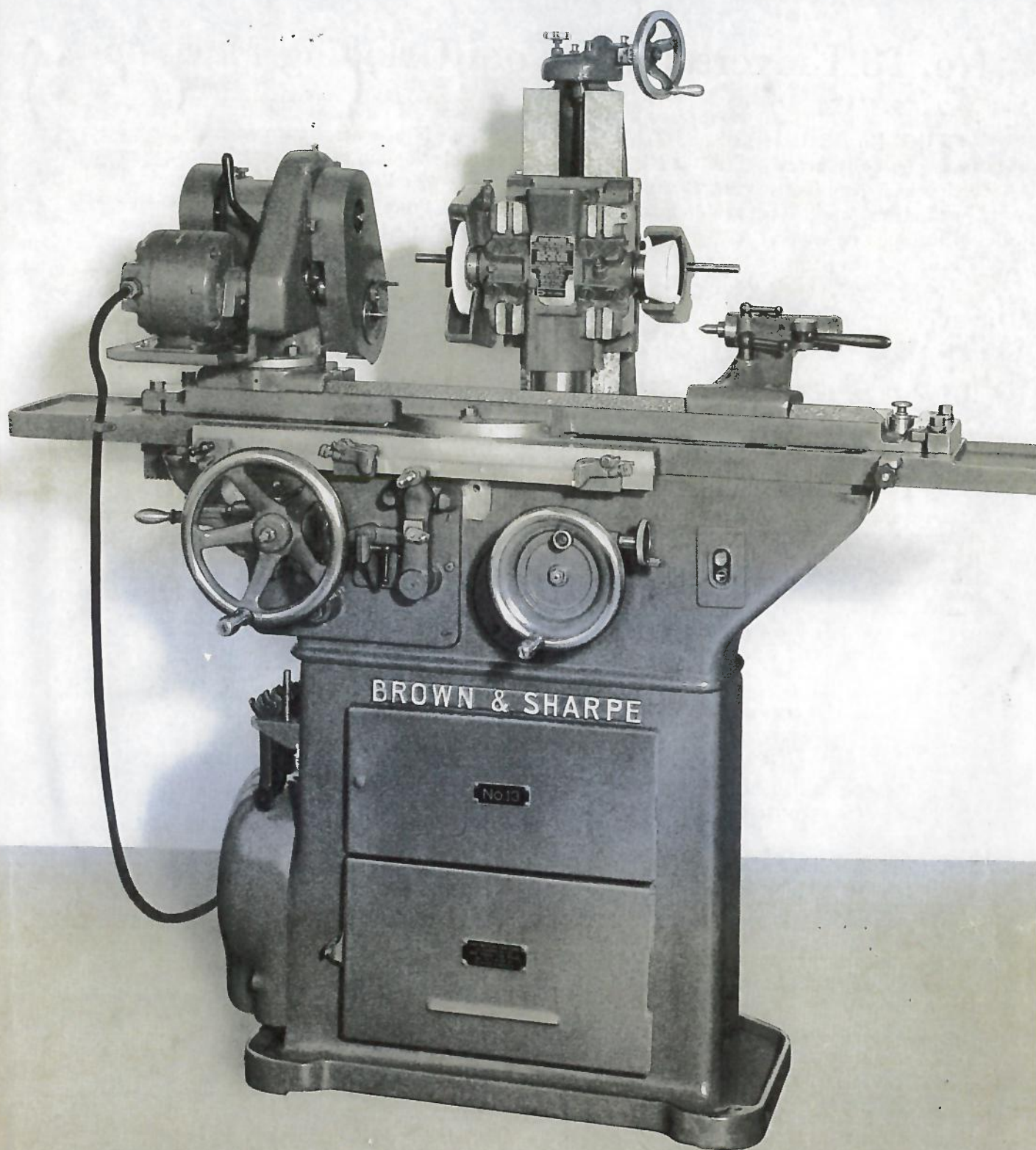




BROWN & SHARPE
No. 13 UNIVERSAL AND TOOL
GRINDING MACHINE

No. 13 Universal and Tool Grinding Machine

THE No. 13 Universal and Tool Grinding Machine is a general-purpose machine of unusually broad utility, and is particularly suitable for toolroom operations such as sharpening milling cutters, reamers and similar tools, grinding small and medium-sized cylindrical work, form grinding and miscellaneous other types of work, some of which are illustrated on pages 7, 8 and 9 of this circular. A wide selection of additional equipment broadens the scope of the machine to include practically every type of toolroom grinding. The machine and its equipment are described in detail below and in the pages following.

SPECIFICATIONS

CAPACITY Centers swing 8" in diameter; take 24" in length. Maximum longitudinal table travel, 22", automatic. Maximum length of work which can be ground cylindrically with wheel spindle parallel to table ways, 15". Distance, center line of work to center of wheel spindle, greatest, 12 $\frac{3}{4}$ "; least, 2 $\frac{1}{4}$ ". Distance, center of wheel spindle to top of table, greatest, 12 $\frac{1}{8}$ "; least, 3 $\frac{3}{4}$ ". Center rest takes work to 2" diameter.

DRIVE By 2 constant-speed motors. Wheel spindle and table driven by 1 $\frac{1}{2}$ h.p. motor in base. Headstock driven by $\frac{1}{2}$ h.p. motor mounted on headstock assembly. All driving belts guarded. Approximately 1 $\frac{1}{2}$ h.p. required to operate machine at full capacity.

WHEEL GUARDS Six guards furnished, three adjustable and three plain; give adequate protection to the operator. Position adjustable for wheel wear. Provision made for connecting with a dust exhaust system.

WHEEL SPINDLE Alloy steel. Ends tapered to receive grinding wheel sleeves. Bearing surfaces hardened, ground and lapped. Bronze boxes provided with spring shoes for automatic compensation for wear.

