



OPERATOR'S INSTRUCTION BOOK

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51

12", 14", 14h"
and 18"

UA UNIVERSAL
grinding
machines

6854262

CINCINNATI

The Cincinnati Milling Machine Co.

THIS book was written for operators
of CINCINNATI® FILMATIC®
12", 14", 14"H and 18"UA Universal
Grinding Machines (Model DE).

At the time of writing, it was completely
up to date. However, due to continual
improvements in design, it is possible that
descriptions contained herein may vary
to a slight extent from the machine
delivered to you. This merely implies
that the machine has been improved to
better fulfill your requirements.

Publication No. G-805-1

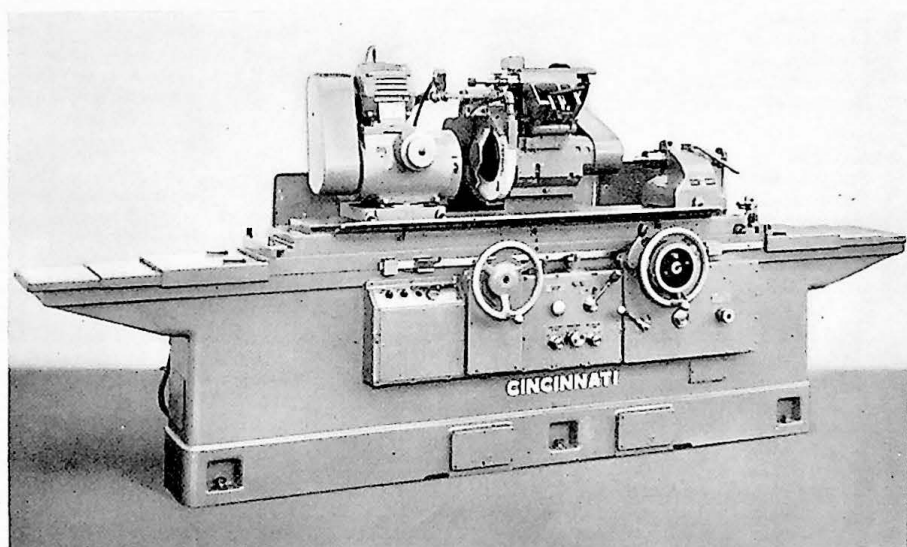
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO 45209

ILLUSTRATION REFERENCE NUMBERS

For your convenience in quickly finding illustrations referred to in the text, we have given all illustrations the same number as the page on which they appear. For example, Figs. 32A and 32B are both on page 32.

SERIAL NUMBER

The serial number is stamped on the front of the base, just below the name "CINCINNATI."



CINCINNATI FILMATIC UA Universal Grinding Machine

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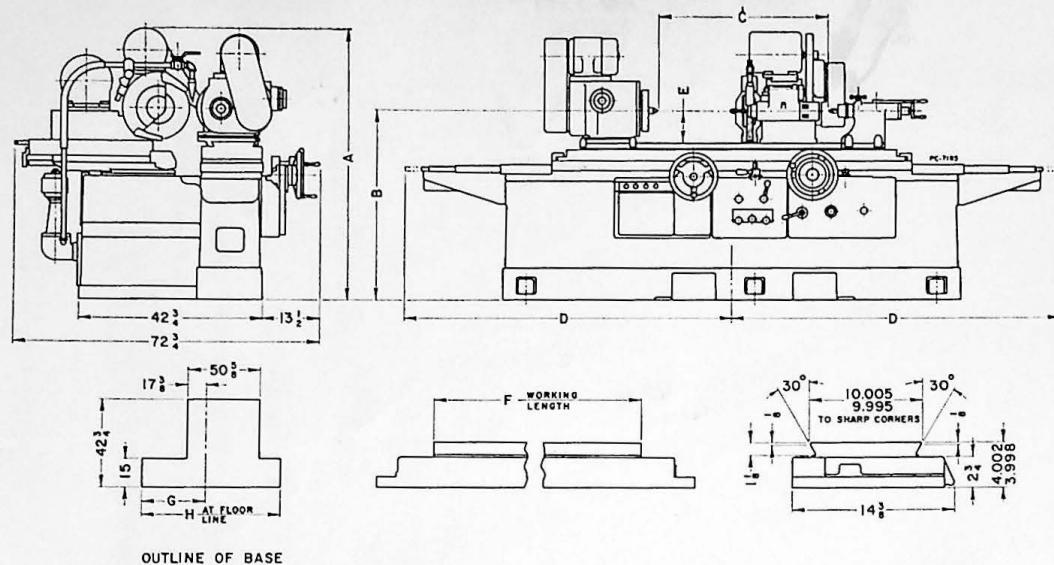


TABLE OF DIMENSIONS

SIZE OF MACHINE	A	B	C	D		E	F	G	H
				Max.	Min.				
12" x 36"	58 $\frac{1}{2}$ "	42 $\frac{3}{4}$ "	38 $\frac{1}{2}$ "	77 $\frac{1}{8}$ "	70 $\frac{7}{8}$ "	6 $\frac{1}{2}$ "	61 $\frac{3}{16}$ "	52 $\frac{1}{8}$ "	104 $\frac{1}{4}$ "
12" x 48"	58 $\frac{1}{2}$ "	42 $\frac{3}{4}$ "	50 $\frac{1}{2}$ "	92 $\frac{1}{2}$ "	83"	6 $\frac{1}{2}$ "	81 $\frac{3}{16}$ "	64 $\frac{1}{8}$ "	128 $\frac{1}{4}$ "
12" x 72"	58 $\frac{1}{2}$ "	42 $\frac{3}{4}$ "	74 $\frac{1}{2}$ "	118 $\frac{1}{8}$ "	111 $\frac{1}{2}$ "	6 $\frac{1}{2}$ "	105 $\frac{1}{16}$ "	88 $\frac{1}{8}$ "	176 $\frac{1}{4}$ "
14" x 36"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	38 $\frac{1}{2}$ "	77 $\frac{1}{8}$ "	70 $\frac{7}{8}$ "	7 $\frac{1}{2}$ "	69 $\frac{3}{16}$ "	52 $\frac{1}{8}$ "	104 $\frac{1}{4}$ "
14" x 48"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	50 $\frac{1}{2}$ "	92 $\frac{1}{8}$ "	83"	7 $\frac{1}{2}$ "	81 $\frac{3}{16}$ "	64 $\frac{1}{8}$ "	128 $\frac{1}{4}$ "
14" x 72"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	74 $\frac{1}{2}$ "	118 $\frac{1}{8}$ "	111 $\frac{1}{2}$ "	7 $\frac{1}{2}$ "	105 $\frac{3}{16}$ "	88 $\frac{3}{8}$ "	176 $\frac{1}{4}$ "
14"H x 36"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	38 $\frac{1}{2}$ "	77 $\frac{1}{8}$ "	70 $\frac{7}{8}$ "	7 $\frac{1}{2}$ "	69 $\frac{3}{16}$ "	52 $\frac{1}{8}$ "	104 $\frac{1}{4}$ "
14"H x 48"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	50 $\frac{1}{2}$ "	92 $\frac{1}{8}$ "	83"	7 $\frac{1}{2}$ "	81 $\frac{3}{16}$ "	64 $\frac{1}{8}$ "	128 $\frac{1}{4}$ "
14"H x 72"	61 $\frac{3}{4}$ "	43 $\frac{3}{4}$ "	74 $\frac{1}{2}$ "	118 $\frac{1}{8}$ "	111 $\frac{1}{2}$ "	7 $\frac{1}{2}$ "	105 $\frac{3}{16}$ "	88 $\frac{3}{8}$ "	176 $\frac{1}{4}$ "
18" x 36"	65 $\frac{3}{4}$ "	45 $\frac{3}{4}$ "	38 $\frac{1}{2}$ "	77 $\frac{1}{8}$ "	70 $\frac{7}{8}$ "	9 $\frac{1}{2}$ "	69 $\frac{9}{16}$ "	52 $\frac{1}{8}$ "	104 $\frac{1}{4}$ "
18" x 48"	65 $\frac{3}{4}$ "	45 $\frac{3}{4}$ "	50 $\frac{1}{2}$ "	92 $\frac{1}{8}$ "	83"	9 $\frac{1}{2}$ "	81 $\frac{9}{16}$ "	64 $\frac{1}{8}$ "	128 $\frac{1}{4}$ "
18" x 72"	65 $\frac{3}{4}$ "	45 $\frac{3}{4}$ "	74 $\frac{1}{2}$ "	118 $\frac{1}{8}$ "	111 $\frac{1}{2}$ "	9 $\frac{1}{2}$ "	105 $\frac{9}{16}$ "	88 $\frac{3}{8}$ "	176 $\frac{1}{4}$ "

Figure 6 Dimensional Drawing



Figure 7
Dimensional Drawing

PRINCIPAL MACHINE SPECIFICATIONS
12", 14", 14"H and 18"UA FILMATIC Universal Grinding Machines (Model DE)
SPECIFICATIONS COMMON TO ALL 12", 14", 14"H AND 18" MACHINES

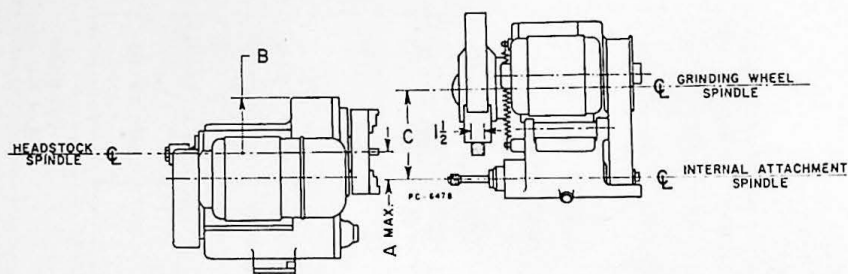
	12" and 14" Machines	14"H and 18" Machines
Grinding Wheelhead		
Swivel range:		
(Lower swivel, right and left.....)	90°	90°
(Upper swivel, right and left.....)	30°	30°
Grinding wheels regularly supplied (diameter x face x hole).....	14" x 1½" x 5" 14" x 1" x 5"	14" x 1½" x 5" 14" x 1" x 5"
Cross Feed		
Automatic infeed at table reversal (diameter reduction) Low.....	.0002" to .005"	.0002" to .005"
High.....	.0005" to .0125"	.0005" to .0125"
Pick Feed selections:		
(Right end only, left end only.....)	Yes	Yes
(Right and left ends.....)	Yes	Yes
Wheelhead movement per turn of crossfeed handwheel: (Low.....)	.050"	.050"
(High.....)	.250"	.250"
Minimum infeed increment in terms of diameter reduction.....	.000050"	.000050"
Headstock and Footstock		
Taper hole in headstock and footstock spindles.....	No. 9 B. & S.	No. 10 B. & S.
Number of work rotation speeds.....	Infinite	Infinite
Range of work rotation speeds, rpm.....	50 to 500	25 to 200
(Footstock center retraction by hand lever)		
Headstock spindle nose, American Lathe Standard.....	5"	6"
Headstock swivel:		
(Toward wheelhead.....)	90°	90°
(Away from wheelhead.....)	30°	30°
Table Traverse		
Number of table traverse speeds.....	Infinite	Infinite
Range of table traverse speeds, inches per minute.....	3 to 220	3 to 220
Minimum movement required to reverse table.....	¾"	¾"
Accuracy of table reversal at all traverse rates.....	.004"	.004"
Independent right-hand and left-hand tarry adjustment, seconds.....	0 to 5	0 to 5
Mechanical hand table traverse per revolution of handwheel (Rapid.....)	1½"	1½"
(Slow.....)	0.2"	0.2"
Power Requirements (Electrical equipment included with machine)		
Wheelhead motor.....	3 hp	5 hp
Hydraulic pump motor.....	1 hp	1½ hp
Headstock motor.....	1 hp	1 hp
Internal grinding attachment motor.....	1 hp	2 hp
Cutting fluid pump motor.....	¼ hp	¼ hp

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

Specifications Applicable To Specific Lengths Only

CAPACITY	12" x 36"	12" x 48"	12" x 72"	14" x 36"	14" x 48"	14" x 72"	14"H x 36"	14"H x 48"	14"H x 72"	18" x 36"	18" x 48"	18" x 72"
Maximum swing over table	12 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "
Maximum diameter machine will grind with full size wheel	12 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "
Minimum diameter machine will grind with either full size or worn out wheel	0	0	0	0	0	0	0	0	0	0	0	0
Nominal distance between centers	36"	48"	72"	36"	48"	72"	36"	48"	72"	36"	48"	72"
Distance from floor to centers	41 $\frac{3}{8}$ "	41 $\frac{3}{8}$ "	41 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	42 $\frac{3}{8}$ "	44 $\frac{3}{8}$ "	44 $\frac{3}{8}$ "	44 $\frac{3}{8}$ "
Swivel table graduated to an angle: Toward wheelhead	11°	9°	7°	11°	9°	7°	11°	9°	7°	11°	9°	7°
Away from wheelhead	3°	2°	2°	3°	2°	2°	3°	2°	2°	3°	2°	2°
Swivel table graduated to taper per foot: Toward wheelhead	4 $\frac{1}{2}$ "	3 $\frac{1}{4}$ "	3"	4 $\frac{1}{2}$ "	3 $\frac{3}{4}$ "	3"	4 $\frac{1}{2}$ "	3 $\frac{1}{4}$ "	3"	4 $\frac{1}{2}$ "	3 $\frac{3}{4}$ "	3"
Away from wheelhead	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "
Floor space required	72 $\frac{3}{4}$ " x 154 $\frac{1}{4}$ "	72 $\frac{3}{4}$ " x 185"	72 $\frac{3}{4}$ " x 237 $\frac{3}{4}$ "	72 $\frac{3}{4}$ " x 154 $\frac{1}{4}$ "	72 $\frac{3}{4}$ " x 185"	72 $\frac{3}{4}$ " x 237 $\frac{3}{4}$ "	72 $\frac{3}{4}$ " x 154 $\frac{1}{4}$ "	72 $\frac{3}{4}$ " x 185"	72 $\frac{3}{4}$ " x 237 $\frac{3}{4}$ "	72 $\frac{3}{4}$ " x 154 $\frac{1}{4}$ "	72 $\frac{3}{4}$ " x 185"	72 $\frac{3}{4}$ " x 237 $\frac{3}{4}$ "
SHIPPING DATA												
Net weight, approximate, including all motors	9,200	9,700	11,300	9,300	9,900	11,400	9,800	10,400	11,900	10,000	10,600	12,100
Gross weight, domestic	11,300	12,000	14,500	11,400	12,100	14,600	11,900	12,600	15,100	12,100	12,800	15,300
Gross weight, export	12,800	14,000	16,300	12,900	14,100	16,400	13,400	14,600	16,900	13,600	14,800	17,100
Approximate size of case	142" x 58" 73"	166" x 58" 73"	223" x 58" 73"	142" x 62" 73"	166" x 62" 73"	223" x 62" 73"	142" x 62" 73"	166" x 62" 73"	223" x 62" 73"	142" x 66" 73"	166" x 66" 73"	223" x 66" 73"
Volume of case, cubic feet. (Approximate)	360	420	580	360	420	580	360	420	580	396	462	594

PRINCIPAL MACHINE SPECIFICATIONS—Concluded INTERNAL GRINDING ATTACHMENT



Size Machine	A	B	C
12" & 14"	4 $\frac{3}{4}$ "	4 $\frac{15}{16}$ "	10"
14"H & 18"	6 $\frac{3}{4}$ "	5 $\frac{7}{8}$ "	12"

Figure 10
Internal Grinding Attachment

The internal grinding attachment furnished as standard equipment includes: one spindle No. 282449, quill No. 267401-19, two grinding wheels, and one driving belt. Spindle speed 18,000 rpm Motor, motor mounting, and control equipment.

Listed on pages 70-73 are other quills with corresponding wheels which can be used with spindle No. 282449 and which may be obtained as extra cost equipment.

All spindles are interchangeable in the bracket of the standard attachment.

All quills and spindles have right hand threads.

STANDARD EQUIPMENT

STANDARD EQUIPMENT SUPPLIED WITH THE MACHINE FILMATIC 12", 14", 14"H, and 18"UA Universal Grinding Machines (Model DE)

Headstock — Swivel base, combination live and dead spindle having Lathe Standard Spindle Nose. Includes headstock center. Motor driven, including motor and controls.

Footstock — Combination lever and screw type with diamond holder bracket and diamond holder (without diamond nib.) Includes footstock center.

Back Rests — Two-shoe, two-screw type, maple wood shoes: $\frac{1}{2}$ " to 4" capacity; three with 36", four with 48" and five with 72" machines.

Center Rest — $\frac{1}{2}$ " to 4" maximum work diameter.

Diamond Bracket — Table type for external and internal truing (without diamond nib).

Internal Grinding Head — Hinged type, including fitted bracket, one spindle, quill, two grinding wheels, motor pulley and one driving belt, motor, motor mounting and control equipment.

Chuck — Four jaw independent. (Light pattern, iron body, with solid reversible jaws) Mounts directly on spindle nose

Face Plate — Mounts directly on spindle nose.

Wheel Mount — Balancing type, for 5" hole wheels up to 1" web thickness.

Work Driving Dogs — Reversible type; one $\frac{1}{4}$ " to $2\frac{1}{2}$ ", one $1\frac{1}{8}$ " to 4", and one 4" to 6" capacity.

Wheel Guard, Reversible — For wheels up to 14" diameter x $1\frac{1}{2}$ " face, with cutting fluid piping and nozzle.

Grinding Wheels — One 14" diameter x 1" face x 5" hole. One 14" diameter x $1\frac{1}{2}$ " face x 5" hole, recessed one side 8" diameter x $\frac{1}{2}$ " deep.

Cutting Fluid Pump — Individually motor driven with complete piping or sewer connections (not both)

Splash Guards.

Center Knockout Bar.

