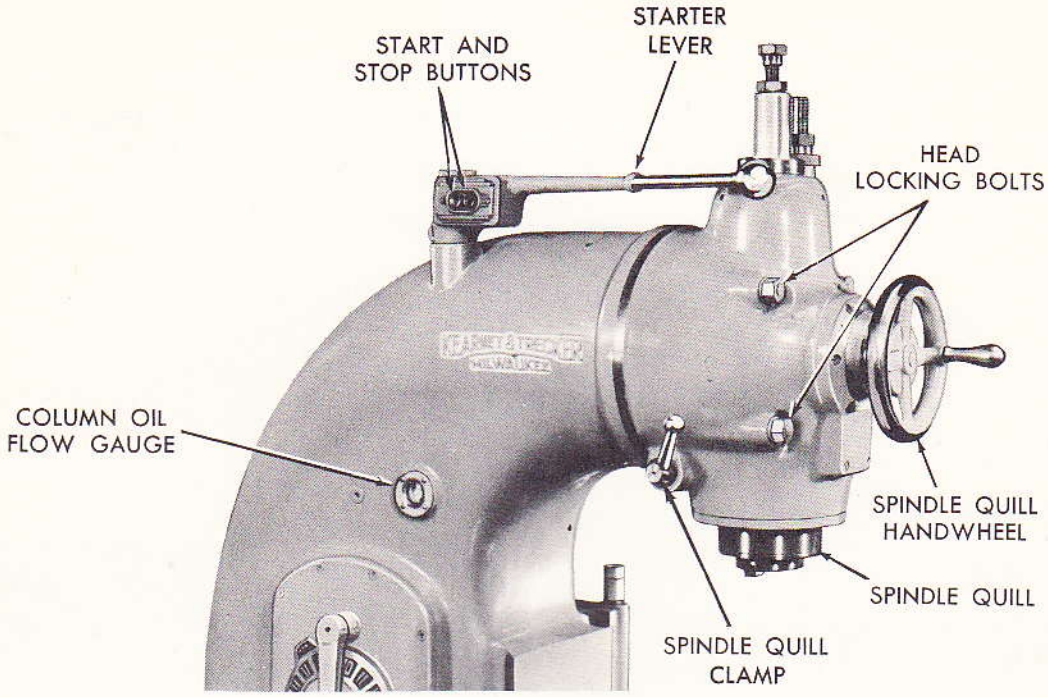


Fig. 5. 2CH Vertical Head—Left and Right Front Views



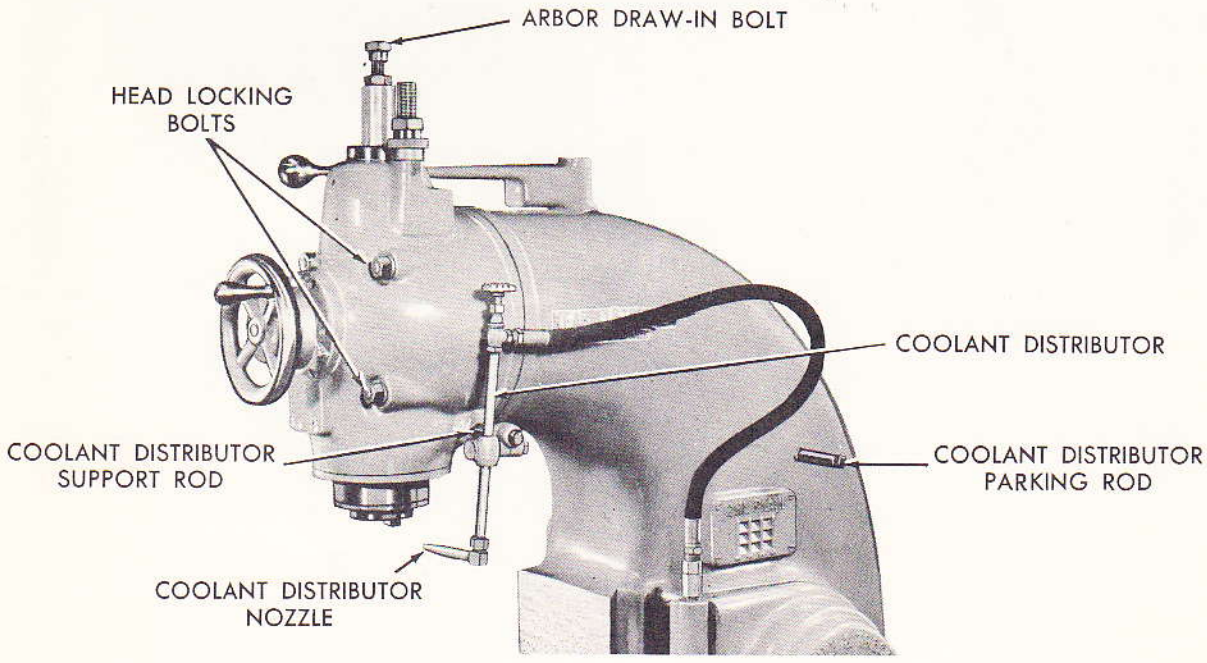


Fig. 6. 1CH, 2CHL, 18"-24" AC Swivel Head
Vertical—Left and Right Front Views

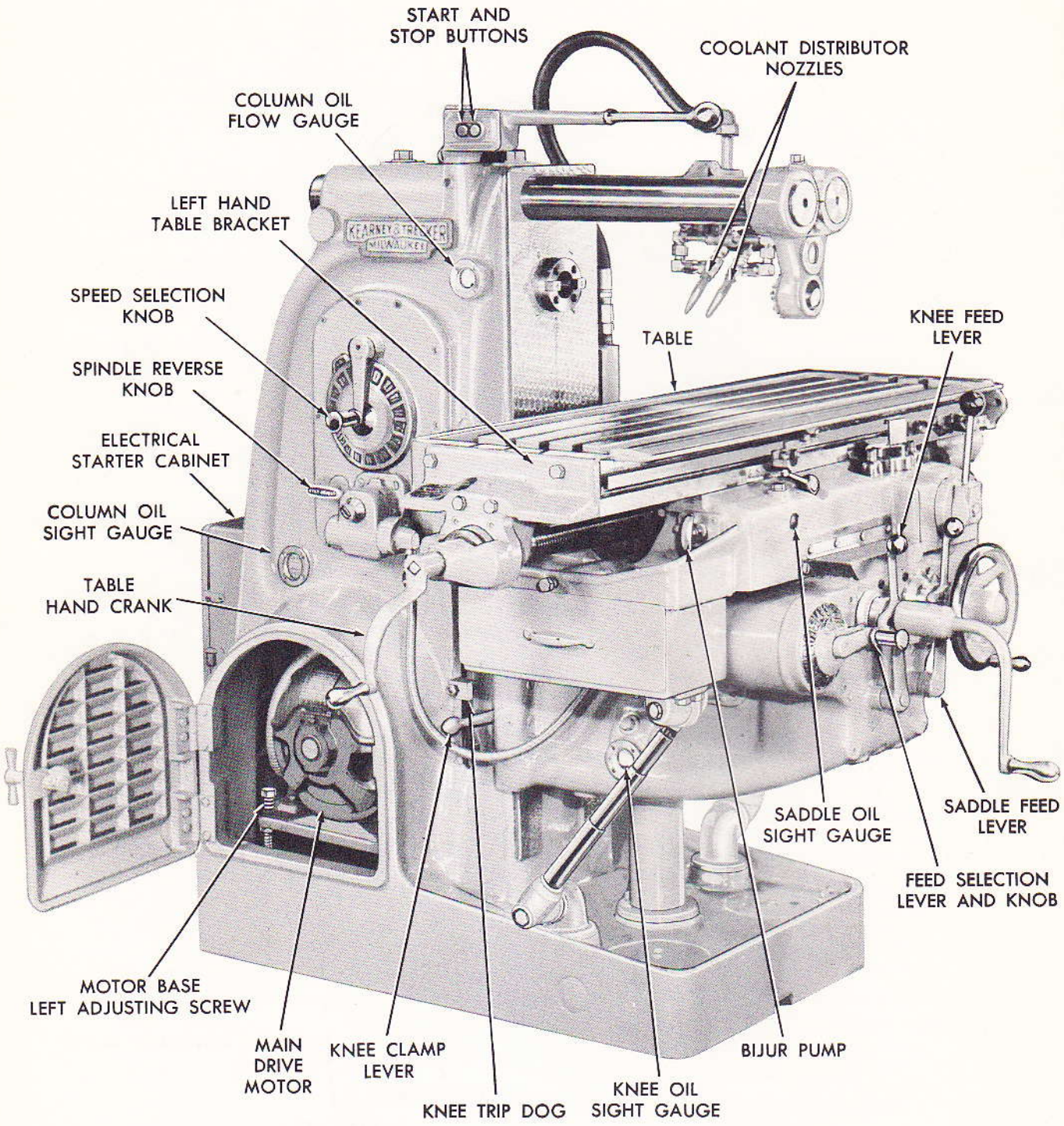


Fig. 7. 18"-24" AC Plain Machines — Left Front View

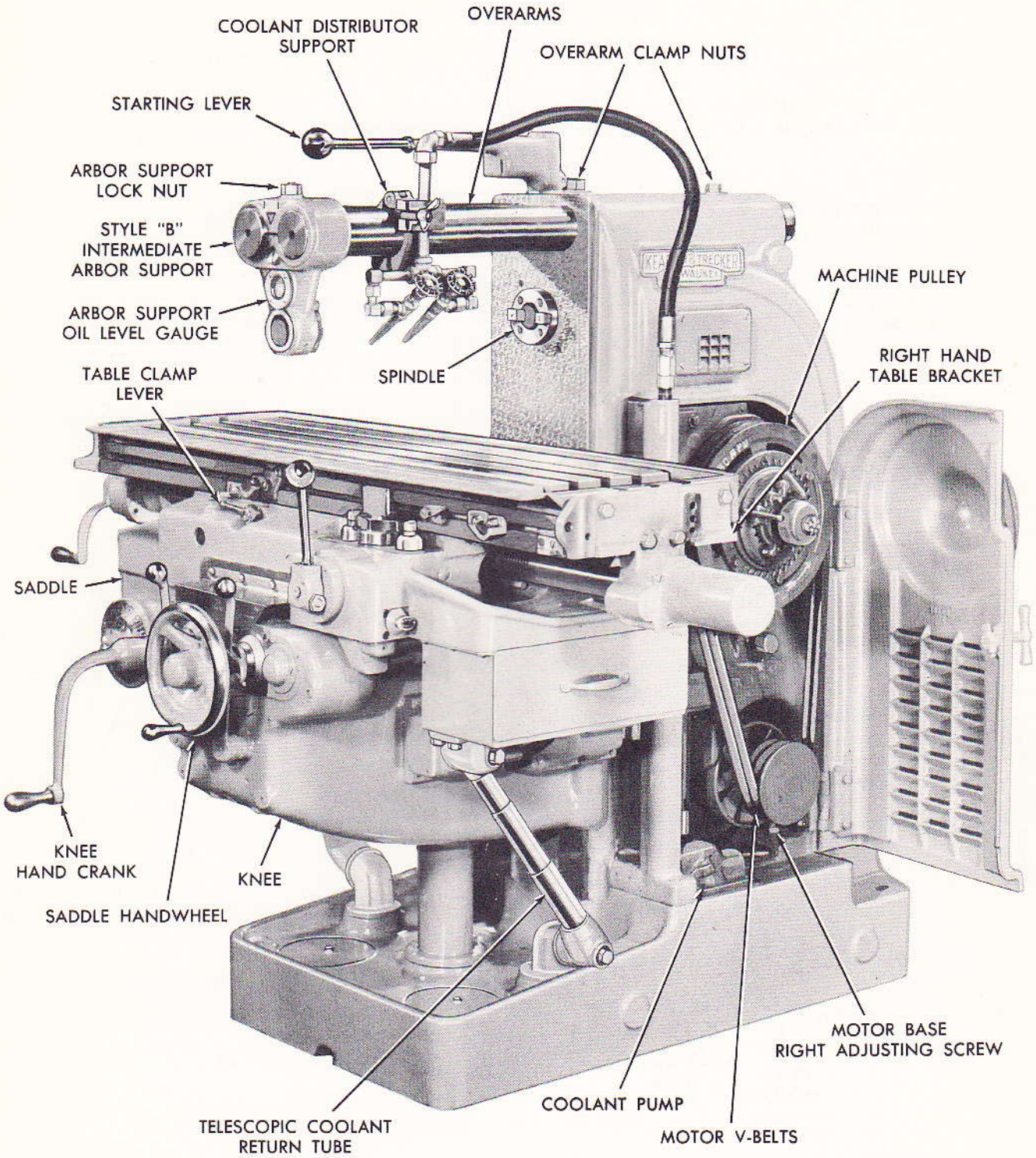


Fig. 8. 18"-24" AC Plain Machines—Right Front View

SECTION I

ELECTRICAL SYSTEM

The electrical system consists of the main drive motor and the necessary controls. This motor drives the spindle and supplies power for the feed and rapid traverse drives to knee, saddle, and table on all machines and to the vertical head on sliding head vertical machines.

A master disconnect switch which controls all current from the main line to the electrical starter cabinet is actuated by a lever on the cabinet. The lever must be in the ON position before power operation is possible. The master start and stop buttons control the main drive motor. This motor must be running in order to move the knee, saddle, table and vertical head by power.

Control fuses, heater elements and overload relays are incorporated in the electrical system to provide the maximum protection for the motor and controls. Because of the complexity of the electrical system, we recommend that only a competent electrician be permitted to work on any of the equipment.

SECTION II

LUBRICATION SYSTEM

DESCRIPTION

There are individual lubricating systems for the moving parts of the column, the knee, the saddle, and the vertical head. Each system is provided with a sight gauge to indicate the oil level. The gauges for the knee (plain machines only) and head also indicate whether or not oil is flowing. The column is provided with an individual flow gauge. Oil flows in the column and knee systems whenever the motor is running. Oil flows in the vertical sliding head system whenever the spindle is running. The saddle system is operated merely by withdrawing and releasing the handle of the Bijur pump.

INSTRUCTIONS

1. Follow all directions given in the Lubrication Charts on pages 20, 21 and 22.

2. Periodically check the oil sight gauges. The oil should be at the high point in the level gauges when the machine is not in operation and should drop during operation. If oil is not passing through the flow gauges during operation, stop the motor and check the oil level.

> Note Oil flow does not register in the knee oil sight gauge on automatic cycle machines.

3. Wipe the accumulated dirt from the exposed sections of the overarms and apply a thin coat of oil once each day.