WHEEL SPINDLE SLIDE Vertical adjustment, 8 $\frac{3}{8}$ ". Operated by adjustable handwheel graduated to read to .0005".

SPINDLE SLIDE UPRIGHT Transverse movement, 10 $\frac{1}{2}$ ". Swivels. Base graduated in degrees to 90° each side of zero.

SWIVEL TABLE Turns on tapered steel pivot, permitting angular settings to 90° in either direction. Construction of pivot permits adjustment for wear. Table clamped at both ends and near pivot. Setting indicated in degrees from either of two zero marks, by graduated arc at front reading in each direction from zero to 90°. Fine screw adjustment, with scale at end of table, provides for accurate setting of table for tapers up to 3" per foot. Table has one T-slot, $\frac{1}{2}$ " wide. Height, floor to top of table, 40".

SLIDING TABLE Has power travel and two rates of hand travel. Driven by rack and pinion. Reverse controlled by dogs adjustable along dog rack at front. Dogs have both coarse and fine adjustment. Table slides on one V and one flat way, scraped and

adequately guarded. Ways proportioned to give large bearing surfaces. Oil distributed evenly by rollers. A bracket on base and a stop adjustable along dog rack provide for using a dial indicator for precise longitudinal measurements.

SPEEDS Speeds of wheel and work independent of each other. Changes obtained by use of change pulleys. 3 changes of wheel speed: 2455, 3545 and 5730 r.p.m. 3 changes of work speed for both dead-center and revolving-spindle grinding: 120, 300 and 530 r.p.m.

LONGITUDINAL TABLE TRAVEL Independent of operation of wheel spindle and headstock. 4 changes in rate of power table travel: 12", 24", 46" and 84" per minute, available for any work speed. Changes obtained through cone pulleys. Fast and slow hand longitudinal travel also provided. Fast, 6 $\frac{1}{4}$ " per revolution of handwheel; slow, $\frac{1}{2}$ " per revolution.