Complete Electrical Equipment—All electrics are wired in accordance with NMTBA "Machine Tool Electrical Standards" as follows:

(a) Standard single voltage is 208 or 575, 3 phase 60 cycle, A.C.

(b) Standard dual voltage is 230/460, 3 phase, 60 cycle, A.C.

Any voltage other than above must be referred to the factory for price and delivery.

INSTALLATION INSTRUCTIONS

Lifting the Machine. The CINCINNATI FILMATIC UA Universal Grinder has been built for extremely accurate grinding. To maintain the accurate alignment of the machine, it should always be lifted properly and carefully.

The grinder is lifted with a three-point hook-up. Lifting points for the machine are obtained by one eyehook and two eyebolts; heavy lines indicate cables for these lifting points in Figure 12.

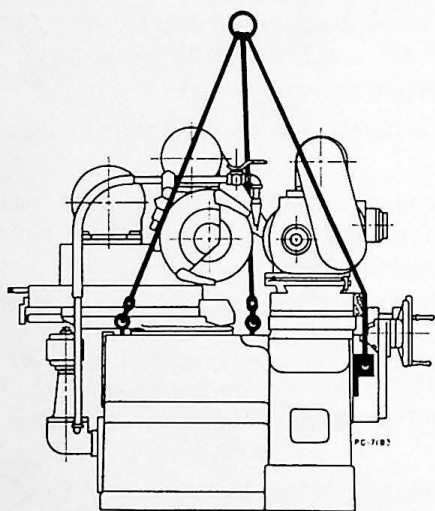


Figure 12
Lifting the Machine

The eyehook, bolted to the left front of the bed provides one lifting point (It is painted bright red and must be returned to The Cincinnati Milling Machine Company).

The second and third lifting points are obtained by screwing eyebolts into the tapped holes in the top section of the bed.

Be sure that the chains or cables clear the swivel table, sliding table, and telescoping table way guards. And also, that the finished surfaces of the machine are protected by using wood blocks as shown in Figure 12.

Location of Machine. When selecting the location for this machine, be certain that the machine will not be exposed to the direct rays of the

sun, nor should it be near any heating appliance. Either or both of the preceding conditions may cause localized heating and subsequent distortion, which will result in less accurate grinding.

Foundation. To maintain the accurate alignment that has been built into this machine, it must be placed on a stable foundation. If the floor is constructed of good, reinforced concrete, 8 inches or more in thickness, no special foundation will be required. For floors of lesser stability and strength, a foundation should be built up equal to or better than this foundation specification.

Wherever possible, the machine should be installed on a floor which is supported by solid earth. The foundation should not be affected by the vibrations generated by nearby machines or any other source. This requirement is necessary to obtain the best grade of finish.

INSTALLATION INSTRUCTIONS

Leveling Instructions. After the machine has been moved to its proper location, it must be carefully leveled. Select a sensitive, graduated tube spirit level, reading to 10 seconds per graduation (.0006 per foot) and provided with screw adjustment. Accuracy of the level depends upon the glass tube and not upon the length of the frame. A short level having a long tube is best. Do not use a carpenter's level or the level in a machinist's combination square as they are not accurate enough. To re-establish perfect alignment in the machine, proceed in the following manner:

1. Place the leveling instrument on the top finished surfaces of the bed (Figure 13A).

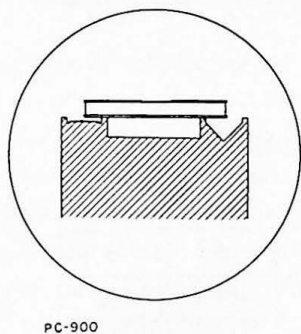


Figure 13A
Leveling Instrument on Bed Ways

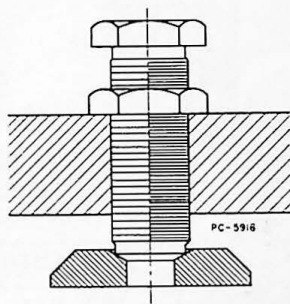


Figure 13B
Leveling Jack Assembly.
Washers Under the
Screws are Supplied
With the Machine

2. Adjust the leveling screws (Figure 13B), indicated by the numeral "1" at the front and rear of the bed (Figures 14A and 14B), slowly and evenly until the leveling instrument indicates absolutely level both lengthwise and across.
3. Now adjust leveling screws at the points, indicated by numeral "2", until leveling instrument indicates absolutely level. Adjust the remaining leveling screws, indicated by numeral "3", tight enough to contact the floor and prevent the machine from sagging.
4. Errors in alignment may be corrected by deflecting the bed with screws provided on the leveling and aligning blocks. These screws are indicated by letters "A", "B" and "C", Figures 14A and 14B. For a section view of these screws see Figure 16, "BB" and "CC".

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

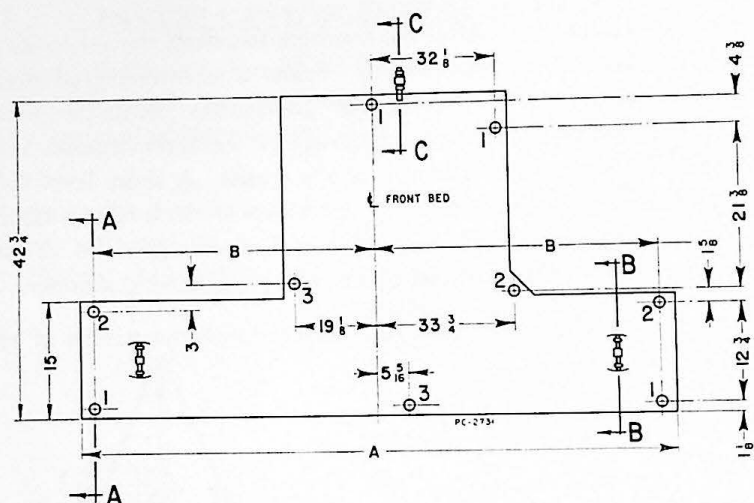


Figure 14A
Location of Leveling Screws

Machine	A	B
12", 14", 14"H. and 18" x 36"	104 1/4	46 5/8
12", 14", 14"H. and 18" x 48"	128 1/4	58 5/8

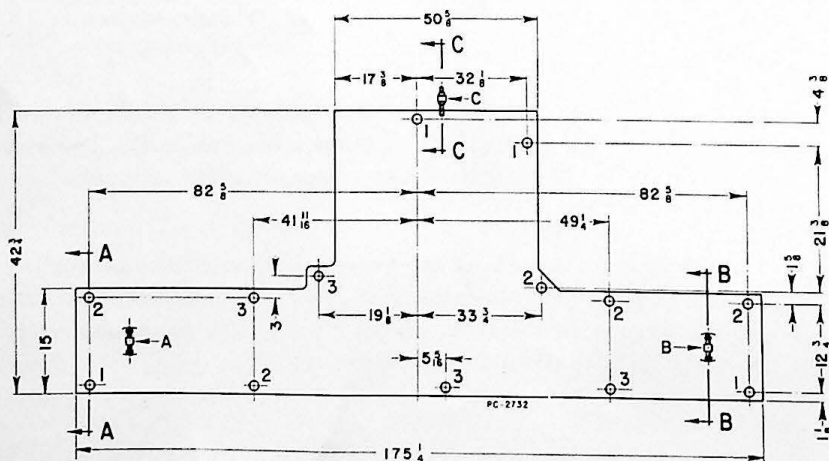


Figure 14B
Location of Leveling Screws
for 72" Machines

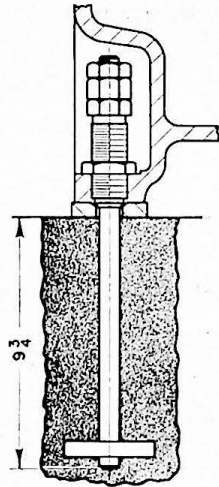
INSTALLATION INSTRUCTIONS

Warning: Do not attempt to correct for large errors in this manner. In case of difficulty, check setup, hardness of grinding wheel, leveling, etc.

5. If the bed is high at the extreme ends hold down bolts are supplied for straightening (Figure 15, section A-A).
6. Re-check for level at both ends of the bed and re-adjust the leveling screws if necessary; then lock all leveling screws in position.

Bolting the Machine to the Foundation.

Where extreme grinding accuracy is required, on the 36", 48" and 72" machines, it is recommended that the standard leveling screw be replaced with a combination leveling jack and hold-down bolt. The combination leveling jacks and hold-down bolts, shown in Figure 15, are supplied as standard equipment with the 72" length machine and at extra cost for the 36" and 48" length machines.



SECTION A-A

Figure 15
Anchor Bolt

Bolting the machine to the foundation may be accomplished by means of the hole through the center of the leveling jack. Each jack consists of an adjusting screw, locking nut, and a steel disc screw-seat (Figure 13B) which increases the effective bearing area of the screw upon the foundation. Before proceeding, it will be necessary to accurately locate the bolt holes. Notice that the center distances of bolt holes, given on the "floor plans" shipped with the machine, are approximated. Proceed as follows:

1. Drill the bolt holes about 6" in diameter.
2. Lower the machine onto several 1" thick boards, and engage the hold-down nuts on the anchor bolts. When lowering the machine over the anchor bolts, the steel disc screw-seats must first be dropped over the anchor bolts before inserting the bolts through the leveling screws.

3. Fill the holes around the anchor bolts with quick drying cement, thin enough to flow easily.

After the cement around the anchor bolts has set, the boards should be removed, the machine carefully leveled, and the anchor bolts tightened securely

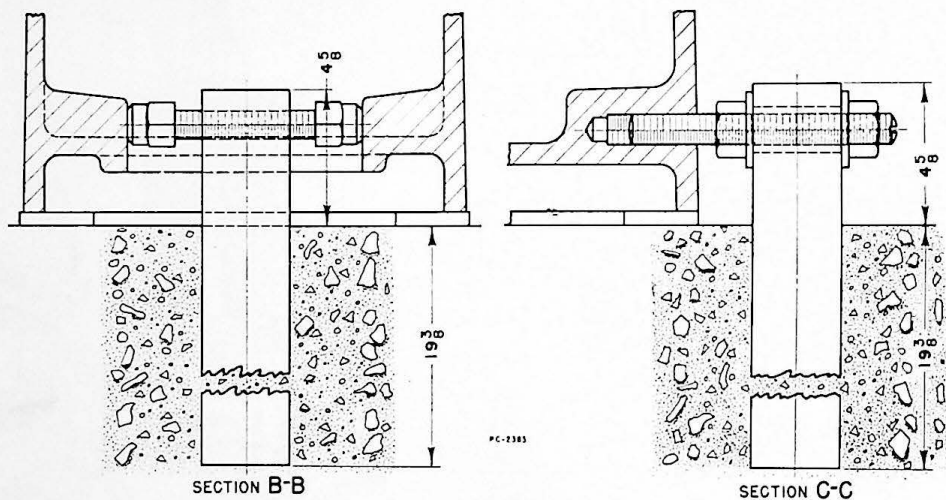


Figure 16
Aligning Blocks

LUBRICATION

LUBRICATION

The importance of correct lubrication cannot be over-emphasized. The continued accuracy and long life of the machine depends largely upon proper lubrication at all times, so do not neglect lubrication after the machine has been installed. Read the "Lubricating Instructions and Specifications" carefully (pages 20 and 21). It is extremely important that you use only those grades of oil which meet the specifications. The following paragraphs present a general description of the lubricating systems.

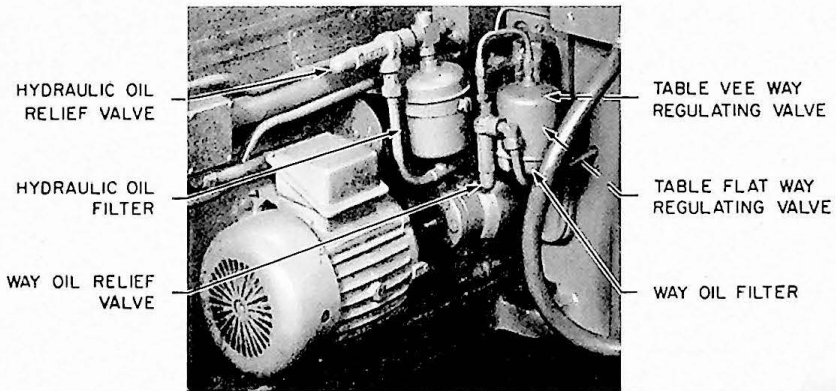


Figure 17
Hydraulic Pump Unit and Lubricating Valves

Spindle Bearings. The grinding wheel spindle bearings are of multiple shoe construction, steel backed and bronze lined, and self-adjusting for variations in load imposed by the amount and rate of stock removal. The spindle is supported at both ends by these shoe-type bearings, while a self-adjusting and self-aligning plain bronze thrust bearing, located in the center of the spindle, takes the thrust load.

The lubrication of the spindle bearings is a very important factor in the ability of the CINCINNATI FILMATIC UA Universal Grinding Machines to take heavy cuts and produce extremely smooth finishes.

The spindle bearings of the 12", 14", 14"H and 18" grinding machines are lubricated by a pump unit, belt driven by the same motor that drives the hydraulic and lubricating pumps (Figure 17). The hydraulic oil is pumped from the hydraulic reservoir to the spindle bearing compartment. After the oil fills the bearing compartment it overflows into a second compartment. As the second compartment is filled a safety float switch is actuated

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

in the electrical circuit, allowing the grinding wheel drive motor to be started when the START button is pressed the second time. If the oil flow to the bearing compartment stops for any reason the safety switch will open and the grinding wheel motor will automatically stop. This is an important safety feature of the machine which insures perfect lubrication of the spindle bearings at all times.

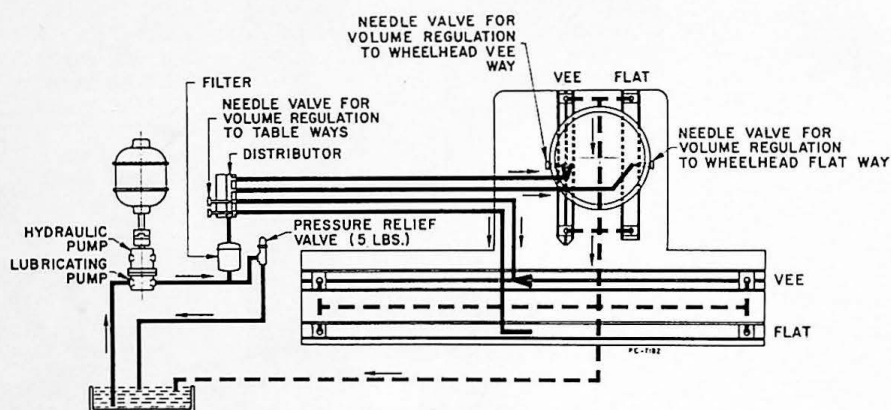


Figure 18
Diagram of Table and
Wheelhead Way Lubricating System

Table and Wheelhead Ways. The table and wheelhead ways are pressure lubricated with filtered oil from a vane pump mounted in tandem with the hydraulic oil pump at the left rear of the bed (Figure 17). The oil is pumped to the central portions of the table and wheelhead ways and flows outward to both ends of the units, as shown in Figure 18. This prevents the entrance of foreign matter. For further protection, all ways are completely enclosed by guards. Covered peep holes in the table way guards provide a visible check of the flow of oil over the table ways.

Headstock Unit. Proper lubrication of the headstock unit is very

LUBRICATION

important, not only from the standpoint for successful operation, but also to reduce the amount of service calls.

WARNING: Use only the oils specified for Station 7 on pages 20 and 21.

The oils which have been selected for lubricating the Speed Ranger drive parts were chosen for special qualifications. These oils and no others should be used. Improper oils will cause the ring and cones to slip.

The oil should be drained and refilled with clean filtered oil every 2 to 3 months of operation. To drain the unit, turn the filler elbow and fill with clean oil. If the oil is exceedingly dirty when drained from the headstock, flush out the unit with kerosene before refilling.

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

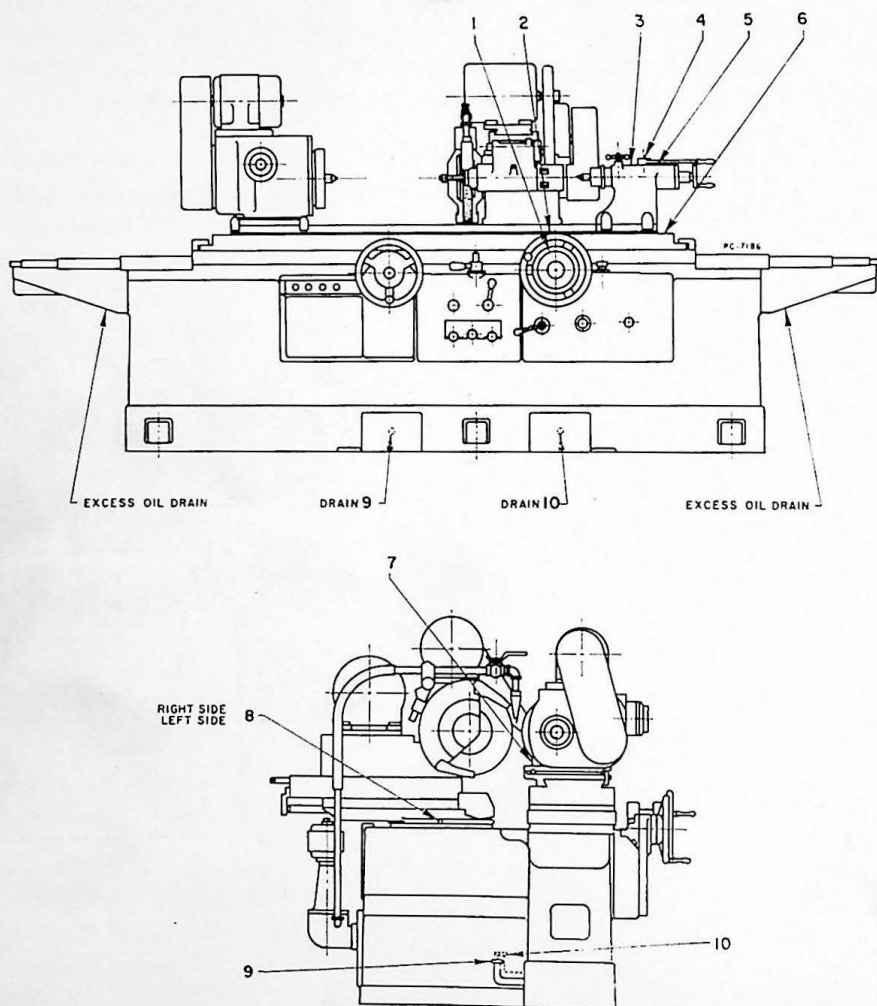


Figure 20
Lubrication Diagram

- LUBRICATION

LUBRICATING INSTRUCTIONS AND SPECIFICATIONS

See Lubrication Diagrams, opposite page

Thoroughly oil all moving parts as they are installed. Then lubricate all principal points as listed below before starting machine. Periodic and thorough lubrication with correct lubricant, as specified, will help maintain the long life and accuracy built into machine. The intervals listed are based on a normal eight-hour day.