4. Periodically grease the motor if it is provided with two zerk fittings. If the motor is equipped with sealed-for-life bearings, refer to the manufacturer's recommendations.

SECTION III

COOLANT SYSTEM

DESCRIPTION

The coolant pump distributes coolant from the reservoir in the base of the column up through pipes and nozzles to the cutter. From here the coolant falls to the table and returns to the reservoir through the telescopic coolant return tube. The coolant distributor nozzles (two on the horizontal machines and one on the vertical machines) can be swiveled to distribute the flow to all types of cutters and are equipped with valves for regulating the coolant flow. The distributor can be attached to either overarm on horizontal machines by means of the coolant distributor support. When used on vertical machines the distributor is mounted on a support rod with a compound adjustable clamp. A similar rod is used to hold the distributor when it is not in use.

INSTRUCTIONS

1. Keep the screen covers on the two openings in the column base when the machine is used without coolant.
2. Periodically remove and clean the screens in these pockets.
3. Use light cutting oils or soluble oil mixtures; they are equally as efficient as heavy oils.
4. Periodically check the level of coolant in the reservoir. Fill the reservoir by removing the covers and adding coolant until the level rises to the screens.

SECTION IV

CONVENTIONAL OPERATION

GENERAL

This section describes conventional operation (in which the travel of the table is manually controlled by means of the table feed control lever) of the plain, universal and vertical machines. See Section V, page 17 for automatic cycle operation with the mono-lever. Operation of plain and universal machines is identical except in applications which require swiveling of the table. For such applications the table on universal machines can be swiveled approximately 47 degrees in either direction from the normal position. The table can be locked in position with five clamp screws on the 2CH machines — two on each end of the saddle and one on the front. Four clamp screws are used on the 1CH and 2CHL machines.

Instructions for using the dividing head and lead attachments in spiral milling and indexing operations will be found in catalog UHS-10.

The main drive motor must be running before any power movement is possible. To start this motor, see that the lever on the electrical starter cabinet is set to the ON position, then push the master start button. Be sure to push the master stop button whenever the machine is not to be used for some time.