CROSS FEED Hand operated. Wide-spaced graduations on cross feed handwheel read to .001" on work diameter. Twenty revolutions of handwheel moves spindle slide upright 1". For finer feed, knurled knob on cross feed handwheel engages smaller adjacent handwheel, one revolution of which turns the larger handwheel through one graduation (.001" on work diameter).

UNIVERSAL HEAD Can be set to an angle in both horizontal and vertical planes. Vertical scale graduated in degrees to 90° each side of zero mark. Horizontal scale graduated in degrees to 180° each side of zero mark. Has vertical adjustment of 4". Work up to 16" in diameter will swing over the table and, by placing the head at right angles to the table, light work up to 24" in diameter can be taken. Carries cutter bars, taper shank mill bushings, and straddle and face mill arbor.

HEADSTOCK An independent unit. Adjustable along table. Swivels. Setting indicated in degrees by scale on base graduated to 100° each side of zero. Spindle hardened and ground. Bronze boxes provided with means of compensation for wear. Spindle nose threaded, 1 $\frac{1}{2}$ "-6-N.C., r.h., and has No. 6 B & S taper hole. Has both dead-center and revolving-spindle drive. Quick-acting clutch, operated by lever at front, starts and stops rotation of work without stopping driving motor. Height, floor to center line of spindle, 44".



Equipment illustrated is regularly furnished with machine.

FOOTSTOCK Adjustable along table. Clamped in position by lever. Spindle has No. 6 B & S taper hole, is operated by spring lever, and is protected from grit and coolant. Clamp lever provided for locking spindle.

ELECTRICAL CONTROLS Conform with Machine Tool Electrical Standards. Main driving motor and headstock motor started and stopped in unison through single magnetic switch controlled by push-button switch at front. (Headstock stopped separately by lever-operated clutch.) Motors protected by overload relays having automatic reset. Overload of either motor stops entire machine. Magnetic switch and overload relays mounted on panel in compartment in front of base; protected by hinged cover.

FLOOR SPACE At right angles to spindle, 45". Parallel to spindle, 84".

STANDARD EQUIPMENT Driving motor for wheel spindle and table, headstock motor, electrical controls and wiring complete; driving belts for wheel spindle, table and headstock; and pulleys for obtaining speed changes of headstock and wheel spindle.

Universal head— $\frac{3}{8}$ " cutter bar, bushing and $\frac{1}{2}$ " sliding shell with set of collars, including 2 stepped

collars; $\frac{3}{4}$ " cutter bar and $\frac{7}{8}$ " sliding shell with set of collars, including 4 stepped collars; arbor and 3 collars for straddle and face mills; taper shank mill bushing sleeve, holder and 2 bushings for Nos. 7 and 9 B & S tapers.

7 wheel sleeves, $1\frac{1}{4}$ " diameter; wheel sleeve puller; wheel spindle guard; 4 wheel arbors—1, $\frac{1}{4}$ " r.h.; 1, $\frac{1}{4}$ " l.h.; 1, $\frac{1}{2}$ " r.h.; 1, $\frac{3}{4}$ " r.h.; 3 plain and 3 adjustable wheel guards.

11 grinding wheels—7 straight, 2 dish and 2 flaring cup. Sizes given in inches, diameter x thickness x hole.—

Straight

1—1 x $\frac{1}{4}$ x $\frac{1}{4}$
1—2 x $\frac{1}{4}$ x $\frac{1}{4}$
1—3 x $\frac{1}{4}$ x $\frac{3}{4}$

1—6 x $\frac{1}{4}$ x $1\frac{1}{4}$
1—6 x $\frac{3}{8}$ x $1\frac{1}{4}$
2—7 x $\frac{1}{2}$ x $1\frac{1}{4}$

Dish

1—3 $\frac{1}{2}$ x $\frac{1}{2}$ x $\frac{1}{2}$
1—6 x $\frac{1}{2}$ x $1\frac{1}{4}$

Flaring Cup

1—4 x $1\frac{1}{2}$ x $1\frac{1}{4}$
1—7 x 2 x $1\frac{1}{4}$

Face plate; face chuck; wheel truing fixture; center rest; tool rest; 4 tooth rests and holders; center head; 3 centers, including reamer grinding center; set of work driving dogs; and set of wrenches.