PURCHASE LUBRICANTS FROM RELIABLE DEALERS!

When to Oil	Station Number	Instructions	Parts Lubricated	Specifications
Daily	1	Oil button, apply a few drops. Use a bench oiler.	Cross feed index mechanism.	P-55. A good quality paraffinic base rust and oxidation inhibited oil. Viscosity range 200-220 S.U.S. @ 100°F.
	2	Oil button, apply a few drops. Use a bench oiler.	Pick feed mechanism.	
	3 and 5	Oil button, apply a few drops. Use a bench oiler.	Front and rear footstock spindle.	
	4	Oil button, apply a few drops. Use a bench oiler.	Footstock spindle shifting linkage.	
	6	Oil button, apply a few drops. Use a bench oiler.	Table swivel adjusting screw nut.	
	7	*Keep filled to threads of pipe fitting. Use oil pot to fill. (Check daily.)	Speed ranger drive mechanism.	
Weekly	8	Apply 1 or 2 shots of grease. Use a hand grease gun.	Wheelhead swivel bearing & cross feed mechanism. (2 station, right & left side.)	P-64 A No. 2 Medium quality cup grease, for cup service.
	9	*Keep filled to high limit on bayonet gage on filler cap. Use oil pot to fill.	Table ways and wheelhead ways.	P-47 #A medium slide-way oil. Viscosity range 300-350 S.U.S. @ 100°F.
	10	*Keep filled to high limit on bayonet gage on filler cap. Use oil pot to fill.	Hydraulic oil system.	P-45 High quality light hydraulic oil. Viscosity 95 to 115 S.U.S. @ 100°F.

*Quantities required: Station No. 7 approx. 1 pt. (change every 2 or 3 months). Station No. 9 approx. 5 gals. (change every 12 months). Station No. 10 approx. 25 gals. for 12", 14", 14"H, 18"UA machines (change every 12 months).

†This is an oil having slideway characteristics.

Note. — Lubricate motor according to motor manufacturer's specifications.

A list of approved lubricants which meet the above specifications may be obtained by writing for Pub. No. M-2258-3.

Internal Grinding Attachment. The internal grinding attachment is supplied with the spindle packed in grease and lubricated for life.

Oil Reservoirs. The way lubricating oil and hydraulic oil reservoirs are cast integral with the front section of the bed and are filled through stand pipes at the rear of this front section. The hydraulic oil reservoir is filled through the standpipe at station 10 (Figure 20) and holds about 2½ gallons in the 12", 14", 14"H, and 18" machines. The way lubricating oil reservoir is filled through the standpipe at station 9 (Figure 20) and holds about 5 gallons. Oil levels may be checked by the "bayonet" gages, incorporated in the caps of the standpipes.

Station 9 and 10 should be cleaned every 12 months. This may be done by draining the oil through the lower end of the standpipes or by pumping them out with a portable pump, and then removing the two small covers from the front of the bed near the floor line. Flush out the reservoirs, using kerosene, and refill with clean oil.

On each end of the bed, as shown in Figure 20, there is a drain plug. These are provided to drain the small amount of excess oil that accumulates from the ways. Remove the plugs and drain the oil about every 6 months.

These machines use the same oil for both the spindle bearing lubrication and the hydraulic system. The oil is pumped into the spindle bearing cavities by an independent pump and is returned to the hydraulic reservoir through a drain line.

WARNING: Do not start pumps for spindle oil, hydraulic and lubricating oil, or cutting fluid until their respective reservoirs have been filled and the oil levels have been checked.

Oil Filters. The hydraulic oil filter should be replaced every six months and the way oil filter should be replaced at least once a year. To do this, remove the cover at the left rear of the machine. Cartridge type oil filters, (Figure 17) will now be visible and can easily be replaced.

The spindle oil filter is located on the rear of the wheelhead. This is also a cartridge type filter and can easily be replaced.

OPERATING INSTRUCTIONS

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Starting a New Machine for the First Time. After the machine has been properly installed, wash off the slushing oil and dirt accumulated in transit, using naphtha or some similar solvent of grease. Fill all of the reservoirs and lubricate the machine in accordance with "Lubricating Instructions and Specifications" (page 21).

Before proceeding, momentarily start the motors and notice their direction of rotation. The motor shafts must rotate in the directions indicated by the metal tags mounted on or near the motors.

Allow the motors to run for several minutes and then check to be certain that the oils are reaching the points which they are intended to lubricate. It may be necessary to prime the lubricating oil pump.

Try all movement of the hand controls to familiarize yourself with the machine. Set the table dogs for a full stroke reciprocating cycle and allow the machine to run idle for an hour or so to insure complete lubrication of all the bearings and to expell all of the air from the hydraulic system. It is also good practice to run the table through several full strokes each morning before starting to grind, this expells any air that may have entered the hydraulic system overnight.

If the machine is equipped with Hand Servo Control familiarize yourself with its operation (page 51).

With the machine running "idle," operate the hand servo lever and notice how responsive the wheelhead is to the infeed servo control, as the lever is shifted to the various positions from "A" to "C" (Figure 52).

Check rapid approach of the wheelhead by shifting the hand lever from "B₁" to position "B₂" and observe the change in the feed rate as you change the rate of lever rotation when shifting it from "B₂" to "C" position.

Electrical Control Panel. You will notice the electrical control buttons conveniently grouped in the left-hand panel on the front of the bed. The red button on the right is the master stop. Pressing this button stops all of the motors on the machine (Figure 24).

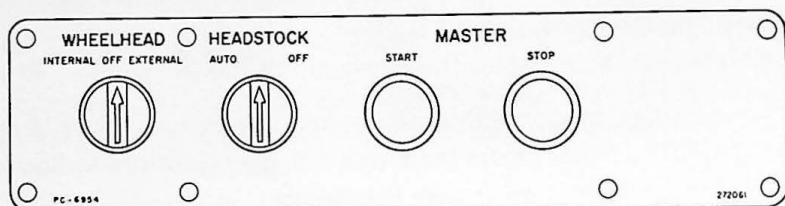


Figure 24
Electrical Control Buttons

The button next to the stop button is for starting the hydraulic and lubricating oil pump, the spindle oil pump and the grinding wheel drive motor.

The next or third button to the left controls the headstock and cutting fluid pump motors. If the button is turned to the left, the cutting fluid pump and headstock motors will both run. If the button is turned to the right, the cutting fluid pump motor runs independently of the headstock, a convenience when truing the grinding wheel. If the button is turned with the arrow pointing straight up, neither motor will run. The cutting fluid pump will not run unless the external or internal grinding wheel is also running.

The next button, the one at the far left, is a selector switch for internal and external grinding. If this button is turned to the left, the internal motor runs and the external motor is stopped. If the button is turned to the right, the external motor runs and the internal motor is stopped. If the button is turned with the arrow pointing straight up, both motors stop.

To start the machine:

1. Press the start button.
2. Select "internal" or "external" grinding as desired with the wheelhead button.
3. Again press the start button.

OPERATING INSTRUCTIONS

Table Hand Operation. The table may be moved by means of the "table traverse handwheel" (Figure 25). This handwheel has two operating positions. By merely pulling out or pushing in the handwheel, two table traverse speeds are available. The high traverse rate of approximately $\frac{15}{16}$ " per revolution is obtained with the handwheel pushed in; the low traverse rate of approximately .200" per revolution with handwheel pulled out. The high traverse rate is used to quickly position the table when setting up, the low traverse rate may be used effectively when grinding shoulders.

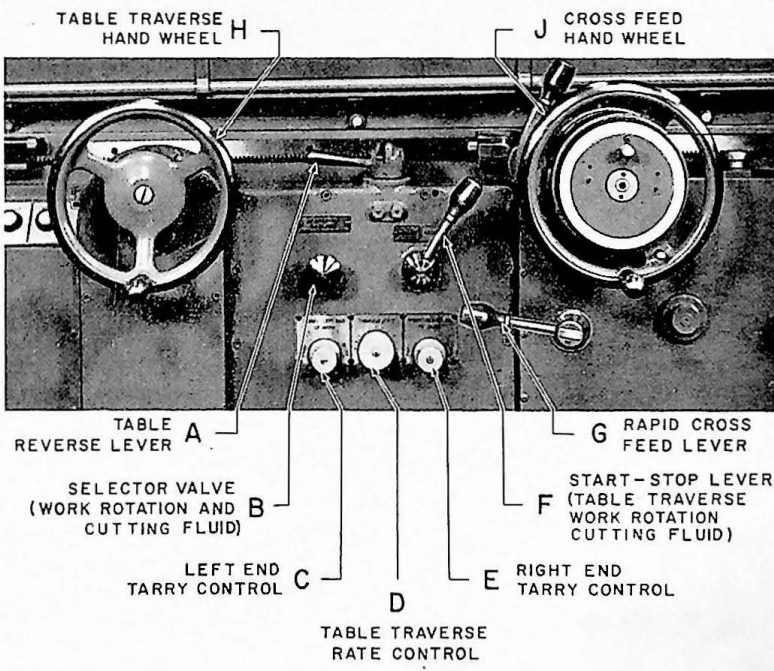


Figure 25
Operating Controls

Table Power Feed Controls. The operating controls for table power feeds are conveniently grouped between the handwheels. The "table start-stop lever" may be considered as the major control for table movements. This lever controls the starting and stopping of the table traverse and will, if desired, simultaneously start the headstock and coolant motors, providing the "Headstock switch" is in the "AUTO" position. The lever has two

operating positions marked "START" and "STOP". To start the table motion, headstock, and coolant, merely shift the lever to the left as far as it will go to the "START" position. To stop the table motion, headstock rotation, and coolant flow at any time, it is only necessary to shift the lever to the "STOP" position. When the lever is in the "START" position, the hand table traverse is inoperative and the handwheel will spin freely. This is an important safety feature.

The direction of table motion is controlled by the "table reverse lever" which has two operating positions. When the lever is rotated counter-clockwise the table feeds from left to right, when rotated clockwise the table feeds from right to left. The length of stroke on traverse work is controlled by dogs, (see "Reversing Dogs", page 34) mounted on a rack on the front of the table, which act upon a pawl in the "table reverse lever" to automatically reverse the direction of table motion. Power reversal of the table may be accomplished with a table stroke as short as $\frac{3}{32}$ ", to give excellent reciprocating action for infeed grinds. The table reverses accurately within .004", a desirable feature when grinding next to a shoulder. Table traverse rates are infinitely variable from 3 to 220 inches per minute, under the control of the "table traverse rate control."

If the power table traverse is not being used, then the headstock and cutting fluid are controlled by the selector valve knob. Pull this knob out to start the headstock and/or cutting fluid or push it in to stop them.

Hand Cross Feed Control. The handwheel shown in Figure 27, along with its several component parts, controls all cross feed movements of the wheelhead, whether hand or automatic feed. The variations possible are shown in Figure 29A.

The cross feed handwheel is provided with a clutch which permits the handwheel and micrometer dial to be disengaged from the cross feed mechanism for sizing adjustments in conjunction with the positive stop. With the positive stop engaged, disengage the handwheel by flipping the clutch release lever (Figure 27) in toward the center of the handwheel. Turn the handwheel clockwise until the desired diameter reduction is shown on the rear graduated dial. Then, re-engage the clutch and rotate the handwheel counter-clockwise against the positive stop. Fine increments of cross adjustments are obtained by pulling out the fine increment adjust-

OPERATING INSTRUCTIONS

ment knob (Figure 27) and rotating it counter-clockwise until the desired amount of diameter reduction is indicated by the graduated dial on the front of the handwheel. After making the adjustment, re-engage the knurled knob and rotate the handwheel counter-clockwise against the positive stop. The fine increment adjustment dial is graduated in increments of .000050" diameter reduction and is equipped with a knurled clamping screw to permit "zeroing" of the dial before making fine cross adjustments.

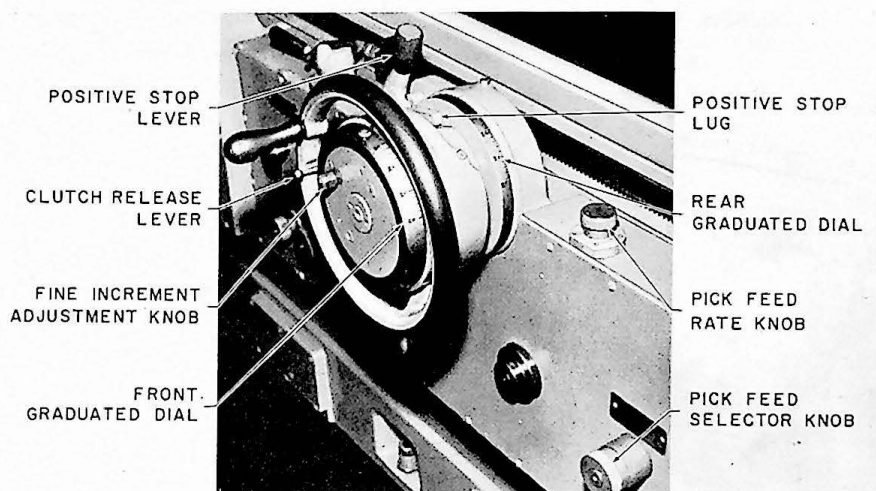


Figure 27
Cross Feed Handwheel

Hand Rapid Positioning of Wheelhead. The "rapid cross feed lever" (Figure 28) engages a single tooth clutch for the rapid movement of the wheelhead. This arrangement assures the maximum accuracy in returning the wheelhead to a given point as required when grinding multiple diameter work, since the clutch tooth may be returned to the slot in the clutch at the exact starting point (assuming that the number of turns of the cross feed handwheel are counted while moving the wheelhead out and back again). When re-engaging the lever, pull it up lightly with the left hand while slowly rotating the cross feed handwheel with the right hand.

Automatic Pick Feed Mechanism. The pick feed unit is completely hydraulic, and picks in increments from .0002" to .005" low range and .0005" to .0125" high range, on the diameter. The pick feed rate control knob is located on top of the front cross feed panel (Figure 27). Each revolution of this knob advances the pick feed rate .0004" on the diameter.

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

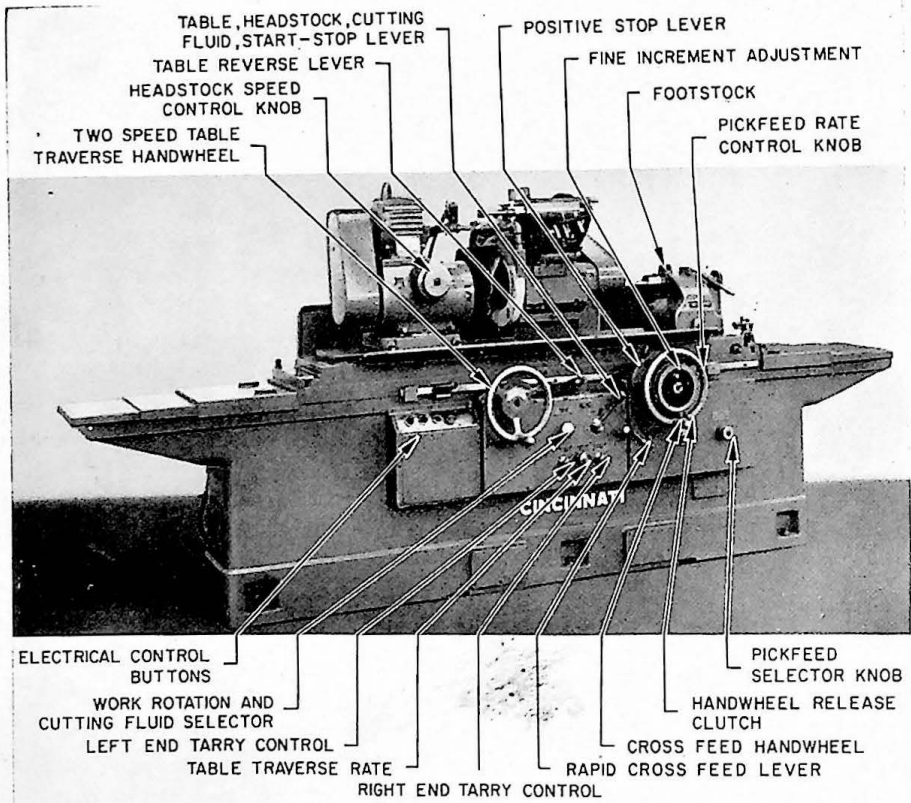


Figure 28
Functional Diagram

OPERATING INSTRUCTIONS

This unit also has a pick feed selector with four separate stations. These are:

1. Stop.
2. Pick left end of work only.
3. Pick right and left end of work.
4. Pick right end of work only.

The pick feed selector knob is located on the right side of the front cross feed panel (Figure 28). The pick feed unit has been designed so the handwheel can pick all the way to the positive stop.