SPINDLE CONTROL

The spindle is controlled by means of the starting lever. On horizontal and swivel head vertical machines the spindle is started by moving the lever to the left and on sliding head vertical machines by moving the lever upward. To stop the spindle, move the starting lever in the opposite direction. The lever on horizontal and swivel head vertical machines can be placed in any position through a 300-degree arc merely by raising it at the hub, rotating it to the desired position and then lowering it into place. The lever on sliding head vertical machines can also be located conveniently for the operator by removing it at the hub and replacing it on the serrations as desired.

AUTOMATIC SPINDLE STOP

The 18" -24" AC and 2CH machines can be equipped with a control which automatically stops the spindle during rapid traverse table movements and automatically starts the spindle at the start of table feed in automatic cycle operation. This control, called the automatic spindle stop, is located on the speed gear box. The spindle will start and stop automatically when the knob on the automatic spindle stop is placed in the ON position. The spindle will run continually when the knob is in the OFF position. When using the automatic spindle stop, disengage the starting lever at the hub and lock it in the disengaged position with the thumb screw provided. This will prevent movement of the starting lever whenever the spindle starts or stops in automatic cycle operation.

SPINDLE REVERSE CONTROL

The direction of spindle rotation can be reversed as follows:

1. Stop the spindle. Jog the spindle with the starting lever and push or pull the reverse knob for the desired rotation. Do not reverse the rotation while the spindle is running.
2. To disengage the drive to the spindle, set the knob to the center or neutral position.

SPINDLE SPEED CHANGE CONTROL

The spindle speed is changed as follows:

1. Stop the spindle and withdraw the speed selection knob on the speed gear box. Do not change speed while the spindle is running.
2. Rotate the lever and knob until the desired speed as shown on the speed selection dial lines up with the RPM plate. Do not use force in rotating the lever. Jog the spindle with the starting lever while rotating the lever if the lever does not rotate freely.
3. Insert the knob plunger in the hole provided to lock the lever in position.

SPINDLE SPEED RANGE CONTROL (2CH VERTICAL ONLY)

The range of spindle speeds is indicated on the speed selection dial. The particular speeds which can be used are controlled by the spindle speed range control lever. When the lever is set to the SLOW position, spindle speeds from 25 through 170 RPM are available. When the lever is in the FAST position, speeds from 225 through 1500 RPM are available.

COOLANT PUMP CONTROL

The coolant pump is driven through a manually-operated clutch either by the feed drive shaft or the rapid traverse drive shaft. When driven by the feed drive shaft, coolant will flow only when the spindle is running. When driven by the rapid traverse drive shaft, coolant will flow when the drive motor is started whether or not the spindle is running. The clutch is secured in the engaged (down) or disengaged (up) position by a detent and can be shifted merely by moving it by hand.

The pump is normally driven by the feed drive shaft. To change the drive, remove the pump cover plate and move the drive gear to the other side of the driven gear. Rotate the cover plate end for end and replace it on the pump cover. Slip the drive clutch off the feed drive shaft and catch the spring and two balls. Insert the balls and the spring in the hole near the bottom of the rapid traverse shaft and slip the clutch on the end of the shaft to the disengaged (up) position.

POWER FEED CONTROLS

These machines are equipped with levers for engaging power feed (when the spindle is running) to all movable units. When power feed is not desired, move the control lever to the center or neutral position.

A safety clutch in the feed gear train will slip automatically to protect the gear train when an overload is imposed. If this happens, reduce the feed rate and replace the cutter if it has become dull. A safety clutch in the rapid traverse drive will also slip automatically if an overload is imposed while the rapid traverse drive is operating. While these features have been incorporated to prevent expensive repairs and lost time, it is still possible to break cutters, bend arbors and damage gears. Develop the habit, therefore, of seeing that the correct speed and feed is being used, that overhanging fixtures do not interfere with the movement and that the cutter does not engage the workpiece at the rapid traverse rate.

Power movement of the knee is obtained by means of the knee feed lever. The knee is fed downward by moving the lever to the left.

Power movement of the saddle is obtained by means of the saddle feed lever. The saddle is fed to the rear, or inward, by moving the lever to the right.

Power movement of the table is obtained by means of the table feed lever. The table is fed to the right by moving the lever to the right. The lever can be raised to prevent interference with a pre-set table dog.

Power movement of the vertical sliding head is obtained by means of the vertical head feed lever. The head is fed downward by moving the lever downward.

HAND FEED CONTROLS

These machines are also equipped with handwheels and cranks for moving the various units by hand. Safety interlocks are incorporated in these controls to prevent their engagement while power feed is engaged and vice versa.

Hand movement of the knee is obtained by means of the knee hand crank. The knee is fed downward by turning the crank counterclockwise.

Hand movement of the saddle is obtained by means of the saddle handwheel. The saddle is fed to the rear, or inward, by rotating the handwheel clockwise.

Hand movement of the table is obtained by means of the table handwheel. The table is fed to the right by rotating the handwheel clockwise.

Hand movement of the sliding vertical head is obtained by means of the head handwheel. The sliding head is fed downward by rotating the handwheel clockwise. The spindle quill on swivel head vertical machines can be moved through a distance of 3-1/2 inches by means of the quill handwheel. The quill is fed downward by rotating the handwheel clockwise.

MICROMETER DIALS

Graduated micrometer dials on the handwheels permit the movable units to be brought to any predetermined position. For example, when the desired position of the table in a setup has been determined,

the handwheel dial can be set to indicate this position and the table can then always be quickly and accurately located. The dials can be adjusted by pulling them outward, rotating them to the desired setting and then releasing them.

POWER FEED CHANGE CONTROL

The rate of feed movement for the knee, saddle, table and vertical head is indicated in inches per minute and is controlled by the feed selection lever and knob. To change the feed rate be sure the spindle is running. Withdraw the feed selection knob, rotate the lever in either direction until the arrow on the dial lines up with the desired feed rate. Release the lever so that the plunger enters the hole provided and locks the lever in position.

The feed rates and the range of feed rates for the knee and vertical head are one-half of those shown on the dial. That is, if the arrow is lined up with 3/8, the saddle and table will feed at 3/8 inches per minute, but the knee and vertical sliding head will feed at 3/16 inches per minute.

RAPID TRAVERSE CONTROL

The knee, saddle, table and vertical sliding head can be moved at the rapid traverse rate when the motor is running by first engaging the respective feed lever and then raising the rapid traverse lever. Refer to Section V, page 18 for instructions on using rapid traverse control in automatic cycle operation.

TRIP DOGS AND LIMIT STOPS

Adjustable trip dogs are supplied to stop the travel of the movable units at any point within their range of travel. The two dogs for the knee are located at the left rear end of the knee. The two dogs for the saddle are located at the front and rear of the saddle to the left of the way. Four dogs are used with the table and the two dogs used with the vertical sliding head are located on the right side of the head. Positive limit stops are also provided to restrict the total travel of each movable unit.

The four table dogs when properly used insure safe operation and speed production. Figure 9 illustrates the manner in which the dogs would be positioned for a typical setup. After the workpiece has been secured, the table is moved at the rapid traverse rate (indicated by a full line) until the dog (A) shifts the table trip lever to the neutral position and stops the table. This dog must be positioned to stop the table just before the cutter contacts the workpiece. This prevents any possibility of the cutter engaging the workpiece when the table is moving at the rapid traverse rate and still permits the workpiece to be brought to the cutter in the shortest possible time. Then, by raising the table lever to bypass the dog and shifting it in the desired direction, the table will feed (dotted line) until the cutting operation is completed and the dog (B) shifts the lever to neutral and stops the table. The table can then be returned at the rapid traverse rate until the dog (C) stops the travel to complete the cycle.

Operations in which a workpiece is loaded on each end of the table can also be safely and quickly performed by properly locating the trip dogs. We recommend that each setup be studied to determine that maximum use of the trip dogs is being made.

CLAMPS

Clamps are provided to lock the movable units in any position within their range of travel. The clamp levers are serrated so that they can be removed and repositioned if necessary. The knee is locked by moving the knee clamp lever outward. The saddle is locked by moving the saddle clamp lever inward. The table is locked by moving the table clamp lever clockwise. The vertical sliding head (2CH models) is locked for normal milling operations by pulling the head clamp lever forward, toward the operator. For heavy duty milling, lock the head in position with the clamp lever and the three nuts, one of which is on the left and two of which are on the right side of the head. The spindle quill on swivel head vertical machines is locked by moving the quill clamp lever clockwise and the swivel head is locked in place with the four head locking bolts.

Be sure to clamp all units which will not be moved during the setup. For example, if a job requires only table travel, lock the knee, saddle and vertical head. Release all clamp levers when the job is finished.