WEIGHTS AND SHIPPING DATA	Net Weight, Lbs. (Approx.)	Domestic Shipping Weight, Lbs. (Approx.)	Foreign Shipping Weight, Lbs. (Approx.)	Dimensions for Shipment, Inches	Space Occupied, Cu. Ft.
Machine fitted with motors*	2450	2825	2950	65x47x67	119

*Because of the demand for quality finish, motors must be mounted at our factory. When furnished by customer, they must be **balanced motors**.

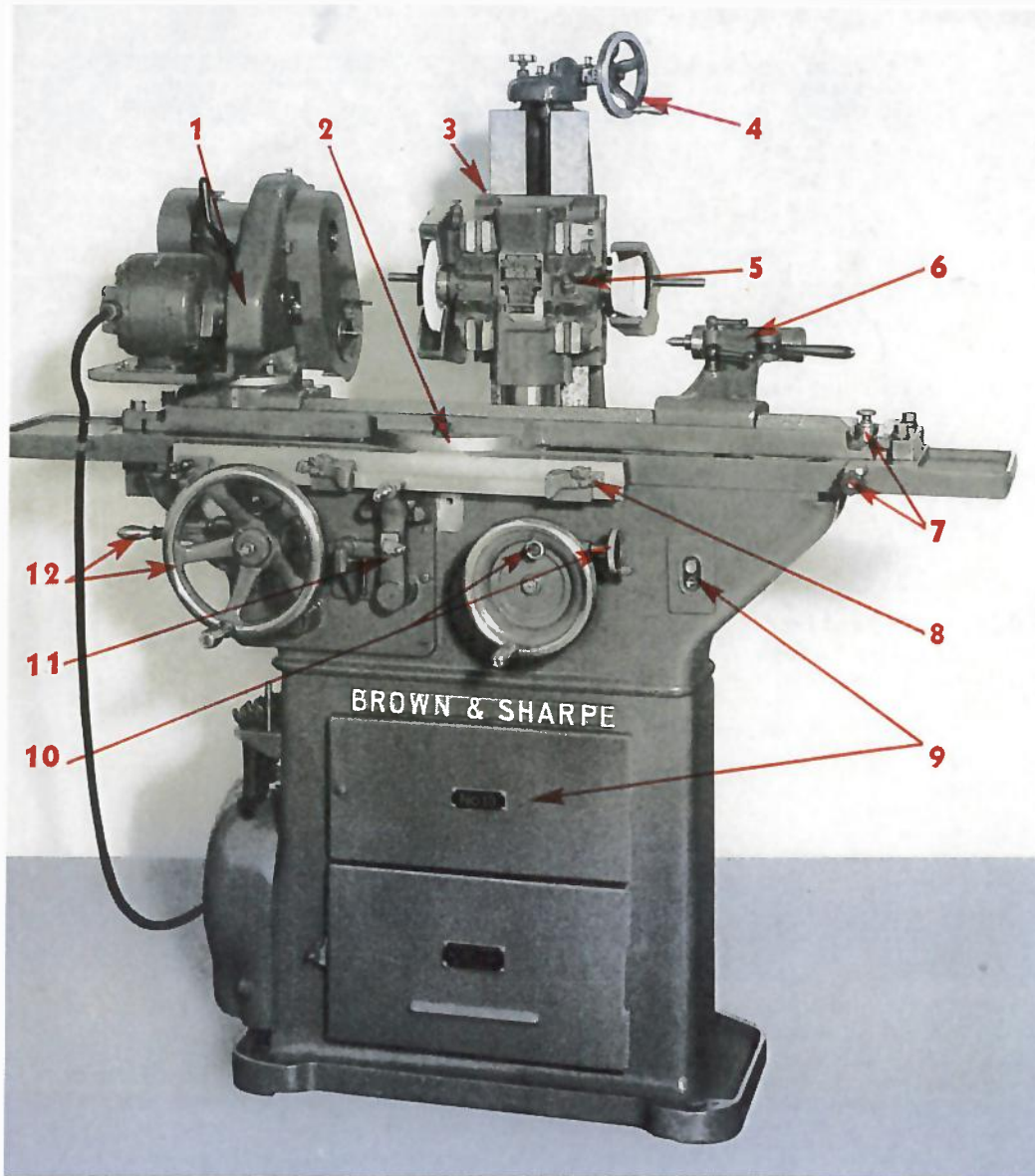
— Additional Equipment —

A wide variety of additional equipment is available at extra cost for use with this machine. These items, listed below, are illustrated and described in detail in pages 10 to 20 of this circular.—

Wet Grinding Attachment
Exhaust Attachment
Castered Base for Use with Wet Grinding and Exhaust Attachments
Circular Forming Tool Grinding Equipment
No. 13 End Mill Sharpening Attachment
Adapters and Collets for Use with No. 13 End Mill Sharpening Attachment
No. 13 Formed Cutter Sharpening Attachment (Through-Feed Type)
No. 13 Formed Cutter Sharpening Attachment (In-Feed Type)
Index Centers

Radius Grinding Attachment
Taper Holding Attachment
No. 13 Face Mill Sharpening Attachment
Hob Sharpening Attachment
Angle Wheel Truing Attachment
Internal Grinding Attachment
Internal Grinding Attachment (Ball Bearing Type)
Magnetic Chucks
Bushings, for Use in Universal Head
Spring Chuck, for Use in Headstock
No. 1 Adjustable Vise
Surface Grinding Attachment
Equipment Cabinet

FEATURES