PC-3234 ADVANCEMENT ON DIAMETER	QUICK FEED LEVER	
	DOWN	UP
PER REVOLUTION OF HANDWHEEL	100"	.250"
PER REVOLUTION OF FINE INCREMENT ADJUSTMENT WHEEL	.004"	.010"
PER GRADUATION ON REAR GRADUATED RING	.0005"	.001250"
PER GRADUATION ON FRONT GRADUATED RING	.000050"	.000120"
INFEEED AT TABLE REVERSAL	MIN.	.0002"
	MAX.	.005"
		.0125"

Figure 29A
Cross Feed Instruction Chart

Two Speed Grinding Wheel Drive. The grinding wheel spindle and the driving motor are equipped with double diameter sheaves to provide increased wheel speed for worn wheels (Figure 29B). When new wheels are used the two driving belts should be located in the inner pairs of sheaves. When the wheel has worn to approximately $9\frac{1}{2}$ " in diameter the belts should be shifted to the outer pairs of sheaves in order to reestablish correct cutting speed. A built-in safety device prevents the installation of a grinding wheel of more than $9\frac{1}{2}$ " diameter when the belts are in the outer or high speed sheaves. This safety device consists of a two-position interfer-

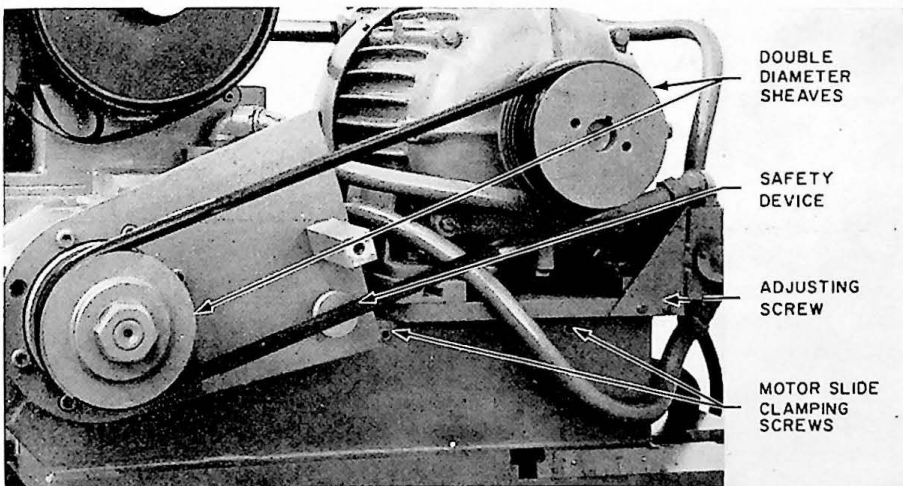


Figure 29B
Grinding Wheel Drive with Cover Removed

ence bar mounted in the path of the driving belts. When the belts are shifted to the high speed sheaves it is necessary to push this bar in toward the wheelhead. The opposite end of this device then projects into the wheel guard to prevent the mounting of a grinding wheel larger than $9\frac{1}{2}$ " diameter until the belts have again been shifted to the inner sheaves.

Some machines are equipped with double-end motors (extra cost) for the purpose of face grinding with the wheel on the right-hand end of the spindle. When changing the wheel from the left to the right hand end, be sure to remove the safety device and insert it through the other side of the wheelhead housing. It is made with an extra pair of grooves to engage the detent plunger.

The grinding wheel drive motor is mounted on an adjustable slide to simplify the adjustment of belt tension and provide an easy means of releasing belt tension when changing spindle speeds. The motor slide is clamped by two "motor slide clamping screws" on the right-hand side of the wheelhead (Figure 29B). The motor slide is easily adjustable, after

releasing the clamping screws, by means of a square headed adjusting screw projecting from the rear of the wheelhead. After adjusting the belts to the proper tension always lock the motor slide in position by retightening the clamping screws.

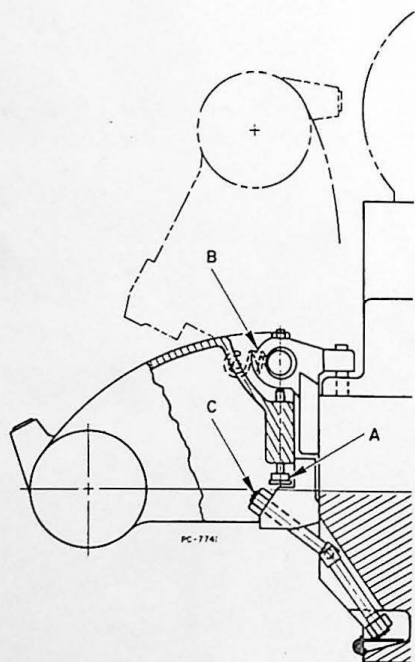


Figure 30
Diagrammatic Sketch
of Internal Attachment

Internal Grinding Attachment.

When grinding an external surface, the internal grinding attachment is swung up out of the way as shown by phantom lines in Figure 30. The attachment is held up by the locking pin "A" engaging shoulder "B" on the mounting bracket.

To arrange the attachment for internal grinding pull pin "A" and lower the internal head. Pin "A" may be released after it has been lowered past shoulder "B". Check the flat drive belt to assure that it is mounted on the pulleys of the internal motor and spindle. When the internal head has been lowered

OPERATING INSTRUCTIONS

into position, swing the pivot clamping screw "C" up into position as shown in Figure 30. Tighten the clamping bolt snugly with a wrench.

After the internal head has been clamped in position, lower the hinged belt guard and clamp it securely to the internal head. A selector switch (Electrical Control Panel, Figure 24) controls the internal drive motor.

When internal operations have been completed and the internal motor stopped, raise the internal belt guard, loosen the pivot clamping screw "C" and swing it behind the retaining spring on the wheelhead housing. Then raise the internal head until the spring loaded pin "A" snaps into position against the engaging shoulder "B". Turning the selector switch (Figure 24) to "EXTERNAL" will activate the main drive motor when the machine is again started.

Headstock. An infinite number of headstock spindle speeds may be obtained by turning the speed selector knob at the front of the headstock. Speeds range from 50 to 500 r.p.m. on the 12" and 14" grinding machines, and from 25 to 200 r.p.m. on the 14"H and 18" grinding machines. A dial which indicates the speed setting is conveniently located within a window in the housing behind the selector knob.

Caution: Spindle speeds should be changed only while the spindle drive is rotating.

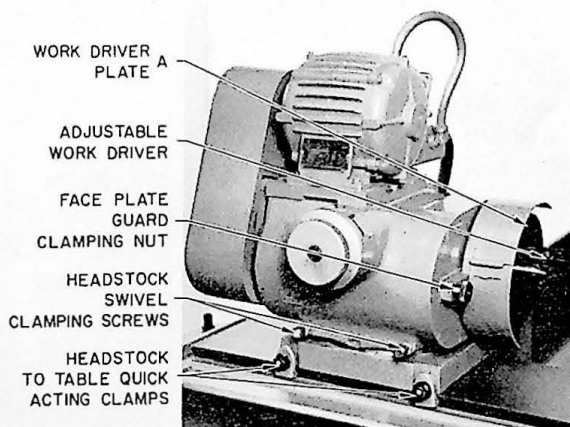


Figure 31
Headstock Unit for 12" and 14" machines
with Lathe Standard Spindle Nose

The headstock is arranged for either a live or dead spindle set up. In a live spindle set up the headstock center rotates with the work, whereas the headstock center is stationary in a dead spindle set up. Change to a *live spindle* for work held in a chuck or on a face plate, and for all internal grinding. Change to a *dead spindle* for work held between centers (see page 33).

To swivel the headstock, loosen the quick acting clamps at the front, pull out the zero alignment taper pin at the rear and swivel the unit to the desired degree. When resetting, reverse the process. The taper pin relocates the unit in perfect alignment.

Either the face plate or chuck (standard equipment for the headstock) may be mounted directly on the spindle or on an intermediate adapter and then on the spindle nose. The face plate (Figure 32B) is designed for mounting fixtures used for either internal or external grinding. The chuck (Figure 32A) may be used not only for internal grinding, but also for external grinding work not easily held between centers.

The adapter (Figure 32B—extra equipment) may be used not only in conjunction with the face plate and chuck, but also for mounting special grinding fixtures which are not conveniently mounted on the face plate. It also permits the removal of work and chuck (or face plate) as a unit, for inspection or other reasons.

The face plate, chuck, and adapter all require a live spindle set-up. To change from a dead spindle to a live spindle, proceed as follows:

1. Remove work drive plate "A" (Figure 31) which is held in place by three socket head set screws.
2. In drive plate "B" (Figure 32B) you will notice a key which engages in a slot in the spindle. To engage the key, push it forward and lock in position with the screw provided.
3. Pull out and rotate the knurled knob, on the rear of headstock, until pin is out of slot (12" and 14" machines) or shift spindle locking lever, on the front of headstock, to the "Live Spindle" position (14"H and 18" machines).
4. Mount the face plate, chuck, or adapter on the spindle nose with the bolts provided.

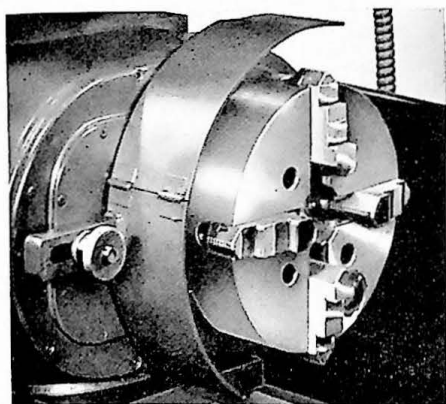


Figure 32A
Headstock with Chuck
Mounted in Position

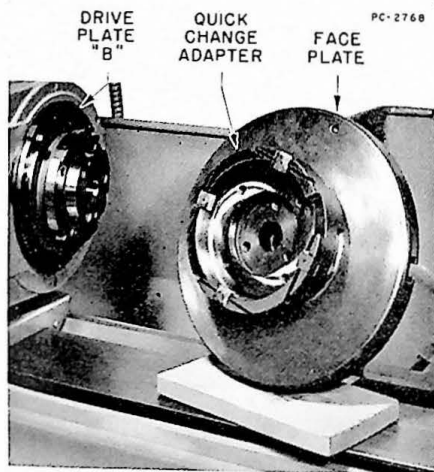


Figure 32B
Headstock with Face Plate and
Adapter Ready to be Mounted
on Spindle Nose

OPERATING INSTRUCTIONS

To change from a live to dead spindle set up, proceed as follows:

1. Remove face plate, chuck, or adapter.
2. Disengage driving key by loosening the locking screw.
3. Replace work drive plate.
4. Rotate knurled knob until pin goes into slot (12" and 14" machines) or shift spindle locking lever to the "Dead Spindle" position, on front of headstock (14"H and 18" machines). It will be necessary to turn the work driver by hand until the locking lever can be shifted to the "dead spindle" position. *Be careful not to start the headstock with the driving key engaged in the spindle and knurled knob or the spindle locking lever in the dead spindle position.*

Lever and Handwheel Retraction of Footstock Center. When grinding comparatively light work with a moderate rate of stock removal, the lever control for advance and retraction of the footstock center may be economically used to advantage because it is much faster than the hand-wheel operated screw. On the other hand, when grinding heavy work, work with a high rate of stock removal or extremely small work, the hand-wheel control of the center should be used. This positive control acts as a safety measure to prevent retraction of the center while grinding heavy work or work with a high rate of stock removal, and to prevent buckling of long slender work from spring pressure.

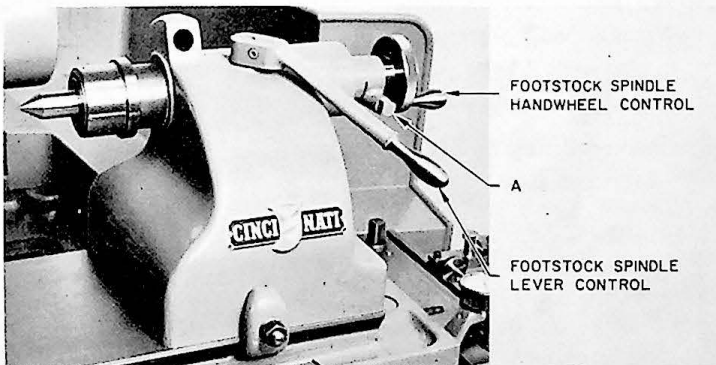


Figure 33
Footstock

To change from lever control of the footstock center to positive handwheel control, tighten screw "A" (Figure 33). This firmly clamps a sleeve in position and prevents movement of the footstock center by the hand lever. The movement is now controlled by the handwheel only. An expansion compensating spring is built into the footstock spindle in order to prevent excessive pressure on the centers when the spindle is positively positioned by the screw.

When inserting the center in the footstock spindle be certain that both are perfectly clean. Solidly seat the center but do not drive it into the footstock spindle. Should the center accidentally become stuck or frozen in the spindle, do not try to remove it by excessive twisting pressure on the footstock screw because of the severe strain or even breakage which may occur to parts within the unit. Remove the cap and footstock screw from the right end of the footstock and then drive out the center, using a small steel bar.

Placing the Work in the Machine. Inspect the centers of the work and machine, for imperfect centers will not allow production of accurate work. Set the headstock and footstock at such a distance apart that the spring in the footstock is but slightly compressed when the work is in grinding position. Remember that the headstock and footstock are both movable units, so that the work may be held in the center of the table rather than always near the headstock end of the table.

Reversing Dogs. Adjustable dogs on the front of the table may be set to reverse the direction of table travel by acting on the reversing lever. Coarse adjustment is made simply by pushing down on the dog and sliding it along the rack to the desired position, as in Figure 34. Fine adjustment is accomplished by adjusting the knurled screw on the inner end of the dog. This, along with accuracy of table reversal within .004", permits power table traverse to be used when grinding close to shoulders.

Power table reversal may be set as short as $\frac{3}{32}$ " with the dogs.

Should you desire to true the wheel while the dogs are set for power reversal of the table, it will not be necessary to move the right-hand dog in order to bring the diamond holder in line with the face of the wheel. The forward

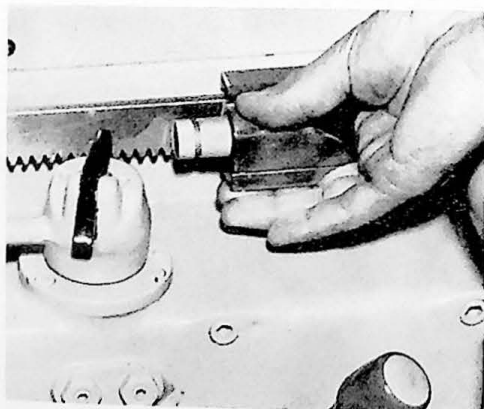


Figure 34
Reversing Dog

OPERATING INSTRUCTIONS

portion of the reversing lever is pinned in such a manner that it may be swung up to clear the top of the dog; however, the left-hand dog does not permit overriding. This safety feature prevents interference between head-stock and grinding wheel.

Back Rests. On all centertype work which is of such size or weight that it will either bend under its own weight or be deflected appreciably upon contact with the grinding wheel, it is necessary to use back rests to insure that the work will be ground both round and straight (Figure 35A). The back rests supplied with this machine are the positive feed screw type and are supported by, and solidly clamped to the table. The lower of the two replaceable wood blocks supports the work forward of its axis and tends to force the work up and back against the second wood block.

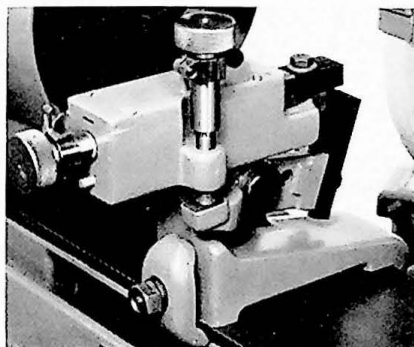


Figure 35A
Screw Type Back Rest

As the work is ground, compensation for stock removal is made by adjusting the upper wood block inward.

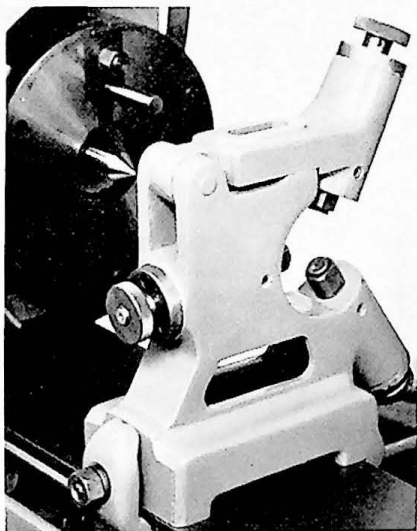


Figure 35B
Center Rest

Center Rest. When the grinding operation is confined to one end or when grinding long internal diameters, the center rest may be used to support one end of the workpiece while the other end is being supported by the chuck, face plate, or the center (Figure 35B).

The center rest supplied with the machine has a capacity of $\frac{1}{2}$ " to 4" diameter work and is clamped to the table by means of a quick-acting clamp.

The removable cast iron tips are brought into position by means of the knurled headed screws.

Swivel table. The headstock and footstock are mounted on an auxiliary swiveling table, carried by the machine table. This table provides the means by which the work may be swiveled to grind tapers. The swivel table may be locked firmly in any position by means of the "swivel table clamping screws" at each end of the table (Figures 36A and B) and may easily be swiveled when unclamped by means of the "swivel table screw" (Figure 36B). To assist in accurately setting up for taper work, the footstock end of the swivel table is provided with a pointer. The scale, engraved on the clamping strip, is graduated both in degrees and inches per foot taper on the work diameter.