MICROMETER STOP RODS

The vertical machines can be equipped with a single position stop or a four position turret stop unit to limit the downward travel of the head on sliding head vertical machines and the spindle quill on swivel head vertical machines. The precision stop screws are set by turning them in or out of the stop barrel and locking them in place with the lock nuts and the graduated collars. These collars are graduated in thousandths of an inch to permit accurate final setting of the screws.

On machines equipped with four position turret

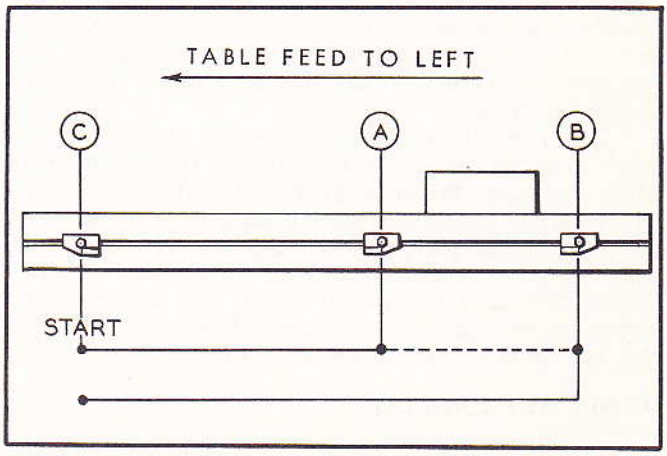


Fig. 9. Use of Table Dogs

stops, the dial indicator is used to accurately measure the final depth of a cut. For example, if a cut .005" deep is to be made, the sliding head (2CH machines) can be power fed to trip out within approximately .010" of the final setting with proper adjustment of the stop rod. The final setting is then obtained by hand-feeding the head while observing the dial indicator.

The four position turret stop, which can be rotated by means of the precision stop ratchet lever, permits up to four settings of the spindle for step milling operations.

SPEED AND FEED CHARTS

The following three charts are included at the rear of this manual:

1. Rules for determining speeds and feeds.
2. Guide to correct speed selection.
3. Guide to correct feed selection.

We recommend that these charts be used to determine the proper speed and feed for the particular cutter and material being used.

ARBOR SUPPORTS AND ARBORS

The arbor supports provide additional support for extended arbor and arbor assemblies. If the setup permits the use of only one arbor support, additional rigidity can be obtained by inverting the other support and mounting it midway between the column and the support being used.

When removing or applying arbor supports, extend one overarm approximately 6 inches beyond the other. Slide the arbor support first onto the extended overarm and then onto the other. Position the arbor supports and overarms, and then clamp them with the lock nuts. The adjustable arm feature permits arbor supports to be handled with a minimum of effort.

The spindle on 2CH machines is equipped with a No. 50 standard non-sticking steel taper. The spindles on 1CH,2CHL and 18" -24" AC machines are equipped with a No. 40 standard taper. The spindle is also equipped with two keys for driving arbors and cutters. When removing arbors, first loosen the nut on the arbor draw-in bolt at the rear of the column on horizontal machines, and on top of the vertical head on vertical machines. Then hold the arbor and tap the draw-in bolt with a soft hammer until the arbor is loose. Screw the bolt out of the arbor and then remove it. When installing an arbor, hold it in place in the spindle taper, engage the draw-in bolt, then tighten the lock nut.

Observe the following rules when working with arbors and arbor supports:

1. Tighten or loosen the arbor nut with the arbor support in place.
2. Be sure arbor nuts are always tight during operation.
3. Adjust the arbor support bushings to provide a running fit for arbor bearings.
4. Be sure the arbor diameter is large enough to withstand the cutting forces which will be encountered.
5. Be sure the cutter-arbor setup runs true over its entire length.
6. Be sure both spindle keys are seated properly.
5. Keep the spindle, arbors and cutters clean. Even a particle of dirt can affect the accurate alignment of the precision ground surfaces.
8. When face mill cutters are mounted to the spindle, draw up the retaining screws evenly before tightening them.
9. Periodically check the oil level in the arbor support oil sight gauge.

OVERARMS

The arbor supports are mounted on two parallel overarms which provide accurate alignment and maximum rigidity for the arbor and cutter assembly. Self-equalizing overarm clamps are locked and unlocked by means of clamp nuts.

The position of the overarms on 2CH machines can be adjusted with the overarm handwheel. The left overarm only can be moved by pulling the handwheel out and rotating it in the direction desired. Both overarms can be moved simultaneously by pushing the handwheel in and rotating it in the direction desired. The right overarm can not be moved independently. The overarms on 1CH, 2CHL and 18"-24" AC machines are moved by pushing them to the desired position.

The double overarms eliminate the necessity of completely removing the arbor support when replacing arbors and cutters. When this is necessary, merely slide the support onto an extended overarm, swing the support upward and let it rest on the other overarm.

OUTER ARM BRACE

The outer arm brace is used to tie the overarms and the knee together for heavy milling operations. The slots in the brace permit it to be used at various settings of the knee. To install the brace, proceed as follows:

1. Mount the arbor supports so that the outer face is flush with the end of the overarms.
2. Position the overarms so that the arm brace can be located as close to the saddle as possible.
3. Mount the brace on the knee, bring it into contact with the arbor support and secure it to the arbor support and knee.

PULLEY BELT ADJUSTMENT

If the pulley belts become loose, adjust them as follows:

1. Loosen the lock nut on the adjustment screw at the left rear of the motor base and the nut on the lock screw at the right rear of the base.
2. Lower the base using both screws until the belts, at a point midway between the pulleys, can be deflected sidewise by hand approximately 3/4" in each direction from their normal position. Tighten the lock nut on both screws to maintain the setting.

SECTION V

AUTOMATIC CYCLE OPERATION

(18"-24" AC and 2CH Plain and Vertical Only)

MONO-LEVER CONTROL OF TABLE
(See figures 10 and 11)

This section describes operation of the 18"-24" AC and 2CH plain and vertical machines equipped with the mono-lever for automatic cycle operation.

Both feed and rapid traverse movements of the TABLE are obtained merely by changing the position of the mono-lever. In automatic cycle operation the mono-lever is shifted by the rate, reverse and stop dogs. In conventional operation the mono-lever is shifted by hand.