1 Motor-driven headstock has both dead-center and revolving-spindle drive. Swivels on graduated base. Lever operates quick-acting clutch.

2 Swivel table turns on stud to 90° either side of zero. Double scale, graduated to degrees, indicates setting from either of two zero marks.

3 Zero mark on column provides for setting wheel slide with spindle at center height.

4 Elevating screw handwheel swivels to any convenient operating position. Bracket clamped by knob. Handwheel graduated to read to .0005".

5 Double-ended wheel spindle carried in sturdy slide. Has vertical adjustment of 8 3/4". Proper adjustment of spindle boxes automatically maintained by spring shoes.

6 Footstock clamped in position by lever. Spindle operated by spring lever. Spindle hand clamp provided.

7 Spring latch, and knob for fine adjustments of swivel table. Latch engages knob.

8 Table reversing dogs quickly positioned along rack. Have fine thumbscrew adjustment.

9 Main start-stop push button conveniently located. Controls both motors. All electrical controls enclosed in base.

10 Fine cross feed operated by small handwheel; engaged by knob on cross feed handwheel.

12 Convenient three-position lever permits quick selection of power table travel, or two rates of hand travel by adjacent handwheel.

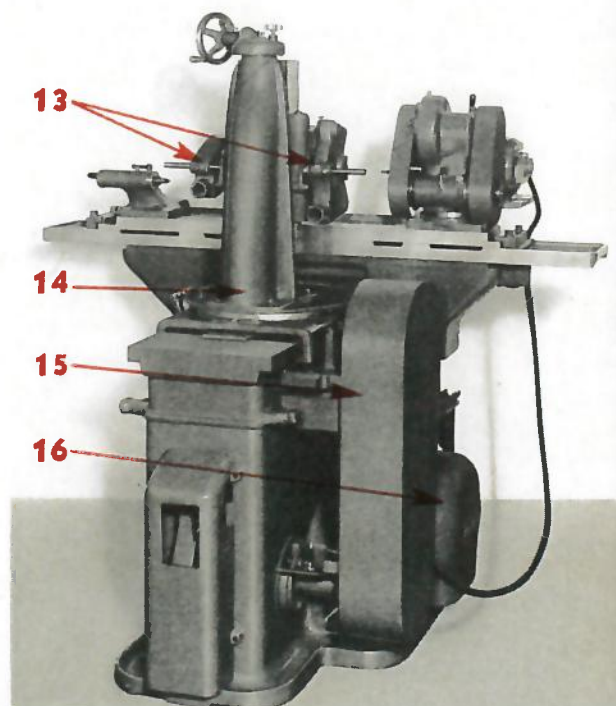
11 Table reversing lever. Can be operated by hand. Lock prevents engagement of longitudinal power travel when hand-wheel is in use.