Always loosen the clamping screws before swiveling the table and reclamp firmly after reaching the new position.

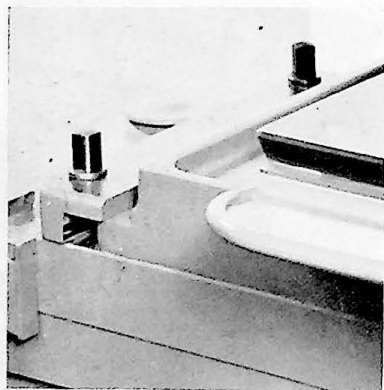


Figure 36A

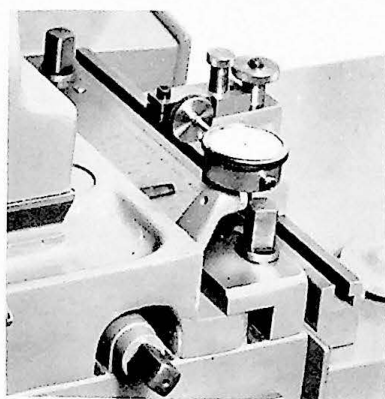


Figure 36B

Swivel Table Clamping Screws and Swivel Table Screw

Swiveling the Wheelhead. The wheelhead unit is accurately graduated and may be swiveled 90 degrees left and right of center. Loosen four nuts "C" (Figure 37), two on each side of the wheelhead swivel base, and connect an air hose to the "air lift" outlet "D" (Figure 37). This air pressure arrangement to the lower swivel, relieves wheelhead weight. Swivel the entire unit by hand until the desired graduation lines up with the pointer mounted on the swivel base. Disconnect air hose from air lift outlet and then tighten the four nuts "C". With the entire wheelhead swiveled in this manner, the direction of infeed will be the same as the angle to which the wheelhead has been swiveled.

Occasionally it may be necessary to move the wheelhead housing forward or backward on the slide, or to swivel the wheelhead housing on the slide

OPERATING INSTRUCTIONS

to obtain compound settings. Loosen bolt "B" at the rear of the wheelhead and bolt "A" at the front of the wheelhead to swivel the housing from side to side or to slide the housing forward or backward. The housing may be swiveled 30 degrees right and 90 degrees left of center. By swiveling the wheelhead housing in this manner, the direction of infeed remains unaltered. The direction remains the same as determined by the angle at which the entire unit has been swiveled, described in the preceding paragraph.

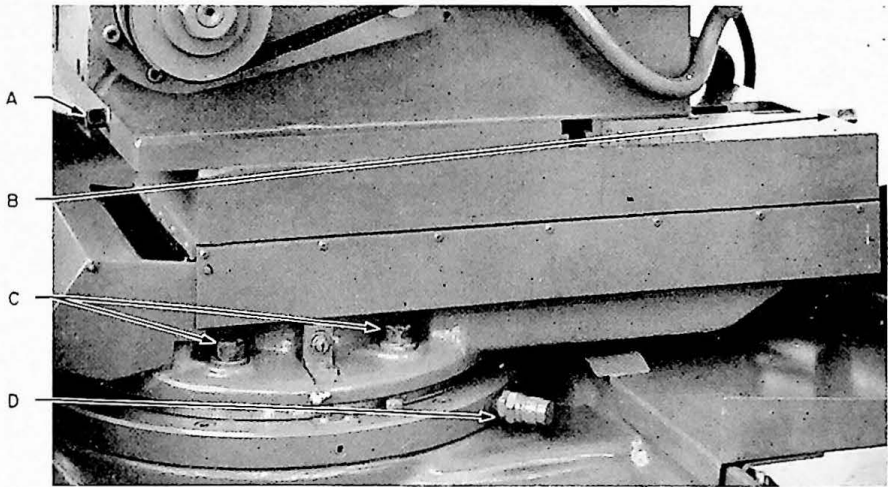


Figure 37
Right Side View of Wheelhead

Truing the Grinding Wheel. An important factor in maintaining satisfactory production and obtaining the best possible finish on the workpiece is a free cutting wheel. Given a certain grade of wheel, the only way it can be kept in a free cutting condition is to carefully true it often enough to prevent it from becoming glazed or loaded with particles of metal from the workpiece.

Two truing devices are included with these machines as standard equipment. One of them consists of a bracket attached to the footstock and an adjustable bar for carrying the diamond nib, which is used mainly for truing the periphery of the external grinding wheel (Figure 38). The second device consists of a bracket which clamps to the table and an adjustable bar for carrying the diamond nib, which is used for truing the internal and external grinding wheels, the sides of the external wheel and occasionally the periphery of the external wheel (Figure 39). The adjustable bar in both of these brackets are designed to the correct truing angle, producing the correct "wiping" action of the diamond across the face of the wheel.

Since production and finish, not to mention the life span of the diamond, are affected by the truing operation, it is important that you observe a few elementary precautions. Clamp the footstock firmly to the table and lock the footstock spindle in position with the screw clamp "A" (Figure 33). As soon as the diamond contacts the wheel, turn on the cutting fluid. We do not recommend dry truing for any type of wheel or truing device.

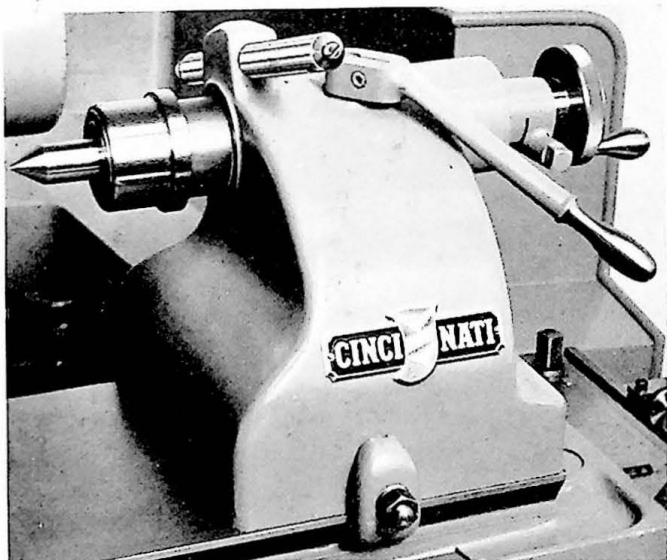


Figure 38
Footstock Truing Device

Do not remove more than .002" per pass. This setting is easily governed by adjusting the cross feed handwheel. The rate of traverse of the truing tool across the face of the wheel should not be too rapid or both the life of the diamond and the finish of the work will be adversely affected. The truing traverse rate for a diamond tool should be approximately 0" to 20" per minute for rough grinding operations and 4" to 7" per minute for finish grinding operations. It is good practice to stop the headstock motor while truing the wheel.

The maximum life of the diamond will be realized by rotating the holder after each few passes across the wheel, presenting new cutting edges to the wheel, and by having the diamond re-set when it becomes worn.

OPERATING INSTRUCTIONS

Coolant Control Valve. Rapid, convenient control of the flow of coolant is provided by the coolant control valve (Figure 28), mounted directly above the grinding wheel. This single valve may be used for momentary or permanent shut-off, or for adjusting the volume of coolant flow.

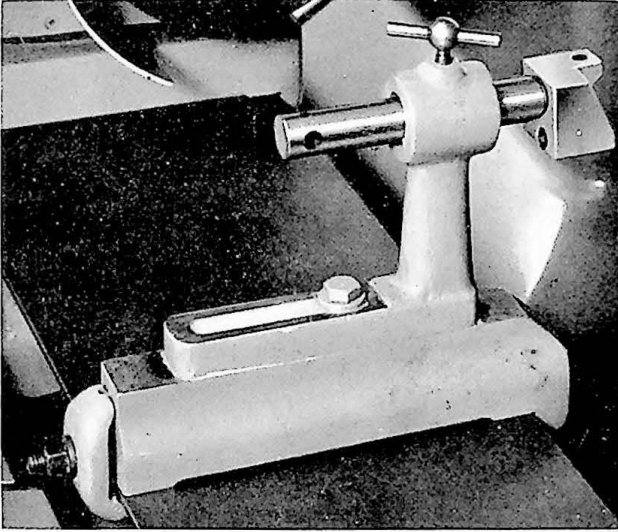


Figure 39
Table Type Truing Device

Coolant Supply. The cutting fluid reservoir is cast integral with the rear section of the base. The pump is located at the left hand rear corner of the bed viewing the machine from the operator's position. The returning coolant runs into two settling basins, located in the top of the bed, from which it overflows into the main coolant reservoir. These two basins should be removed and cleaned about once a day.

Cleaning the Coolant Reservoir. The coolant reservoir should be emptied and thoroughly cleaned about once or twice a week, more frequently if finish requirements are high.

Be sure that the receptacle is large enough (about 125 gallons), and keep the pump running until the cutting fluid reservoir is empty. If the pump should be stopped when the reservoir is partially empty, the suction head will be lost and it will be impossible to pump out the remainder of the cutting fluid without again filling the reservoir above the level of the impeller.

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

For this purpose use the pipe line "A" (Figure 40A) branching from the discharge line of the pump "B" over the rear base to the settling tank.

Swing this branch line upward. Connect an extension hose to the open end "C" of sufficient length to reach the container. Start the pump and open the valve "D" in the branch line to drain the machine reservoir of the used coolant into the container.

Now remove the plate over the clean-out opening on the rear of the bed near the floor line and scrape the sludge out into a flat pan (Figure 40B).

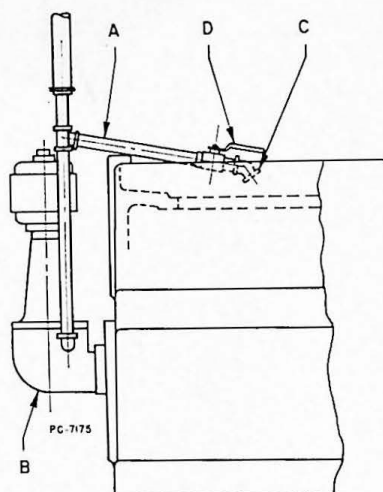


Figure 40A
Coolant Drain Piping

Before starting a job that requires an extremely smooth finish, it is advisable to also clean the inside of the wheel guard. The finish will then be free from scratches caused by grit and particles of metal circulating with the cutting fluid.

It may occasionally be necessary to clean the grit from the slots between the sliding and swivel tables to allow a free return of cutting fluid to the reservoir.

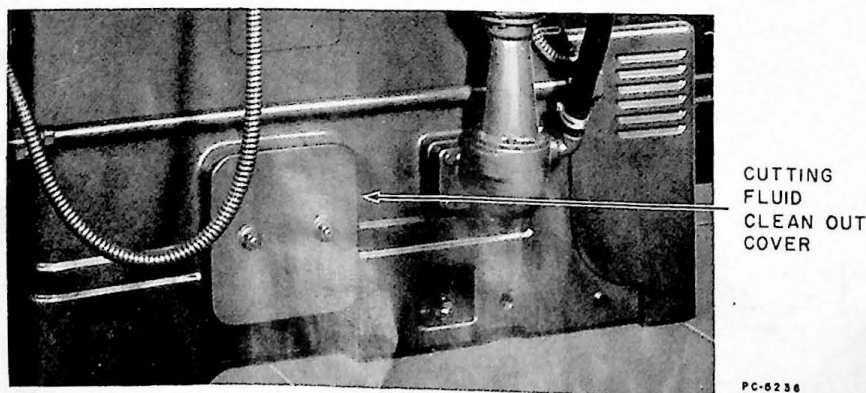


Figure 40B
Rear View Showing Cleanout Cover

RECOMMENDATIONS ON CUTTING FLUIDS

Centertype grinding requires a cutting fluid to keep the parts cool and wash away the chips and grits. The selection of the proper fluid for your application depends on the finish required, stock removal rate, material being ground, and many other factors. We recommend the use of Cimcool Cutting Fluids, developed by our Products Division. This complete line of products is designed to handle any grinding or machining operation. Cimcool Products in addition to washing away chips and grits, being clean, and keeping the part cool, also provides rust and rancidity control. The following list of Cimcool Products are available for Centertype grinding.

Five-Star Cimcool® — A one-mix chemical emulsion type fluid for general purpose applications.

Cimcool® S2 — A chemical emulsion type fluid — Used with Cimplus for improved rust control. The two phase mix offers greater flexibility in handling specific shop conditions.

Cimplus® — A transparent solution type product for use on ferrous work.

Cimcool® AL — A water-based fluid for grinding aluminum.

Cimcut® Grinding Oils — Straight oils available either pre-blended for a particular job or as base additives to be mixed with mineral oil.

Recommended Dilutions. The recommendations below are suggested dilutions for general purpose centertype grinding. They may vary with the type of water used and specific conditions of the job. For recommendations as to the proper cutting fluid to use on roll grinding operations we suggest you contact your Cincinnati representative for help in selecting the proper product for your application.

Steel — Low Carbon to Special Aircraft	Cast Iron	Bronze and Brass	Aluminum
Five-Star Cimcool 1:60 or Cimcool S2 — 1:100 with Cimplus 1:200	Five-Star Cimcool 1:60 or Cimcool S2 — 1:100 with Cimplus 1:200	Cimcool S2 1:50	Cimcool AL 1:25

General Instructions — When preparing a mix of Cimcool S2 and Cimplus, always follow this procedure. (1) Fill mixing tank with water, (2) add proper amount of Cimplus, (3) add proper amount of Cimcool S2. Avoid mixing Five-Star Cimcool, Cimcool S2, or Cimplus with other cutting fluids.

When replenishing the cutting fluid supply, always add a premixture of the cutting fluid concentrate with water. Never add water alone. Keep cutting fluid reservoir full.

Cimcool Machine Cleaner, a product of the Products Division, of The Cincinnati Milling Machine Company, is an exceptional machine cleaner that has a two phase operation. One phase to attack the dirt and grit, and the other to attack the slime and oil. Cimcool Machine Cleaner should be thoroughly mixed at 1:25 with hot water, and allowed to circulate for at least one half hour. The machine should then be drained and flushed thoroughly with clean hot water for three minutes

MOUNTING AND BALANCING THE WHEELS

Assembling the Grinding Wheel Mount. The unit, consisting of the collet, wheel, flange, screws, balancing weights and washers, referred to in this book as the wheel mount, is easier to assemble if the collet is placed on a bench. The parts are assembled on the collet as shown in Figure 43.

When mounting a new wheel, do not force it on the collet because of the danger of starting a crack in the wheel. The wheel should fit the collet with a clearance not exceeding .005" on the diameter.

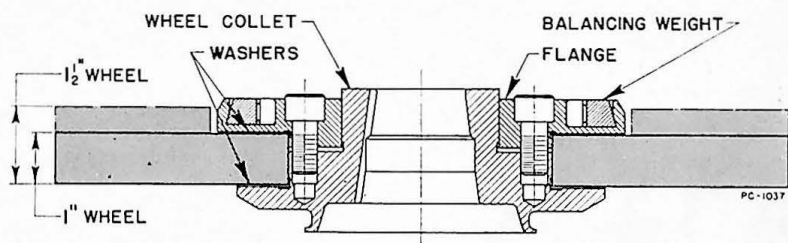


Figure 43
Section Through Wheel Mount

Compressible washers or blotting paper washers should always be placed between the sides of the wheel and the collet and flange in order to evenly distribute the clamping pressure. Very satisfactory results can be obtained with safety type washers, which consist of a very thin sheet metal base covered with rubber. To further even distribution of clamping pressure, when inserting the collet screws, lightly tighten them prior to applying a consistent locking action around the periphery of the collet.

It is advisable when changing wheels, particularly if a thinner wheel is used, to check the screws and make sure they do not extend into the slinger groove on the inside of the collet.

We strongly recommend the use of a separate wheel mount for each wheel regularly used. Such practice saves time required for balancing and truing and prolongs the life of the wheel.

Important: The wheel mount should be removed from the spindle at least once every month to clean the grit out of the slinger grooves in the back of the collet and the drain hole in the oil retainer on the outside of the

wheelhead housing. This permits free drainage of any cutting fluid that might get between the wheel collet and retainer. If this is neglected, cutting fluid and grit may enter the oil seals and eventually damage the spindle bearings.

Balancing the Grinding Wheel. Wheel balance is one of the fundamental requirements that must be observed in order to meet present day requirements for fine finishes and close tolerances and to realize normal wear of the wheel, diamond and spindle bearings. The advantages of proper wheel grading, well conditioned equipment and skillful operation are without value while there exists an out-of-balance condition of the wheel.

Most new wheels are inspected for balance by the manufacturer, but the method of assembling the wheel mount, which must necessarily allow a slight clearance between the wheel and collet, makes re-balancing essential. The procedure for balancing either a new wheel or one that has been removed from the collet is essentially the same. The various steps being outlined as follows:

1. Assemble the grinding wheel mount as described on page 43.
2. Place the wheel mount on the spindle nose and roughly true the periphery of the wheel. Allow the wheel to run for several minutes with the cutting fluid turned off before starting the balancing operation. If this precaution is not observed, retained water in the wheel will indicate a false heavy side.
3. Remove the entire wheel mount from the spindle and insert the balancing arbor into the wheel mount. Now place the entire unit on the balancing stand, being sure that the stand is reasonably level.
4. Remove the four sliding balancing weights from the flange and allow the wheel to turn until it has come to rest with the heavy side down. Mark this heavy point with a chalk mark and also mark a horizontal line through the wheel axis (Figure 45).
5. Place the four balancing weights in the groove in the flange, spaced at approximately 90 degree intervals. The addition of the weights in these positions should not alter the position of the heavy side.

MOUNTING AND BALANCING THE WHEELS

6. Move the two top weights towards one another, as in Figure 45A, until arriving at conditions of perfect balance. If the wheel is still out of balance when the two top weights are moved towards one another until they touch, it will then be necessary to move the two lower weights up towards the horizontal chalk mark until the wheel is in balance, as in Figure 45B.