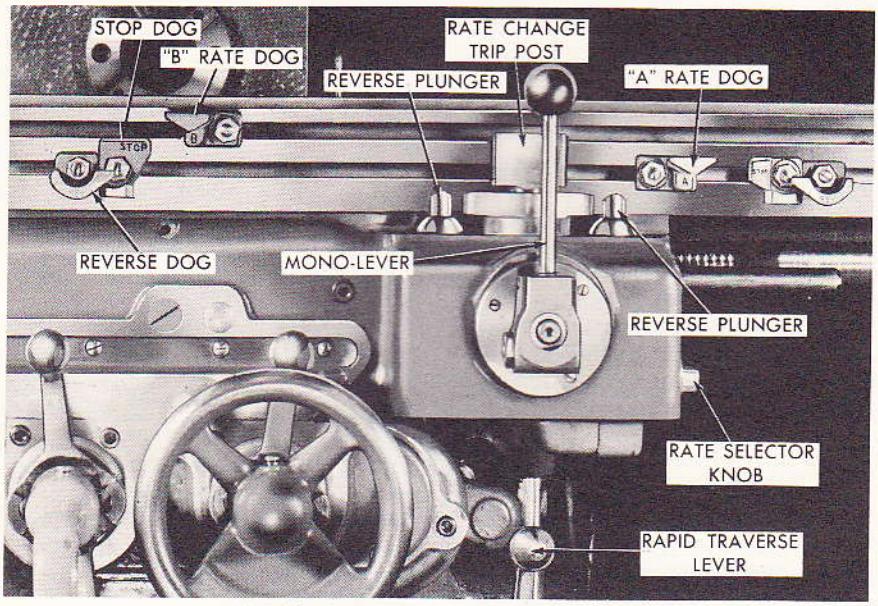


Fig. 10. Automatic Cycle Controls — 2CH Machines

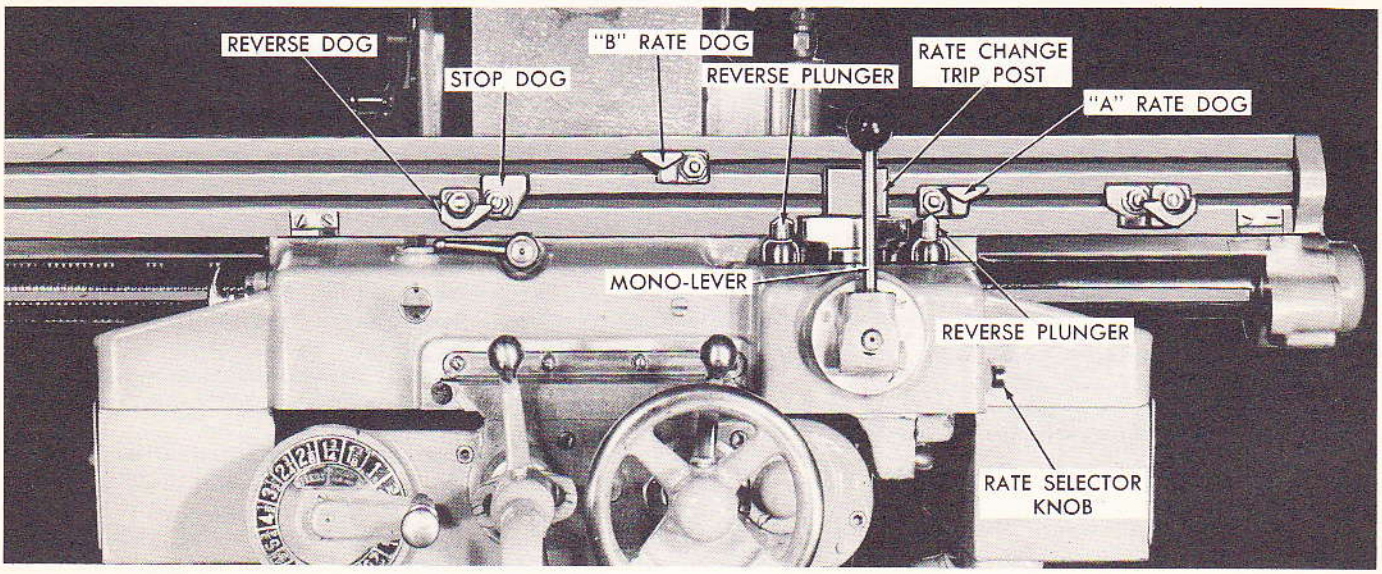


Fig. 11. Automatic Cycle Controls — 18" — 24" AC Machines

Each position of the mono-lever and the corresponding rate and direction of table travel is shown in Figure 12. The desired position of the mono-lever in automatic cycle operation is obtained by means of the dogs which are placed in the T-slots at the front of the table. The three dogs used and their functions are as follows:

1. A and B rate dogs — actuate the trip post and move the mono-lever to either the feed or rapid traverse position.
2. Reverse dogs — depress the reverse plungers and reverse the direction of table travel.
3. Stop dogs — actuate the feed trip sleeve and move the mono-lever to the neutral position to stop the table.

When using automatic cycle operation, be sure to follow these instructions:

1. Attach the dogs securely to the front of the table. If the dogs are loose, they will move when contacting the trip post and reverse plungers.
2. Periodically grease the surfaces of the dogs which contact the trip post and reverse plungers.
3. Be sure that stop dogs are set ahead of and in contact with the reverse dogs. If the dogs are set too far from the reverse dogs, they will move the trip post and stop the table before the reverse dogs can depress the reverse plungers.
4. Be sure that the rate dogs are positioned so that the bolted end is toward the trip post. Use the upper or lower table slot, whichever is required to move the trip post in the proper direction.

RATE SELECTOR KNOB

The rate at which the table travels after reversing in automatic cycle operation is controlled by the rate selector knob. When the knob is set to read RAPID REV, the table will travel at the rapid traverse rate after reversal. If the knob is set to read FEED REV, the table will travel at the feed rate after reversal.

HANDWHEEL CONTROL OF TABLE

The table on automatic cycle machines can also be moved by means of the handwheel at the left end of the table. The handwheel automatically disengages when the mono-lever is used and can be re-engaged by setting the mono-lever to the neutral position and pushing the handwheel hub in to engage the clutch. If the clutch does not engage easily, rotate the handwheel slightly while pushing the hub in.

Caution When moving the table by hand, be sure that the dogs at the front of the table will not contact the reverse plungers or trip post.

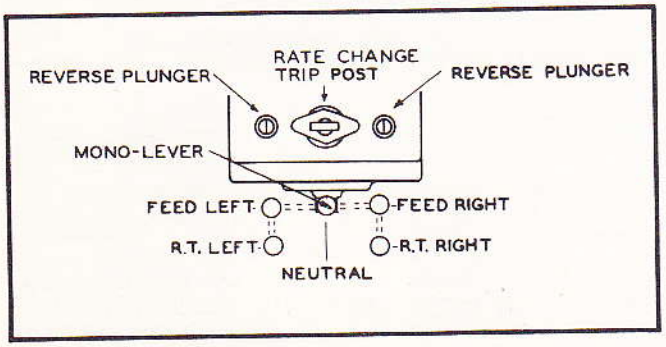


Fig. 12. Mono-Lever Positions

KNEE, SADDLE AND VERTICAL HEAD CONTROL

On 18"-24" AC machines, rapid traverse of the knee and saddle is obtained by engaging the feed control lever and then moving the mono-lever outward from the neutral positions (see Figure 12). On 2CH machines rapid traverse of the knee, saddle and sliding head is obtained by engaging the feed control lever and then raising the rapid traverse lever on the right side of the knee.

Caution When rapid traverse movement is used, be sure to engage the feed lever before engaging the rapid traverse lever. If this is not done, the teeth on the reverse clutches may be damaged.

PLAIN CYCLE — RAPID TRAVERSE RETURN

In all diagrams of automatic cycle arrangements which follow, the rapid traverse rate is indicated by a full line and the feed rate is indicated by a dotted line. The rate dogs, both types A and B, are indicated by circled letters, Ⓐ, Ⓑ and Ⓒ in the diagrams. These letters are used only to identify the dogs in the illustrations and are not to be confused with the type of dog.

Figure 13 illustrates the position of the dogs for table travel which starts to the left. The workpiece is placed on the right end of the table and the cycle is started with the table at the right end of travel. With the selector knob (Figures 10 and 11) rotated to read RAPID REV, move the mono-lever to the left and then outward. The table will travel at the rapid traverse rate until the feed dog Ⓐ contacts and depresses the trip post. This occurs just before the cutter contacts the workpiece. The mono-lever will then shift inward to the feed position and the table will feed until the reverse dog depresses the right reverse plunger to change the direction of table travel. The table will then return at the rapid traverse rate until the stop dog at the left end of the table moves the trip plunger to the neutral position and stops the table. A new workpiece is then put on the table and the cycle is repeated.

Figure 14 illustrates the position of the dogs for table travel which starts to the right. The cycle operates the same as the one just explained except that it is started with the table at the left end of travel and by moving the mono-lever to the right and then outward.