13 Heavy wheel guards protect machine and operator from injury. Can be connected with central exhaust system.

14 Sturdy wheel spindle slide upright supported on broad scraped base. Swivels to 90° either side of zero, with settings indicated by wide-spaced graduations to degrees. Rigid clamping provided.

15 Table driven through cone pulleys (beneath guard) from motor in base. Four rates of power table travel provided; independent of wheel spindle and headstock speeds.

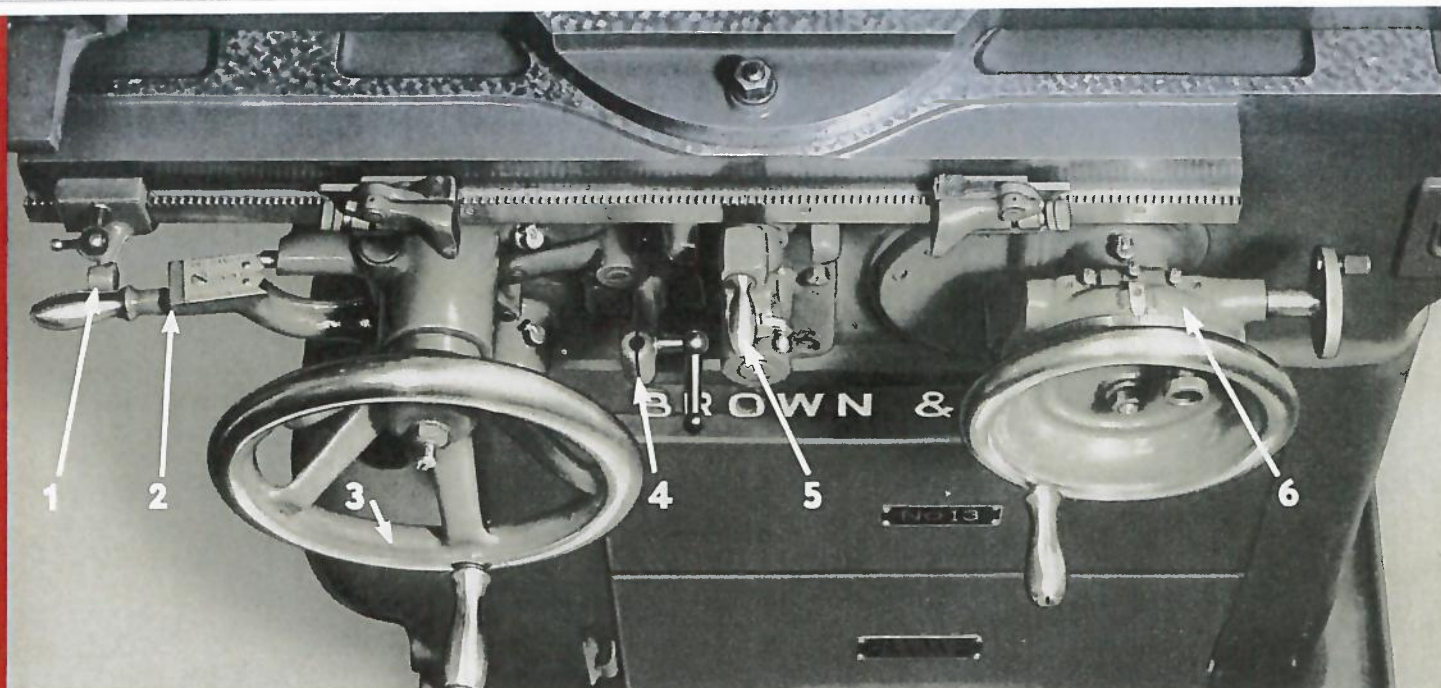
16 Driving motor for wheel spindle and table completely enclosed in base of machine. Adequate ventilation assured by louvers at front and side. In alternating current installations, compartment accommodates generator when electromagnetic chuck is used.