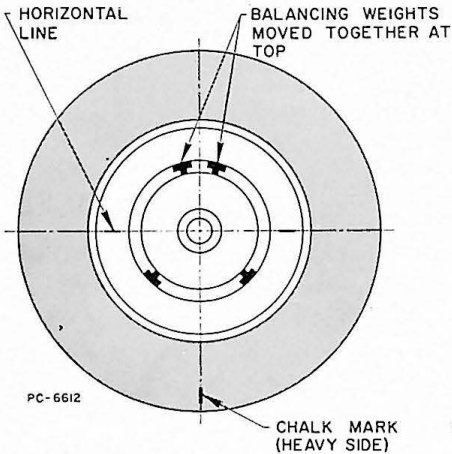


Figure 45A
Balancing Procedure

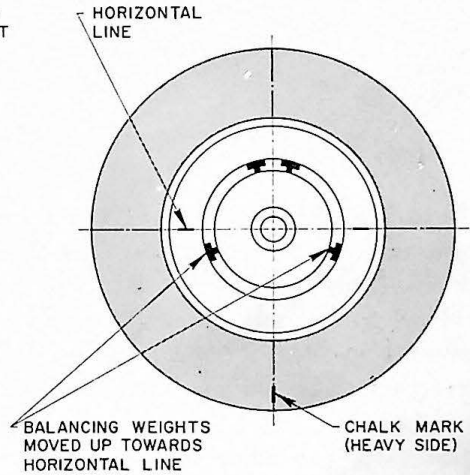


Figure 45B
Balancing Procedure

7. Turn the wheel to various positions to see if the out-of-balance condition has merely shifted instead of being corrected. In such an event, mark the new heavy side and re-adjust the weights accordingly.
8. Remove the balancing arbor, place the wheel mount on the spindle nose and accurately true the wheel for grinding.

SAFETY PRECAUTIONS

Inspection of Grinding Wheels. Immediately upon receipt, all grinding wheels should be closely inspected to be sure that they have not been injured in transit. Inspect for cracks by tapping gently (while suspended) with a light implement, such as the handle of a screw-driver. Wheels must be dry and free of sawdust when applying this test. If they do not emit a clear, ringing sound they should not be used. New wheels should be run at full operating speed for at least one minute before truing the wheel or applying the wheel to the work, during which time the operator should stand at one side. Wheels should be stored in a dry place and supported by pegs in racks.

Grinding Wheel Speed. Most grinding wheels for center-type grinders are designed to operate at about 6,500 surface feet per minute and, accordingly, many companies mark their wheels to show the highest speed at which they should be run. Any attempt to increase the grinding wheel speed above that for which the machine was designed is a highly dangerous practice which will only invite accidents

Set Up. The adjustable units, such as the headstock, footstock, wheel-head, back rests, wheel guard, etc., should be solidly clamped in position before starting to grind. Should any of these units move during the grinding operation, a serious accident may result.

Work and Machine Centers. The headstock and footstock centers should be periodically ground so that they may be kept in perfect condition at all times. Likewise, the work centers should be properly drilled and free from dirt or burrs which might cause trouble. The centers must be lubricated to prevent overheating and possible pick-up. While speaking of centers, be certain that the work is actually between centers and not centered at one end only. While concentrating your attention on engaging the footstock center, it is possible that the headstock center may actually come to rest between the work and the dog or on the flat end of the work. The eccentricity caused by this error may throw the workpiece into the wheel with disastrous results.

Interferences. On machines which are equipped with Automatic Infeed Attachments the length of infeed at a rapid rate is approximately two inch. Be positive that at least this much clearance is available before bringing

SAFETY PRECAUTIONS

the wheelhead into position for either grinding or truing. Also check for clearance between the driving dog and grinding wheel and between the footstock center and grinding wheel. On all machines equipped with automatic infeed, be sure to set up for size with the wheelhead advanced. Any of these, as well as many other possible interferences, may cause an accident if not taken into account.

Feeding Wheel into Work. Good judgment must be exercised in feeding the wheel into the work, for thin shafts may bend or a workpiece of any size may be forced from between the centers by excessive pressure. When shoulder grinding, avoid excessive pressure of the work against the wheel to preclude the possibility of forcing the work from between centers or even breaking the wheel from side pressure.

Keep Hands Away from Wheel. With a little care and foresight, the grinding operation may be planned so that loading and removal of work is done with the hand to one side of the grinding wheel. Besides trying to avoid accidentally touching the wheel, do not invite trouble by feeling the face or sides of the wheel with the fingers, in an effort to determine the smoothness or condition of the wheel.

Electrical Compartment. The electrical compartment door should never be opened except by an experienced maintenance man for electrical control repair work.

FACTORS GOVERNING PRODUCTION

This section has been included so that the less experienced grinding operator may become briefly acquainted with the principles of the grinding art as related to production. While it is true that modern center-type grinding machines possess unparalleled built-in skill and operating features which contribute greatly to successful high production grinding, there remain certain factors which govern the output of the machine that must be fully appreciated if maximum production is to be realized. The various factors are considered singly in subsequent paragraphs.

Grinding Wheel Speed. The machine has been designed so that the peripheral speed of the grinding wheel is approximately 6,500 feet per minute, which is considered correct for modern abrasive wheels. When operating below this speed, the wheel will appear to be softer and will wear in proportions not consistent with the average wheel life which should be obtained. To avoid this situation, double diameter sheaves are supplied on this machine for increasing the grinding wheel speed after the wheel has worn down to a predetermined diameter, providing maximum efficiency until the wheel is completely worn out. See "Two Speed Grinding Wheel Drive", pages 29-30.

It is highly important that the grinding wheel speed be maintained during the cut. Proper adjustment of drive belts and precautions against overloading the motor are steps which should be taken to prevent slowing down while grinding. This momentary slowing down rapidly breaks down the face of the wheel, often to such an extent that re-truing is necessary. It is not difficult to see that, with time spent for more frequent truing and changing of wheels, production will be adversely affected.

Grade and Grain Size of Wheel. The grade and grain size of the grinding wheel used are dependent upon the type of material being ground, its size, speed, stock removal and finish required. Of these, no single factor can be said to definitely determine the grain size or grade. It is rather a combination of the various factors in varying degrees of importance.

In general, rough grinding to remove a large amount of stock requires a relatively coarse-grained wheel, while light finishing cuts should be taken with a finer-grained wheel. However, do not allow the requirement of fine finish to influence your selection of too fine a wheel, for fairly fine finishes can be obtained with the coarser wheels by careful truing and proper selection of work speed.

FACTORS GOVERNING PRODUCTION

The type of material determines the grade of the wheel. The harder materials should be ground using a softer grade of wheel, while the softer materials should be ground using a harder grade of wheel. This, too, is a general statement, for it must be remembered that softness and free cutting are synonymous in most cases because the cutting particles of a soft wheel break away before they have become too dull. The softer wheel will practically always permit a faster removal of stock, resulting in increased production.

However, a high work speed will make the action of the wheel appear to be softer, so under these circumstances a harder grade of wheel is required. Conversely, a low work speed will make the action of the wheel appear harder, requiring a softer wheel.

Wheel Width and Table Travel. Wheel width itself has no apparent effect on production except when considered in conjunction with table travel. It is evident that the advantages of using a wide wheel are of little value unless an adequate table travel is used which will most effectively utilize the available wheel width. A slow table traverse not only limits production but causes the wheel to wear more on the edges, requiring more frequent truing.

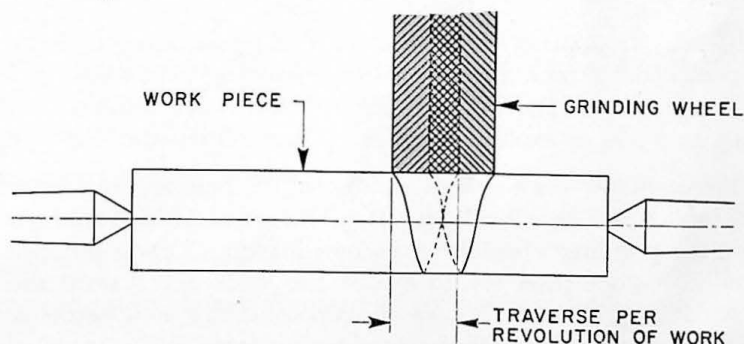


Figure 49
Two-Thirds Width of Wheel Traverse per
Revolution of Work

For rough grinding, the arrangement which will produce the most satisfactory results is to traverse the table from $\frac{1}{2}$ to $\frac{2}{3}$ the width of the wheel per revolution of the work. Figure 49 illustrates the favorable distribution of wheel wear resulting from this arrangement. The shading lines which slant left and right indicate the wheel wear when traversing left and right, indicating that the greatest wheel wear is in the central portion of the wheel. This set-up is adaptable to fairly large work only.

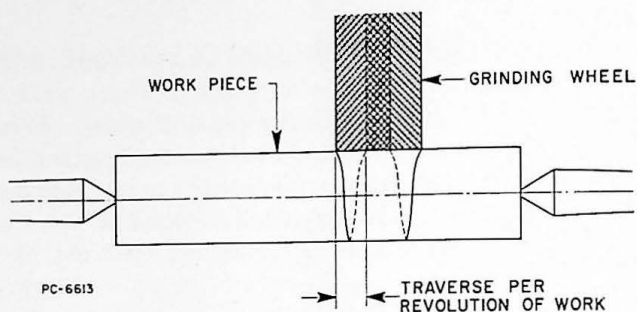


Figure 50
One-Third Width of Wheel Traverse per
Revolution of Work

Figure 50 illustrates the effects of a set-up in which the traverse of the table is about $\frac{1}{3}$ the width of the wheel per revolution of the work. Again shading lines indicate wheel wear when traverse grinding left and right, indicating that the central portion of the wheel is not subject to heavy wear, as are the edges. Frequent truing will be necessary to remove the high portion from the face of the wheel.

Finish grinding is naturally done at a much slower rate of table traverse, since surface smoothness rather than wheel wear or stock removal is the predominating factor.

Work Speed. Production is indirectly limited by work speed in that if too slow a speed is used, table traverse is correspondingly reduced. If too high a work speed is used, the full capacity of the wheel width is not effectively put to work, as explained under "Wheel Width and Table Travel".

Avoid extremely low work speeds because of the heating and distortion of the work which will inevitably result. The effect of high and low work speeds on the grinding wheel were discussed under "Grade and Grain Size of Wheel". Rather than try to adjust the work speed until the wheel neither becomes glazed nor breaks down too rapidly, it is better to select a wheel of proper grade which is suited to the work.

Cross Feed. It would seem that production is governed by cross feed but this is true only if cross feed is insufficient. Excessive cross feed while traversing results only in rapid breaking down and waste of the grinding wheel. Maximum efficiency will result from a high rate of table traverse and a comparatively light cross feed rather than a heavy cross feed at a slower traverse rate.

Coolant Supply. An ample flow of coolant is necessary for successful operation, since local heating must be avoided if accurate work is to result. A fairly high traverse rate and work speed, along with ample coolant, will dissipate the heat rapidly enough to prevent any distortion of the work.

HAND SERVO INFEED

HAND SERVO INFEED

This unit is manually operated and is built into the machine at the factory to provide selective wheelhead movement.

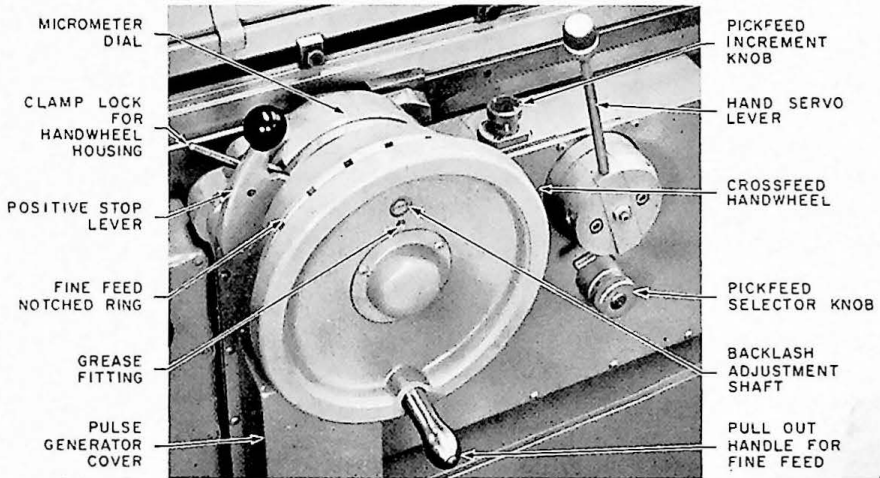


Figure 51
Hand Servo Infeed

Infeed Control Lever. This lever is located to the right of the cross feed handwheel (Figure 51) and is your manual control for the hand servo unit. This attachment provides:

1. Hydraulic powered rapid advance.
2. Feed of the Wheelhead.
3. Rapid retraction of the Wheelhead.
4. Automatic starting and stopping of coolant and work rotation.

All these provisions are under the control of a single extremely sensitive hand lever at the operating position.

The Hand Lever performs these functions:

1. Rapid retraction of the wheelhead, position "A" (Figure 52).
2. Swiveled 15 degrees to the right, position "B-1", starts Headstock Rotation and Coolant Flow.
3. Pulled outward from "B-1" causes rapid wheelhead advance. Pulling the lever out as far as it will go "B-1 to B-2" provides the maximum rate of rapid advance.

NOTE: The distance the lever is pulled outward determines the rapid advance rate and *not* the distance.

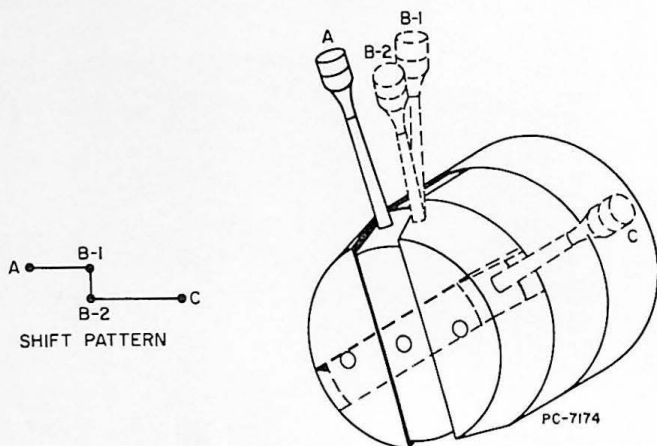


Figure 52
Diagrammatic Sketch of Hand Servo Infeed

To slow the rapid wheelhead advance or to stop it entirely just move the lever to the rear toward the machine (Figure 52), or let go of the hand servo lever and a spring will return the lever to stop position "B-1".

This is an important safety feature and also serves as a sensitive infeed "inching" device when positioning the grinding wheel close to shoulders. A simple latching screw, located beneath the hand servo hub (Figure 51), permits the hand servo lever to be locked in the maximum rate position, if this is desired.

After the rapid advance movement is completed, further movement of the lever to the right controls the rate of the infeed for the grinding operation.

NOTE: Before going into the feed cycle the lever must be in the maximum outward position "B-2".

The rate of grinding wheel infeed movement is controlled by the speed with which you displace the servo lever to the right. Thereby giving you a highly sensitive control means for adapting each cut to the particular condition for maximum grinding efficiency.

If you stop the servo lever at any point of the infeed travel, the wheelhead infeed movement stops until the lever movement is resumed.

When the maximum position "C", 90 degrees to the right, is reached, the infeed movement will be completed and the work diameter will be to size. To retract the wheelhead to its starting position just return the lever to its starting or retracted position "A" (Figure 52).

Hand Cross Feed Control. A two-speed cross feed handwheel is used to control the precise positioning adjustment of the Wheelhead in conjunction with the Hand Servo Infeed Attachment.

The cross feed handwheel has a coarse and fine feed mechanism for infeed compensation. Counterclockwise rotation of the handwheel advances the grinding wheel toward the work; clockwise rotation moves the grinding wheel away from the work.

The cross feed mechanism has a coarse feed graduated dial located behind the fine feed notched ring on the handwheel. This graduated dial is marked with 100 equally spaced graduations. Under normal rotation of the handwheel, which is obtained when the clamp locking lever (Figure 51) is unlocked or in the down position, each graduation represents .0005" infeed movement of the Wheelhead; and rotating the handwheel one complete revolution represents .050" infeed movement of the wheelhead or approximately .100" stock removal.

The fine feed of the wheelhead is engaged when the clamp locking lever (Figure 51) is locked or moved up. To make fine feed adjustments pull out on the handle of the handwheel. Pulling out on this handle disengages the pin from the fine feed notched ring, located directly behind the handwheel. Then with the pin disengaged rotating the handwheel one complete revolution moves the wheelhead .0005". There are twenty equally spaced notches on the fine feed notched ring, so that indexing the pin from one notch to the next or $\frac{1}{20}$ of a revolution is equivalent to .000050" change on the works diameter.

Table Start-Stop Lever. This lever functions the same as described on page 25. However, a machine with Hand Servo Infeed, must have the wheelhead forward before engaging the table "Start-Stop" lever.

Pick Feed Mechanism. The use of the pick feed mechanism is the same as described on page 27. Remember the wheelhead must be in the forward position before engaging the table "Start-Stop" lever.

ACRAFEED DUAL RATE AUTOMATIC INFEEED

Action of Start-Stop Lever. The start-stop lever (Figure 55) has two major functions. First, it controls rapid advance and rapid retraction of the wheelhead. Secondly, it controls starting and stopping of the table traverse mechanism. When the start-stop lever is in the "TABLE-STOP" position and is momentarily pulled forward, the wheelhead will rapid advance. The wheelhead will rapid retract when the lever is momentarily pushed to the rear. In either case, when the lever is released, it will return to a normal "TABLE-STOP" position.