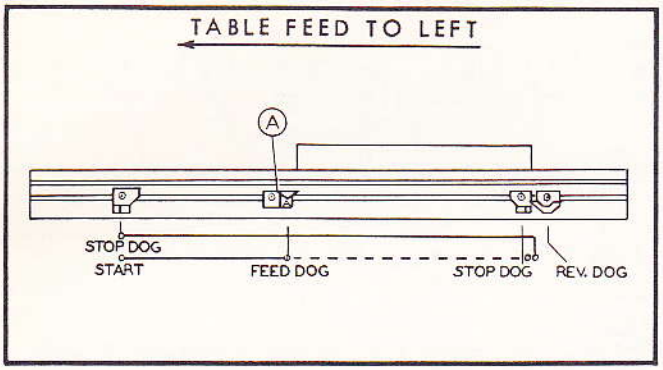


Fig. 13. Plain Cycle — Rapid Traverse Return — Right to Left

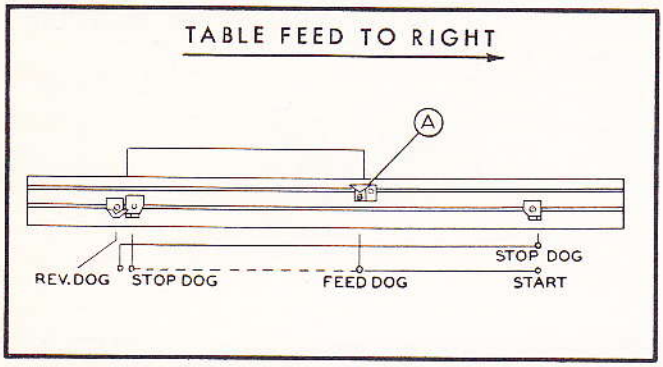


Fig. 14. Plain Cycle — Rapid Traverse Return — Left to Right

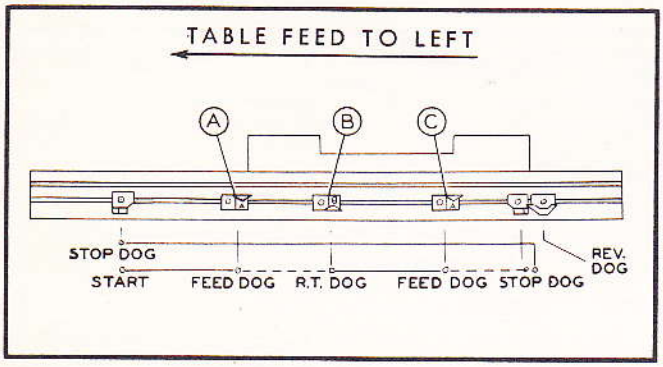


Fig. 15. Intermittent Cycle — Rapid Traverse Return — Right to Left

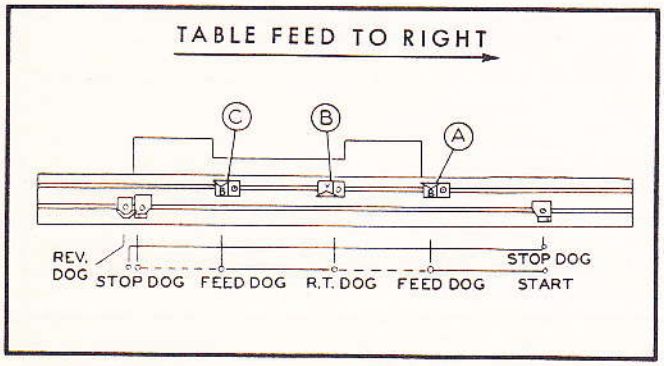


Fig. 16. Intermittent Cycle — Rapid Traverse Return — Left to Right

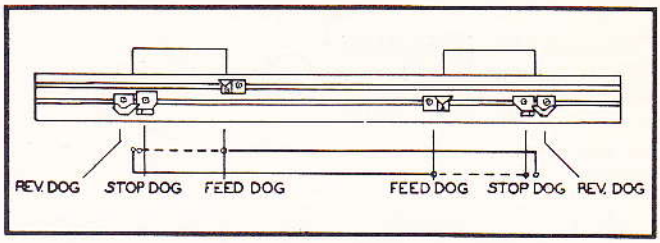


Fig. 17. Continuous Cycle — Rapid Traverse

INTERMITTENT CYCLE — RAPID TRAVERSE RETURN

Figure 15 shows the position of the dogs for table travel which starts to the left. The workpieces are loaded and unloaded while the table is at the right end of travel. With the selector knob rotated to read RAPID REV, move the mono-lever to the left and then outward. The table will travel at the rapid traverse rate until the feed dog (A) contacts and depresses the trip post. This occurs just before the cutter contacts the workpiece. The mono-lever will then shift inward to the feed position and the table will feed to the left until the rapid traverse dog (B) contacts and raises the trip post. The mono-lever will then shift outward and the table will travel at the rapid traverse rate until the feed dog (C) contacts and depresses the trip post. This again occurs just before the cutter contacts the second workpiece. The mono-lever will then shift inward and the table will feed to the left until the reverse dog depresses the right reverse plunger to change the direction of table travel. The table will then return at the rapid traverse rate until the stop dog at the left end of the table moves the trip plunger to the neutral position and stops the table. Two new workpieces are then put on the table and the cycle is repeated.

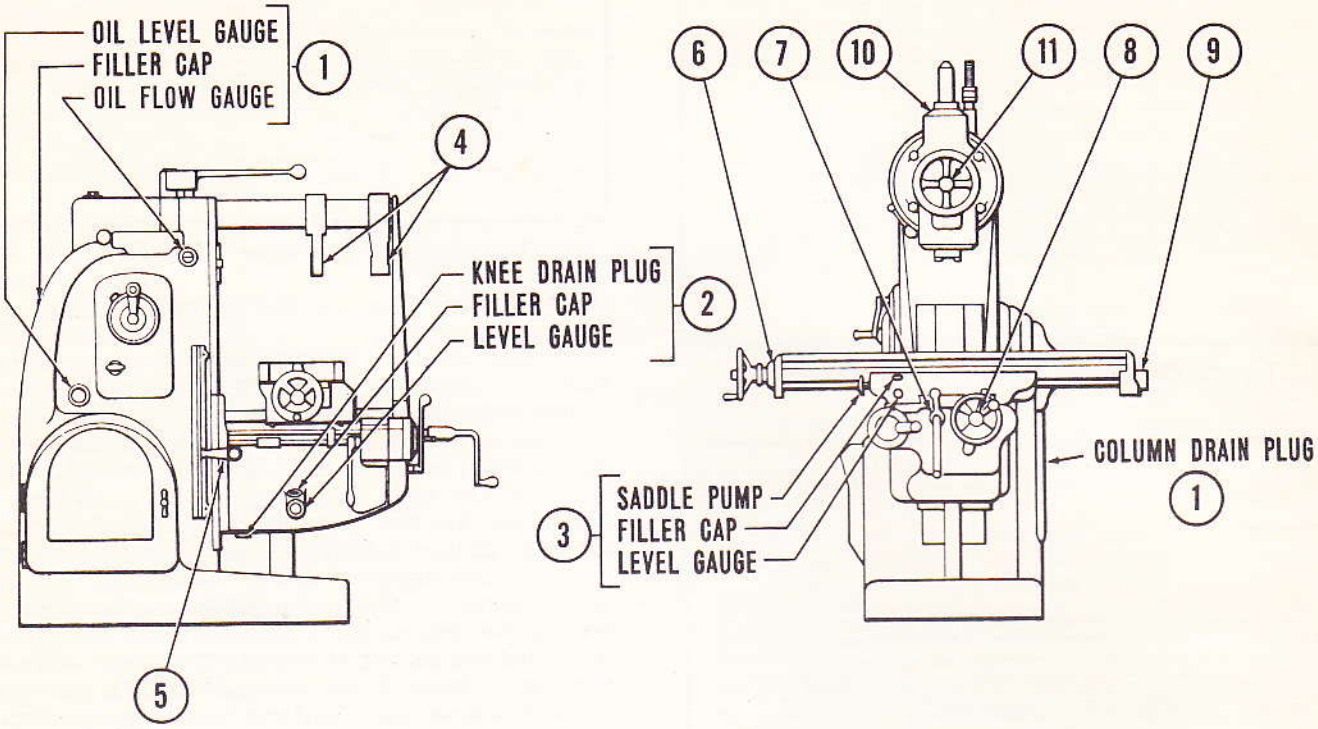
Figure 16 illustrates the position of the dogs for table travel which starts to the right. The cycle operates the same as the one just explained except that it is started with the table at the left end of travel and by moving the mono-lever to the right and then forward.

CONTINUOUS CYCLE — RAPID TRAVERSE

Figure 17 illustrates the position of the dogs for a two-station, high production setup. Since the cycle is continuous, it can be started with the table at either the left or right end of travel by moving the mono-lever to the feed position in the appropriate direction. In this cycle workpieces are unloaded and loaded at one end of the table while the other workpiece is being milled.

Caution Since the table must reverse only while it is in the feed rate and not while in the rapid traverse rate, the dogs must be set so that the table is always in the feed rate at reversal.

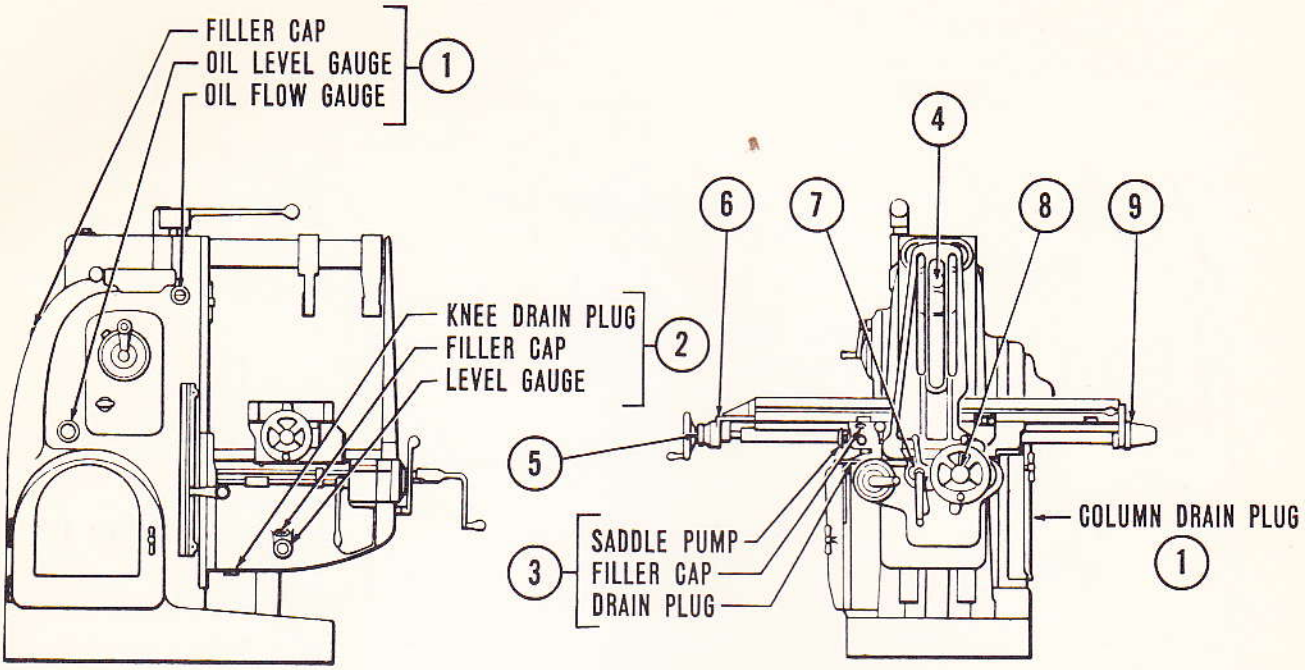
In this cycle the workpieces are conventionally milled at one end and climb milled at the other. It is important, therefore, that the backlash adjustments outlined in catalog CHI-11 be checked to insure satisfactory operation.



OIL RECOMMENDED: GARGOYLE D.T.E. HEAVY MEDIUM OR EQUIVALENT
(SAYBOLT UNIVERSAL VISCOSITY 300-325 SECONDS AT 100° FAHRENHEIT)

		PARTS LUBRICATED	RESERVOIR CAPACITY	INSTRUCTIONS	FREQUENCY
AUTOMATIC OILING	1	Spindle Drive Speed Gear Box Pulley Bracket	3 Gallons	Stop motor and add oil to maintain level at upper line on sight gauge.	As required.
	2	Knee Drive Feed Distribution Box Feed and Rapid Traverse Drive Bracket Column and Knee Ways Elevating Screw	2½ Gallons	Drain reservoir. Fill with flushing solvent and operate machine for approximately ten minutes. Drain and refill reservoir.	Every four months or each 500 hours of machine operation, whichever occurs first.
	3	Saddle and Table Drive Mechanism Knee and Saddle Ways Saddle and Table Ways	1 Pint	Withdraw and release pump handle. Fill reservoir to upper line on sight gauge.	Six times per day. Daily.
	4	Arbor Supports		Add oil to maintain level at upper line on sight gauge.	Daily.
HAND OILING	5	Elevating Trip Lever		Fill oil cups.	Daily.
	6	Bracket Bearing			
	7	Elevating Crank Bearing			
	8	Crossfeed Handwheel Bearing			
	9	Bracket Bearing			
	10	Spindle Bearings		Use Socony-Vacuum Sovarex No. 1 grease or equivalent.	Two strokes with grease gun every 200 hours of operation.
	11				

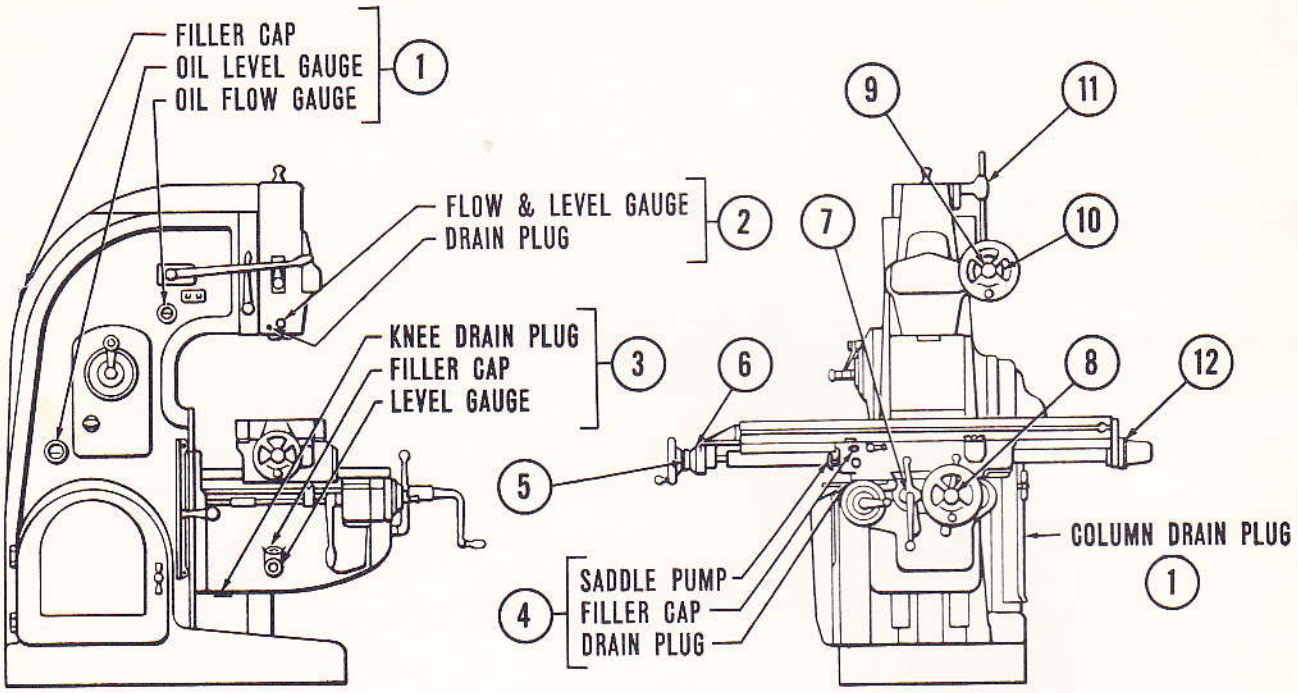
Fig. 18. Lubrication Chart—1CH, 2CHL, 18"-24"
AC Plain and Vertical Machines



OIL RECOMMENDED: GARGOYLE D.T.E. HEAVY MEDIUM OR EQUIVALENT (SAYBOLT UNIVERSAL VISCOSITY 300-325 SECONDS AT 100° FAHRENHEIT)

		PARTS LUBRICATED	RESERVOIR CAPACITY	INSTRUCTIONS	FREQUENCY
AUTOMATIC OILING	1	Spindle Drive Speed Gear Box Pulley Bracket	3½ gallons	Stop motor and add oil to maintain level at upper line on sight gauge.	As required.
	2	Knee Drive Feed Distribution Box Feed and Rapid Traverse Drive Bracket Column and Knee Ways Elevating Screw	1½ gallons	Drain reservoir. Flush with kerosene or liquid flushing solvent for ten minutes with motor running. Refill reservoir.	Every four months or each 500 hours of machine operation, whichever occurs first.
	3	Saddle and Table Drive Mechanism Knee and Saddle Ways Saddle and Table Ways	1 Pint	Withdraw and release pump handle. Fill reservoir.	Six times per day. Daily.
	4	Arbor Supports		Add oil to maintain level at upper line on sight gauge.	Daily.
HAND OILING	5	Table Handwheel Bearings.		Fill oil cups.	Daily.
	6	Bracket Bearings.			
	7	Elevating Crank Bearings.			
	8	Crossfeed Handwheel Bearings.			
	9	Bracket Bearings.			