When the start-stop lever is rotated counterclockwise, the table will traverse at a rate set on the table traverse rate control. The lever cannot be moved counterclockwise unless the wheelhead has first been rapidly advanced to a grinding position (**Note.** See "Grind-True" Selector Switch, page 56). This is a safety feature designed to prevent the wheelhead from being accidentally rapid advanced into the workpiece while traverse grinding. In addition, the wheelhead can be retracted at any time during a traverse cycle, by momentarily pushing the start-stop lever to the rear.

Cross Feed Handwheel. Cross feed handwheel "M" (Figure 55) contains necessary gearing for infeed compensation. Handwheel gears engage and disengage the handwheel from the cross feed screw. When engaged, counterclockwise rotation of the handwheel advances the wheelhead and clockwise rotation retracts the wheelhead. One complete revolution of the cross feed handwheel is equal to .100" on the workpiece diameter.

Caution. Do not engage or disengage handwheel gearing while cross feed selector lever "S" is in "POWER" position.

The infeed compensator mechanism is used during set up to make small corrections in workpiece size, and, during actual production to make corrections resulting from wheel wear and truing. Counterclockwise rotation of the infeed compensator dial "X" will correct for an oversize workpiece and clockwise rotation will correct for an undersize workpiece. One complete revolution of the infeed compensator dial is equal to .004" on the diameter and one graduation equals .000050" on the diameter.

Positive Stop. The positive stop "P" (Figure 55) is used as a size limiting device when machine is used in a conventional manner (without air electric gage).



Figure 55
Operating Controls

Counter. The counter "V" (Figure 55) indicates the number of turns made by the cross feed handwheel "M", this is very helpful when truing. Merely set the counter to zero and rotate the cross feed handwheel until the wheelhead contacts the diamond for the truing operation. After wheel has been trued, rotate handwheel until counter again reads zero.

"Grind-True" Selector Switch. On all machines equipped with the automatic infeed attachment, it is possible to true the grinding wheel with the wheelhead in the retracted position. Turn selector switch "D" from "Grind" to "True" when a wheel truing operation is necessary. With the selector switch in this position, the automatic infeed mechanism is inoperative but the table will traverse in the conventional manner by rotating the start-stop lever counterclockwise.

After truing operation is complete, turn selector switch "D" to "Grind" position to set up machine for its normal cycle operation.

Cross Feed Selector Lever. The cross feed selector lever "S" (Figure 55) has two positions — "POWER" and "MANUAL". This selector lever must be in "Manual" position whenever hand adjustments or hand movements of the wheelhead are desired. The "Power" position has a function only when the automatic infeed mechanism is in operation.

The various signal lights will function only when the cross feed selector "S" is in the "POWER" position.

Stock Removal Dial. Stock removal dial "R" (Figure 55) indicates amount of stock the machine is set up to remove on an infeed cycle. It can be set from a minimum of .005" to a maximum of .080" diameter reduction.

Pick Feed Increment Selector. The pick feed increment selector "W" (Figure 55) selects amount of pick feed. Pick feed is hydraulically controlled and infinitely variable from .0002" to .005" measured in terms of diameter reduction. One complete turn of adjusting knob is equal to .0004" on diameter.

Note. Machines not equipped with automatic infeed attachment see pages 58 and 59; Set up Instructions for Traverse Cycle with Automatic Pick feed Mechanism Disengaged.

Should adjusting knob be difficult to rotate, shift table reverse lever to opposite position.

Pick Feed Selector Lever. Lever "Y" (Figure 55) engages and disengages

the pick feed mechanism and is used to select the desired interval of pick feed. The pick feed selector lever has four positions:

First position — "STOP" . . . no pick feed.

Second position — "LEFT ONLY" . . . pick feed at left table reversal only.

Third position — "RIGHT & LEFT" . . . pick feed at each table reversal.

Fourth position — "RIGHT ONLY" . . . pick feed at right table reversal only

Coarse Feed Rate Control. The coarse feed rate control "U" (Figure 55) determines the primary feed rate during the grinding cycle.

Fine Feed Rate Control. The fine feed rate control "T" (Figure 55) determines the secondary feed rate during the grinding cycle. It feeds the wheelhead forward at a reduced rate until workpiece is to finished size.

Sparkout Timer. The sparkout timer "N" (Figure 55) is a potentiometer controlling the amount of tarry necessary to spark out when infeed grinding without an electric gage. Without the gage, the tarry timer's range is from 0 to 12 seconds. (Note. Timing action starts when wheelhead is advanced from coarse to fine feed portion of the infeed cycle).

SET UP INSTRUCTIONS

Set Up Instructions For Traverse Cycle With Automatic Pick Feed Mechanism Disengaged.

1. Start machine and rotate selector switches "A", "B", "C", and "D", Figure 55, to the following positions: Selector Switch "A" to "EXTERNAL," "B" to "AUTO", "C" to "TRAVERSE" and "D" to "GRIND"
2. Rotate pick feed selector lever "Y" to "STOP" position.
3. Rotate cross feed selector lever "S" to "MANUAL" position.
4. Disengage positive stop "P" by pushing down on left end and locking with stop lever.
5. Mount workpiece between headstock and footstock centers.
6. Rotate the table traverse handwheel to move the table the amount necessary to traverse grind workpiece. Set table dogs for this amount of travel.
7. Set table traverse rate control for desired traverse rate. Also, set table tarry controls for desired tarry time.
8. Depress cycle start button or pull start-stop lever forward to rapid advance wheelhead to grinding position.
Caution: Make certain there is at least $\frac{1}{4}$ " distance between face of grinding wheel and workpiece after the wheelhead is in an advanced position.
9. Turn handwheel "M" counterclockwise until grinding wheel touches workpiece.
10. Engage positive stop "P".
11. Release handwheel by pulling out knob "K". Turn handwheel "M" against positive stop. Push knob "K" in to re-engage handwheel.

SET UP INSTRUCTIONS

12. Depress cycle stop button or push start-stop lever to rear to retract wheelhead.
13. Check workpiece. Then, to obtain correct size, pull out knob "L" and turn the compensator mechanism counterclockwise for the correct amount of stock to be removed. One complete turn of the infeed compensator dial is equal to .004" on the diameter. One graduation on infeed compensator dial is equal to .000050" on the diameter.
Caution: Back off handwheel "M" approximately .010"-.015" to allow clearance between wheel and workpiece.
14. Depress cycle start button or pull start-stop lever forward to bring the wheelhead into grinding position. Turn start-stop lever counterclockwise to "TABLE-START" position and manually pick feed grind workpiece to positive stop.
15. Depress cycle stop button or push start-stop lever to rear to retract wheelhead and rotate clockwise to stop table. Check workpiece for size and taper. Repeat items 13 and 14 above for additional size compensation and make any necessary taper adjustments. (For taper adjustments, see "Swivel Table," page 36.)
16. Set counter "V" to zero.
17. Turn handwheel "M" clockwise to reset for next workpiece. After setup, the complete cycle is as follows:
 - (a) Depress cycle start button or pull start-stop lever to advance wheelhead through rapid approach.
 - (b) Turn start-stop lever counterclockwise to start table.
 - (c) Hand pick feed at each table reversal to size.
 - (d) Depress cycle stop button or push lever to rear to retract wheelhead and rotate clockwise to stop table.
 - (e) Turn handwheel "M" clockwise to reset for next workpiece.
 - (f) Unload workpiece.

Set Up Instructions For Traverse Cycle With Automatic Pick Feed Mechanism Engaged.

1. Start machine and rotate selector switches "A", "B", "C", and "D", Figure 55, to the following positions: Selector switch "A" to "EX-

TERNAL," "B" to "OFF," "C" to "TRAVERSE" and "D" to "GRIND".

2. Move cross feed selector lever "S" to "MANUAL" position.
3. Depress cycle start button or pull start-stop lever forward to rapid advance the wheelhead to grinding position.
4. Synchronize stock removal dial with handwheel dial. Also, set stock removal dial "R" for amount of stock to be removed from workpiece, measured in terms of diameter reduction.
 - (a) To synchronize stock removal dial with handwheel dial. Turn handwheel "M" against positive stop "P". Depress stock removal dial "R" so the pin will enter the slot in the knurled ring. This will release the dial from the handwheel. Rotate the knurled ring so the index mark on the ring matches the scribed line on the machine. Also, rotate the outer knurled knob to line up its index mark with "O" (zero) reading on the stock removal dial "R".
 - (b) To set stock removal dial. Rotate knurled ring so the pin will not enter slot. Depress stock removal dial "R" and prevent rotation of outer knurled knob while rotating cross feed handwheel "M" clockwise an amount equal to the stock to be removed plus an allowance for safety clearance between wheel and workpiece. Release stock removal dial to lock this setting.
5. Depress cycle stop button or push start-stop lever to rear to retract wheelhead.
6. Place workpiece between centers and set table dogs.
7. Turn selector switch "B" to "AUTO" position.
8. Depress cycle start button or pull start-stop lever forward to rapid advance grinding wheel into grinding position.

Caution: Make certain there is at least $\frac{1}{4}$ " distance between face of grinding wheel and workpiece after the wheelhead is in an advanced position.
9. Disengage positive stop.

SET UP INSTRUCTIONS

10. Turn handwheel "M" counterclockwise until grinding wheel touches workpiece.
11. Engage positive stop "P".
12. Release handwheel by pulling out knob "K". Turn handwheel "M" against positive stop. Push knob "K" in to re-engage handwheel.
13. Depress cycle stop button or push start-stop lever to rear to retract wheelhead.
14. Check workpiece. Then, to obtain correct size, pull out knob "L" and turn the compensator mechanism counterclockwise for the correct amount of stock to be removed. One complete turn of the infeed compensator dial is equal to .004" on the diameter. One graduation on infeed compensator dial is equal to .000050" on the diameter.
Caution: Back off handwheel "M" approximately .010"-.015" to allow clearance between wheel and workpiece.
15. Depress cycle start button or pull start-stop lever forward to bring the wheelhead into grinding position. Set table traverse rate control. Adjust table tarry controls. Turn start-stop lever counterclockwise to "TABLE-START" position and manually pick feed grind workpiece to positive stop.
16. Depress cycle stop button or push start-stop lever to rear to retract wheelhead and rotate clockwise to stop table. Check workpiece for size and taper. Repeat items 14 and 15 above for additional size compensation and make any necessary taper adjustments. (For taper adjustments, see "Swivel Table," page 36.)
17. Set counter "V" to zero.
18. Move cross feed selector "S" to "POWER" position.
19. Set pick feed selector "Y" to desired position.
20. Set pick feed increment selector "W" to desired amount.

21. Depress cycle start button or pull start-stop lever forward to rapid advance wheel to grinding position.
22. Rotate start-stop lever to "TABLE-START" position and traverse grind workpiece with pick feed engaged to positive stop.
23. Depress cycle stop button or push start-stop lever to rear to retract wheelhead and rotate clockwise to "TABLE-STOP".

Note: Due to variations in size of workpiece, it is desirable to set up for a stock removal greater than is actually required. Therefore, to bring the wheel into contact with the workpiece, after the wheelhead is in a rapid advanced position, merely hold in on either the cycle start button or hold the start-stop lever forward until wheel contacts workpiece. Release either the cycle start button or start-stop lever, to neutral position, before shifting lever to table start position.

After setup, the complete cycle is as follows:

- (a) Depress cycle start button or pull start-stop lever to advance wheelhead through rapid approach.
- (b) Turn start-stop lever counterclockwise to start table. Pick feed is automatic at each table reversal until handwheel contacts positive stop.
- (c) Depress cycle stop button or push lever to rear to retract wheelhead and rotate lever clockwise to stop table.
- (d) Unload workpiece.

Set up Instructions for Standard Automatic Infeed Cycle.

1. Start machine and rotate selector switch "A", "B", "C" and "D", Figure 55, to the following positions. Selector switch "A" to "EXTERNAL", "B" to "OFF", "C" to "INFEED" and "D" to "GRIND".
2. Move cross feed selector lever "S" to "MANUAL" position.
3. Depress cycle start button or pull start-stop lever forward to rapid advance the wheelhead to a grinding position.
4. Synchronize stock removal dial with handwheel dial. Also, set stock removal dial "R" for amount of stock to be removed from workpiece.

SET UP INSTRUCTIONS

measured in terms of diameter reduction.

- (a) To synchronize stock removal dial with handwheel dial. Turn handwheel "M" against positive stop "P". Depress stock removal dial "R" so the pin will enter the slot in the knurled ring. This will release the dial from the handwheel. Rotate the knurled ring so the index mark on the ring matches the scribed line on the machine. Also, rotate the outer knurled knob to line up its index mark with "O" reading on the stock removal dial "R".
- (b) To Set Stock Removal Dial (Fine Feed). Line up slot in knurled ring with pin. Depress stock removal dial "R" so the pin will enter the slot in the knurled ring. Rotate knurled ring clockwise while holding outer knurled knob to prevent its rotation until index mark of outer knurled knob is lined up with desired reading on stock removal dial (Maximum .005"). Release stock removal dial to lock this setting.
- (c) To Set Stock Removal Dial. Rotate knurled ring so the pin will not enter slot. Depress stock removal dial "R" and prevent rotation of outer knurled knob while rotating cross feed handwheel "M" clockwise an amount equal to the stock to be removed plus an allowance for safety clearance between wheel and workpiece. Release stock removal dial to lock this setting.

Note: Setting of stock removal includes amount of fine feed. For example, if fine feed setting is .002" and setting for stock removal is .015" then .013" is amount of coarse feed and .002" the amount of fine feed.

5. Depress cycle stop button or push start-stop lever to rear to retract wheelhead.
6. Place workpiece between headstock and footstock centers.
7. Turn selector switch "B" to "AUTO" position.
8. Depress cycle start button or pull start-stop lever forward to rapid advance grinding wheel into grind position.

Caution: Make certain there is at least $\frac{1}{4}$ " distance between face of

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grinding wheel and workpiece after the wheelhead is in an advanced position.

9. Disengage positive stop.
10. Turn handwheel "M" counterclockwise until grinding wheel "cleans up" workpiece.
11. Engage positive stop.
12. Release handwheel by pulling out knob "K". Turn handwheel "M" against positive stop. Push knob "K" in to re-engage handwheel.
13. Depress cycle stop button or push start-stop lever to rear to retract wheelhead.
14. Check workpiece. Then, to obtain correct size, pull out knob "L" and turn the compensator mechanism counterclockwise for the correct amount of stock to be removed. One complete turn of the infeed compensator dial is equal to .004" on the diameter. One graduation on the infeed compensator dial is equal to .000050" on the diameter.

Caution: Back-off handwheel "M" approximately .010"-.015" to allow clearance between wheel and workpiece.
15. Depress cycle start button or pull start-stop lever forward to bring the wheelhead into grinding position and grind workpiece manually to positive stop.
16. Depress cycle stop button or push start-stop lever to rear to retract wheelhead. Check workpiece for size and taper. Repeat item 14 and 15 above for any additional size compensation and make any necessary taper adjustments. (For taper adjustments, see "Swivel Table," page 36.)
17. Set counter "V" to zero.
18. Move cross feed selector lever "S" to "POWER".
19. Set tarry timer "N". Allow sufficient tarry so the handwheel will

SET UP INSTRUCTIONS

reach the positive stop. Otherwise, the fine feed cycle will be complete before the handwheel reaches the positive stop.

20. Set coarse and fine feed rate controls for desired feed rates.

Note: Due to variations in size of workpiece, it is desirable to set up for a stock removal greater than is actually required. Therefore, to bring the wheel into contact with the workpiece, after the wheelhead is in a rapid advanced position, merely hold in on either the cycle start button or hold the start-stop lever forward until wheel contacts workpiece. Release either the cycle start button or start-stop lever, to "neutral" position. This action will bypass the normal coarse feed rate and hasten the time normally required for the grinding wheel to contact the workpiece.

After set up, the complete cycle is as follows:

- (a) Place workpiece between centers.
- (b) Depress cycle start button or pull start-stop lever to bring the wheelhead forward.
- (c) Grind workpiece to size.
- (d) Tarry
- (e) Automatic wheelhead retraction.
- (f) Unload workpiece.

EXTRA EQUIPMENT

The following equipment is supplied at Extra Cost and is not Included in the Price of a Standard (Basic) Machine.

1. D.C. Electrical Equipment

2. Wheelhead Motor — for use with 18" x 2" wheels, 5 H.P. 12" and 14" machines; 7½ H.P. 14"H and 18" machines.

3. Draw-in Collet Attachment for Headstock.

Lever Operated — Must be built into the headstock at the factory.

Capacity ⅛" to 1" diameter collets.

Includes adapter for spindle nose and any six collets listed in item 5 to 1" size. Specify collet sizes desired.

4. Draw-in Collet Attachment for Headstock.

Handwheel Operated — Mounts directly on spindle nose.

Capacity ⅛" to 1" diameter collets, 12" and 14" machines; capacity ⅛" to 1¼" diameter collets, 14"H and 18" machines.

Includes any six collets listed in Item 5. Specify collet sizes desired

5. Collets for Draw-in Collet Attachments.

Items 3 and 4: ⅛", 1/8", 3/16", 1/4", 5/16", 3/8", 7/16", 1/2", 9/16", 5/8", 11/16", 3/4", 13/16", 7/8", 15/16", 1", 1 1/16", 1 1/8", 1 1/4", 1 1/2", 1 3/4", 1 5/8", 1 3/4" diameter.

6. Additional full centers for Headstock and Footstock.

No. 9B. and S. taper for 12" and 14" machines and No. 10B. and S taper standard length for 14"H and 18" machines.

7. Half Center for Footstock —

¼" minimum work diameter, 1 3/8" length of flat for 12" and 14" machines. ½" minimum work diameter, 1 1/2" length of flat for 14"H and 18" machines.

8. Permanent Magnetic Chuck with Adapter —

7" diameter Part No. 252588, auxiliary plate included.