Fig. 19. Lubrication Chart – 2CH Plain Machines



OIL RECOMMENDED: GARGOYLE D.T.E. HEAVY MEDIUM OR EQUIVALENT (SAYBOLT UNIVERSAL VISCOSITY 300-325 SECONDS AT 100° FAHRENHEIT)

		PARTS LUBRICATED	RESERVOIR CAPACITY	INSTRUCTIONS	FREQUENCY
AUTOMATIC OILING	1	Spindle Drive Speed Gear Box Pulley Bracket	3½ Gallons	Stop motor and add oil to maintain level at upper line on sight gauge.	As required.
	2	Sliding Head	¾ Pint		
	3	Knee Drive Feed Distribution Box Feed and Rapid Traverse Drive Bracket Column and Knee Ways Elevating Screw	1½ Gallons	Drain reservoir. Flush with kerosene or liquid flushing solvent for ten minutes with motor running. Refill reservoir.	Every four months or each 500 hours of machine operation, whichever occurs first.
	4	Saddle and Table Drive Mechanism Knee and Saddle Ways Saddle and Table Ways	1 Pint	Withdraw and release pump handle. Fill reservoir.	Six times per day. Daily.
HAND OILING	5	Table Handwheel Bearings.		Fill oil cups.	Daily.
	6	Bracket Bearings.			
	7	Elevating Crane Bearings.			
	8	Crossfeed Handwheel Bearings.			
	9	Head Handwheel Bearings.			
	10	Handwheel Shaft Bearing.			
	11	Four Position Stop.			
	12	Bracket Bearings.			

Fig. 20. Lubrication Chart—2CH Vertical Machines

SAMPLE SPEED AND FEED CALCULATION.

PROBLEM: Determine proper SPEED and FEED of a 5" diameter face mill with 10 High Speed Steel blades, milling cast iron.

A) TO DETERMINE SPEED DIAL SETTING (Cutter R.P.M.):

RULE: Divide the feet per minute (F.P.M.) by the circumference of the cutter, expressed in feet.

FORMULA: $\text{F.P.M.} \div \frac{\text{Dia. of cutter} \times \pi}{12} = \text{R.P.M.}$

From Chart 2 under H.S. in Cast Iron, 80 F.P.M. (range 50-80) is selected.

Therefore: $80 \div \frac{5 \times 3.1416}{12} = \text{R.P.M.}$

$$\begin{array}{r} 3.1416 \\ 5 \text{ in. dia.} \\ \hline 15.7080 \end{array} \qquad \begin{array}{r} 1.31 \\ \hline 12 \overline{)\,15.71} \end{array} \qquad \begin{array}{r} 61.1 = \text{R.P.M.} \\ 61.1 \text{ R.P.M.} \\ \hline 1.31 \overline{)\,80.00} \end{array}$$

SHORT FORMULA FOR SPEED:

$$\frac{4 \times \text{F.P.M.}}{\text{Diam. of Cutter}} = \text{R.P.M. or } \frac{4 \times 80}{5} = 64 \text{ R.P.M.}$$

B) TO DETERMINE FEED DIAL SETTING (Feed in inches per minute = F):

RULE: Multiply feed per tooth per revolution by number of teeth in cutter and by the speed (number of revolutions per minute.)

FORMULA: F.T.R. x T. x R.P.M. = F (Feed)

From Chart 3 under Face Mill H.S. in Cast Iron a F.T.R. (chip load) of .012 is selected (range .010-.025). R.P.M. is 61 from speed calculation.

Therefore: .012 x 10 x 61 = Feed.
7.32 = Feed.

RESULT: For the 5" diameter face mill cutter with 10 High Speed blades, milling cast iron—

The SPEED dial setting is 61 R.P.M.
The FEED dial setting is 7.32 I.P.M.

NOTE: The speeds and feeds determined by mathematical computation are approximate and dial settings closest to these results (either higher or lower) are normally satisfactory as a starting point.

TO FIND	HAVING	RULE	FORMULA
Speed of Cutter in Feet per Minute (F.P.M.)	Diameter of Cutter and Revolutions per Minute	Diameter of Cutter (In.) Multiplied by 3.1416, Multiplied by Revolutions per Minute, Divided by 12	$\frac{D \times \pi \times \text{R.P.M.}}{12} = \text{F.P.M.}$
Revolutions per Minute (R.P.M.)	Feet per Minute and Diameter of Cutter	Feet per Minute, Divided by Circumference of Cutter in Feet (Diameter x 3.1416 ÷ 12)	$\frac{\text{F.P.M.} \div D \times \pi}{12} = \text{R.P.M.}$
Feed per Revolution (F.R.)	Feed per Minute and Revolutions per Minute	Feed per Minute, Divided by Revolutions per Minute	F. ÷ R.P.M. = F.R.
Feed per Tooth per Revolution (F.T.R.)	Feed per Minute and Number of Teeth in Cutter	Feed per Minute (In.), Divided by Number of Teeth per Minute (Number of Teeth in Cutter x Revolutions per Minute)	F. ÷ (T. x R.P.M.) = F.T.R.
Feed per Minute (F.)	Feed per Tooth per Revolution, Number of Teeth in Cutter, and Revolutions per Minute	Feed per Tooth per Revolutions Multiplied by Number of Teeth in Cutter, Multiplied by Revolutions per Minute	F.T.R.xT.xR.P.M. = F.
Feed per Minute (F.)	Feed per Revolutions and Revolutions per Minute	Feed per Revolution Multiplied by Revolutions per Minute	F.R. x R.P.M. = F.
Number of Teeth per Minute (T.M.)	Number of Teeth in Cutter and Revolutions per Minute	Number of Teeth in Cutter Multiplied by Revolutions per Minute	T. x R.P.M. = T.M.

R.P.M. = Revolutions per Minute
T. = Teeth in Cutter
D. = Diameter of Cutter
π = 3.1416 (Pi)
T.M. = Teeth per Minute
F. = Feed per Minute
F.R. = Feed per Revolution
F.T.R. = Feed per Tooth per Revolution
F.P.M. = Speed of Cutter in Feet per Minute

Fig. 21 Rules for Determining Speeds and Feeds

Learn what cutters will stand. Start with slow speeds and feeds and step up.

Material To Be Milled	MATERIAL IN CUTTER					
	Carbon Tool Steel	High Speed Steel	Super Hi-Speed Steel	Stellite	Tantalum Carbide	Tungsten Carbide
	CUTTER SPEED IN FEET PER MINUTE					
Aluminum	250–500	500–1000		800–1500		1000–2000
Brass Soft	40–80	70–175		150–250		350–600
Bronze Hard	30–60	65–130		100–160		200–425
Bronze Very Hard		30–50	50–70			125–200
Cast Iron Soft	30–40	50–80	60–115	90–130		250–325
Cast Iron Hard		30–50	40–70	60–90		150–200
Cast Iron Chilled			30–50	40–60		100–200
Malleable Iron	35–50	70–100	80–125	115–150		250–370
Steel Soft	30–45	60–90	70–100		150–250	
Steel Medium	30–40	50–80	60–90		125–200	
Steel Hard		30–50	40–70		100–150	

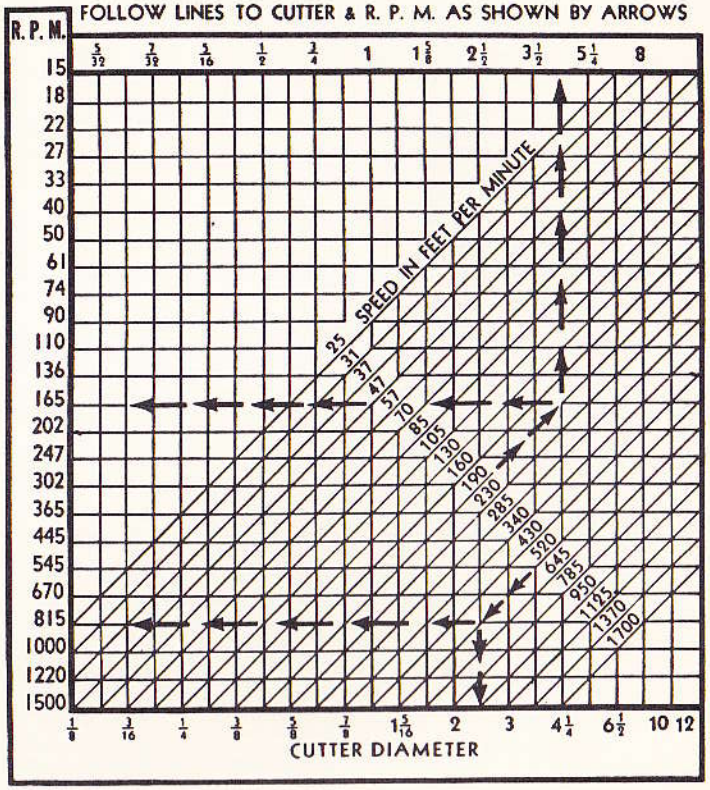


Fig. 22 Guide to Correct Speed Selection