EXTRA EQUIPMENT

8" diameter Part No. 252589, auxiliary plate included

10" diameter Part No. 250756, auxiliary plate not required for 12", 14", 14"H, and 18" machines.

9" diameter Part No. 252590 for 12" and 14" machines only.

12" diameter Part No. 252194 auxiliary plate not required for 14"H and 18" machines only.

14" diameter Part No. 252584 auxiliary plate not required for 14"H and 18" machines only.

9. Quick Change Adapter — For face plate on chuck, complete with special L-head bolts.
10. Magnetic Chucks — Can be supplied for 115 or 230 Volt, direct current, or a rectifier can be supplied to convert A.C. to D.C.
11. Rectifier — For magnetic chuck when D.C. is not available:
 - 50 or 60 cycle, 220/440/550 volts
 - 25 cycle, 220/440/550 voltsChuck, collector rings, adapter plate, water guards and bracket and demagnetizing switch for headstock motor included.
12. Power Rapid Positioning of Wheelhead — Hydraulic rapid traverse for rough positioning from one diameter to another on multiple diameter work. Cannot be used with items 14 and 15.
13. Power Hand Servo Infeed Unit — Includes lever operated selective rapid advance of wheel to work, Servo controlled infeed, rapid wheelhead retraction, and automatic starting and stopping of cutting fluid flow and work rotation. Must be built into machine at the factory.
14. ACRAFEED — Lever Controlled Automatic Dual Rate Infeed Attachment — Hydraulically operated. Complete cycle: rapid advance wheel to work, grind, using combination coarse and fine feed rate and automatic return. Start is by hand. Includes mechanism for automatic starting and stopping of cutting fluid flow and work rotation. Must be built into the machine at the factory.

Note: In items 13 and 14 Rapid Advance and Rapid Retraction are

fixed at 2". This reduces the usable Crossfeed Range by 2".

15. Automatic Gap Eliminator — Reduces infeed cycle time on machines equipped with Automatic Infeed Attachment. Must be built into the machine at the factory.
16. ACRASIZE — Automatic Air Electric Gage Sizing Attachment —
For machines equipped with dual rate Automatic Infeed (Item 15).
Automatically retracts wheelhead when exact size is reached. Must be built into the machine at the factory. Specify size desired.
Cycle Time Stabilizer Included.
Assures constant cycle time when using Gage Sizing Attachment.
Operator never adjusts grinding wheel slide from new to worn wheel.
17. Gage Controlled Dwell — For machines with gage sizing attachment. Third contact stops feed rate just before size is reached, permitting the work to dwell to size under full gage control. Ideal for work requiring extremely close tolerances. Must be built into machine at factory.
18. Calipers for Item 17. Any diameter range from $\frac{1}{4}$ " to $\frac{1}{2}$ ", $\frac{1}{2}$ " to 1", 1" to 2" and 2" to 3".
19. Positive Stop, with $\frac{3}{8}$ " Micrometer Screw Adjustment and dial indicator for positioning the table. Useful when doing face or shoulder grinding operations.
20. Indicator Attachment — To assist in adjusting the taper of the swivel table. Includes .001" dial indicator.
21. ACRALIGN Attachment — Pneumatic device for accurately measuring swivel table adjustment. Useful for removing taper or controlling the grinding of an accurate taper on the workpiece. Must be installed at the factory. Consult factory for machines exceeding 48" table length.
22. Radius Truing Attachment — Table type. Has adjustments for clamping the pivot arm in the middle position for truing the face; adjustable end stops at each end of the 90 degree swivel from center; diamond gage to set the radius; nozzle with coolant supply adjustment

EXTRA EQUIPMENT

and with a quick disconnect from the main coolant supply. Includes a diamond holder and sleeve for truing either from 0" to $\frac{3}{4}$ " convex or from $\frac{3}{8}$ " to $\frac{7}{8}$ " concave radii, but not for both.

23. Extra Diamond Holder and Sleeve — For converting above attachment to true either:

Convex radii from 0" to $\frac{3}{4}$ "

Concave radii from $\frac{3}{8}$ " to $\frac{7}{8}$ "

Special Diamond Nibs required for above Radius Truing Attachment.

For 0" to $\frac{3}{4}$ " Convex radii use Nib No. 277641

For $\frac{3}{8}$ " to $\frac{7}{8}$ " Concave radii use Nib No. 273026

24. Cam Grinding Attachment — Made to order. Submit prints of work.

25. Diamond Nibs. Four sizes:

1.00 to 1.25 carat (Part No. 245378)

1.35 to 1.65 carat (Part No. 210329)

1.85 to 2.15 carat (Part No. 245379)

2.85 to 3.15 carat (Part No. 245380)

26. Double Shaft Motor — Required when wheel and belt guard are interchanged for face grinding operations. Includes motor sheave guard, additional motor sheaves and extra cutting fluid piping.

27. Wheel Guard for Grinding Wheel — Accommodates wheels up to 18" diameter x 2" face width. It includes motor drive parts for 18" wheel. For wheels 18" in diameter we recommend a 5 hp motor for the 12" and 14" machines and a $7\frac{1}{2}$ hp motor for the 14"H and 18" machines.

28. Extra Wheel Mounts — Separate wheel mount recommended for each wheel regularly used. See wheel mount under "Standard Equipment Supplied with the Machine" page 11.

29. Balancing Arbor for Grinding Wheel — Size No. 4.

30. Balancing Stand for Grinding Wheel — Size No. 1 (20" Swing, Sensitive way).

31. Additional Internal Grinding Spindles — Additional Spindles are available for the internal grinding head when speeds other than the 18,000 rpm of standard spindle No. 282449 are desired. These spindles are:

Spindle No. 282448 — 15,000 rpm

Spindle No. 282450 — 25,000 rpm

Spindle No. 282451 — 35,000 rpm

32. Collet Chucks for Internal Grinding Spindles. A collet chuck is available for each internal grinding spindle to permit the use of small mounted grinding wheels in these spindles.

Spindle 282448: 11 Collets — $\frac{1}{4}"$, $\frac{9}{32}"$, $\frac{5}{16}"$, $\frac{11}{32}"$, $\frac{3}{8}"$, $\frac{13}{32}"$, $\frac{7}{16}"$, $\frac{15}{32}"$, $\frac{1}{2}"$, $\frac{17}{32}"$, $\frac{9}{16}"$.

Spindle 282449: 9 Collets — $\frac{1}{8}"$, $\frac{5}{32}"$, $\frac{3}{16}"$, $\frac{7}{32}"$, $\frac{1}{4}"$, $\frac{9}{32}"$, $\frac{5}{16}"$, $\frac{11}{32}"$, $\frac{3}{8}"$.

Spindle 282450: 9 Collets — $\frac{1}{8}"$, $\frac{5}{32}"$, $\frac{3}{16}"$, $\frac{7}{32}"$, $\frac{1}{4}"$, $\frac{9}{32}"$, $\frac{5}{16}"$, $\frac{11}{32}"$, $\frac{3}{8}"$.

Spindle 282451: 7 Collets — $\frac{3}{64}"$, $\frac{5}{64}"$, $\frac{1}{8}"$, $\frac{5}{32}"$, $\frac{3}{16}"$, $\frac{7}{32}"$, $\frac{1}{4}"$.

Quills for Internal Grinding Spindles. A wide assortment of quills (extension arbors) are available for the various internal grinding head spindles:

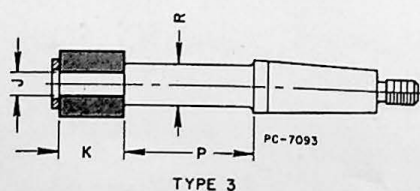


Figure 70A
Type 3 Quill

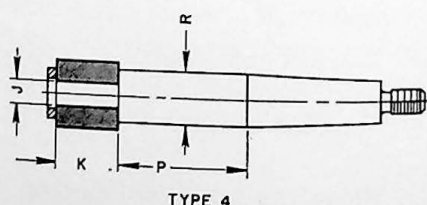


Figure 70B
Type 4 Quill

EXTRA EQUIPMENT

QUILLS FOR SPINDLE No. 282448

Part No.	Type	Projection		Grinding Wheel	
		R	P	J	K
267413-1	3	$\frac{1}{2}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-2	3	$\frac{1}{2}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-3	3	$\frac{1}{2}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-4	3	$\frac{1}{2}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-5	3	$\frac{9}{16}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-6	3	$\frac{9}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-7	3	$\frac{9}{16}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-8	3	$\frac{9}{16}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267413-9	3	$\frac{5}{8}$ "	1"	$\frac{3}{8}$ "	$1\frac{1}{4}$ "
267413-10	3	$\frac{5}{8}$ "	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-11	3	$\frac{5}{8}$ "	2"	$\frac{3}{8}$ "	1"
267413-12	3	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-13	3	$\frac{5}{8}$ "	3"	$\frac{3}{8}$ "	1"
267413-14	3	$\frac{11}{16}$ "	1"	$\frac{3}{8}$ "	1"
267413-15	3	$\frac{11}{16}$ "	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-16	3	$\frac{11}{16}$ "	2"	$\frac{3}{8}$ "	1"
267413-17	3	$\frac{11}{16}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-18	3	$\frac{11}{16}$ "	3"	$\frac{3}{8}$ "	1"
267413-19	3	$\frac{3}{4}$ "	1"	$\frac{3}{8}$ "	1"
267413-20	3	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	$\frac{3}{8}$ "	1"
267413-21	3	$\frac{3}{4}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-22	3	$\frac{3}{4}$ "	$3\frac{1}{4}$ "	$\frac{3}{8}$ "	1"
267413-23	3	$\frac{3}{4}$ "	4"	$\frac{3}{8}$ "	1"
267413-23-A	3	$\frac{13}{16}$ "	1"	$\frac{3}{8}$ "	1"
267413-24	3	$\frac{13}{16}$ "	$1\frac{3}{4}$ "	$\frac{3}{8}$ "	1"
267413-25	3	$\frac{13}{16}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-26	3	$\frac{13}{16}$ "	$3\frac{1}{4}$ "	$\frac{3}{8}$ "	1"
267413-27	3	$\frac{13}{16}$ "	4"	$\frac{3}{8}$ "	1"
267413-28	3	$\frac{7}{8}$ "	1"	$\frac{3}{8}$ "	1"
267413-29	3	$\frac{7}{8}$ "	$1\frac{3}{4}$ "	$\frac{3}{8}$ "	1"
267413-30	3	$\frac{7}{8}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-31	3	$\frac{7}{8}$ "	$3\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-32	3	$\frac{7}{8}$ "	$4\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-33	3	$\frac{15}{16}$ "	1"	$\frac{3}{8}$ "	1"
267413-34	3	$\frac{15}{16}$ "	$1\frac{3}{4}$ "	$\frac{3}{8}$ "	1"
267413-35	3	$\frac{15}{16}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-36	3	$\frac{15}{16}$ "	$3\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-37	3	$\frac{15}{16}$ "	$4\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267413-38	4	1"	1"	$\frac{3}{8}$ "	1"
267413-39	4	1"	2"	$\frac{3}{8}$ "	1"
267413-40	4	1"	3"	$\frac{3}{8}$ "	1"
267413-41	4	1"	4"	$\frac{3}{8}$ "	1"
267413-42	4	1"	5"	$\frac{3}{8}$ "	1"

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QUILLS FOR SPINDLE No. 282449

Part No.	Type	Projection		Grinding Wheel	
		R	P	J	K
267401-1	3	$\frac{3}{8}$ "	1"	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267401-2	3	$\frac{3}{8}$ "	$1\frac{1}{2}$ "	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267401-3	3	$\frac{3}{8}$ "	2"	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267401-4	3	$\frac{1}{4}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-5	3	$\frac{1}{4}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-6	3	$\frac{1}{4}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-7	3	$\frac{1}{2}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-8	3	$\frac{1}{2}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-9	3	$\frac{1}{2}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-10	3	$\frac{1}{2}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-11	3	$\frac{9}{16}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-12	3	$\frac{9}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-13	3	$\frac{9}{16}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-14	3	$\frac{9}{16}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267401-15	3	$\frac{5}{8}$ "	1"	$\frac{3}{8}$ "	1"
267401-16	3	$\frac{5}{8}$ "	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-17	3	$\frac{5}{8}$ "	2"	$\frac{3}{8}$ "	1"
267401-18	3	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-19	3	$\frac{5}{8}$ "	$3\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-20	3	$\frac{11}{16}$ "	1"	$\frac{3}{8}$ "	1"
267401-21	3	$\frac{11}{16}$ "	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-22	3	$\frac{11}{16}$ "	2"	$\frac{3}{8}$ "	1"
267401-23	3	$\frac{11}{16}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-24	3	$\frac{11}{16}$ "	3"	$\frac{3}{8}$ "	1"
267401-25	4	$\frac{3}{4}$ "	1"	$\frac{3}{8}$ "	1"
267401-26	4	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	$\frac{3}{8}$ "	1"
267401-27	4	$\frac{3}{4}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267401-28	4	$\frac{3}{4}$ "	$3\frac{1}{4}$ "	$\frac{3}{8}$ "	1"
267401-29	4	$\frac{3}{4}$ "	4"	$\frac{3}{8}$ "	1"

QUILLS FOR SPINDLE No. 282451

Part No.	Type	Projection		Grinding Wheel	
		R	P	J	K
267399-1	3	$\frac{1}{4}$ "	$\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-2	3	$\frac{1}{4}$ "	1"	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-3	3	$\frac{1}{4}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-4	3	$\frac{1}{4}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-5	3	$\frac{5}{16}$ "	1"	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-6	3	$\frac{5}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-7	3	$\frac{5}{16}$ "	1"	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-8	3	$\frac{5}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-9	3	$\frac{5}{16}$ "	$2\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267399-10	4	$\frac{7}{16}$ "	1"	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267399-11	4	$\frac{7}{16}$ "	$1\frac{1}{2}$ "	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267399-12	4	$\frac{7}{16}$ "	2"	$\frac{3}{16}$ "	$\frac{5}{8}$ "

EXTRA EQUIPMENT

QUILLS FOR SPINDLE No. 282450

Part No.	Type	Projection		Grinding Wheel	
		R	P	J	K
267400-1	3	$\frac{1}{4}$ "	$\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-2	3	$\frac{1}{4}$ "	1"	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-3	3	$\frac{1}{4}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-4	3	$\frac{5}{16}$ "	$\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-5	3	$\frac{5}{16}$ "	1"	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-6	3	$\frac{5}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{8}$ "	$\frac{1}{2}$ "
267400-7	3	$\frac{3}{8}$ "	1"	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267400-8	3	$\frac{3}{8}$ "	$1\frac{1}{2}$ "	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267400-9	3	$\frac{3}{8}$ "	2"	$\frac{3}{16}$ "	$\frac{5}{8}$ "
267400-10	3	$\frac{7}{16}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-11	3	$\frac{7}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-12	3	$\frac{7}{16}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-13	3	$\frac{1}{2}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-14	3	$\frac{1}{2}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-15	3	$\frac{1}{2}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-16	3	$\frac{1}{2}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-17	3	$\frac{9}{16}$ "	1"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-18	3	$\frac{9}{16}$ "	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-19	3	$\frac{9}{16}$ "	2"	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-20	3	$\frac{9}{16}$ "	$2\frac{1}{2}$ "	$\frac{1}{4}$ "	$\frac{3}{4}$ "
267400-21	4	$\frac{5}{8}$ "	1"	$\frac{3}{8}$ "	1"
267400-22	4	$\frac{5}{8}$ "	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267400-23	4	$\frac{5}{8}$ "	2"	$\frac{3}{8}$ "	1"
267400-24	4	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	$\frac{3}{8}$ "	1"
267400-25	4	$\frac{5}{8}$ "	3"	$\frac{3}{8}$ "	1"

ORDERING REPAIR PARTS

You will receive quicker service when ordering repair parts if you will adhere to the following procedure:

1. **State amount wanted.**
2. **Give part number and name or description of part, and where obtained.**
 - (a) Parts catalog.
 - (b) Part number stamped on part.
 - (c) Prior invoice.
3. **Give complete serial number of machine.** The serial number will be found stamped on the front of the base just below the name "CINCINNATI".
4. **Specify each individual piece required.** If only certain parts of a unit are required, never use the word "complete"; it always raises the question as to how much of the unit to supply. In some cases, due to the nature of the parts, it will be less costly to you for us to supply additional related pieces, especially if the part wanted is obsolete.
5. **Specify how and where to ship.** Do not say "Ship quickest way". Be definite and state the agency desired, that is:—Air Mail, Parcel Post, Special Delivery, Express, Motor Freight, Rail Freight, etc.

MEMORANDUM

12", 14", 14"H AND 18"UA UNIVERSAL GRINDING MACHINES

MEMORANDUM

CINCINNATI

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO 45209 U.S.A.

PRODUCTS OF THE CINCINNATI MILLING MACHINE CO. INCLUDE A COMPLETE LINE OF GENERAL PURPOSE MILLING MACHINES, MACHINING CENTERS, PRODUCTION MILLING MACHINES, DIE SINKING AND PROFILE MILLING MACHINES, CUTTER AND TOOL GRINDING MACHINES, CENTERTYPE GRINDING MACHINES, CENTERLESS GRINDING MACHINES, ROLL GRINDING MACHINES, CHUCKING GRINDING MACHINES, MICRO-CENTRIC GRINDING MACHINES, SPECIAL GRINDING MACHINES, ELECTRICAL MACHINING EQUIPMENT, METAL FORMING MACHINES, SPECIAL BROACHING MACHINES, SPECIAL MACHINE TOOLS AND COMPLETE PRODUCTION LINES, SPECIAL MACHINERY, NUMERICAL CONTROL SYSTEMS, TRACING SYSTEMS, GAGING SYSTEMS, HYDRAULIC MOTORS, HYDRAULIC AND ELECTRO-HYDRAULIC VALVES AND COMPONENTS, SERVICE PARTS, CUTTING FLUIDS AND PRECISION GRINDING WHEELS.