> *Wide
Versatility*

> *Convenience
of Operation*

> *Long-Lived
Accuracy*



Controls Arranged for Efficient Operation

THE operating controls are simple in design, conveniently located and easily manipulated, permitting a maximum output of accurate work with minimum operator fatigue.

The three-position lever 2 at the left front of the machine is used to select the table travel desired — fast or slow hand travel (through the adjacent table handwheel 3), or power movement. The lever is held in the desired position by a spring plunger arrangement, each position being clearly indicated. The table handwheel 3 is automatically disengaged when power feed is engaged.

The table reversing lever 5 (between the two handwheels) may be operated either manually or by table dogs which are quickly positioned along a rack. Thumbscrews provide fine adjustment of the dogs. A safety latch on the front of the reversing lever permits positive disen-

gagement of power feed and locks the lever rigidly in vertical position for use as a positive stop.

The handwheel mechanism 6 at the right operates the cross feed. The handwheel itself has wide-spaced graduations reading to .001" on work diameter. The small knurled wheel, which is engaged by turning a knurled knob on the handwheel, is for fine cross feed, one revolution rotating the large handwheel through one graduation.

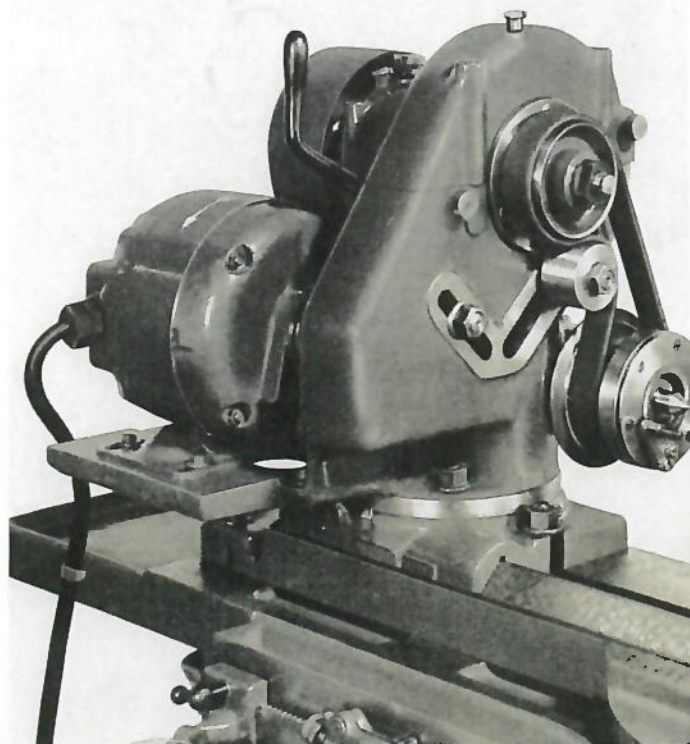
To facilitate face grinding, shoulder grinding or any job where the work is to be fed longitudinally to close limits, a dial indicator holding bracket 4 is located on the front of the machine bed between the reversing lever and the table handwheel. Used in conjunction with this is the adjustable stop 1 shown on the left end of the table dog rack. By setting an indicator in the holding bracket so that its spindle will contact the stop, the operator has an accurate gage for longitudinal measurements.

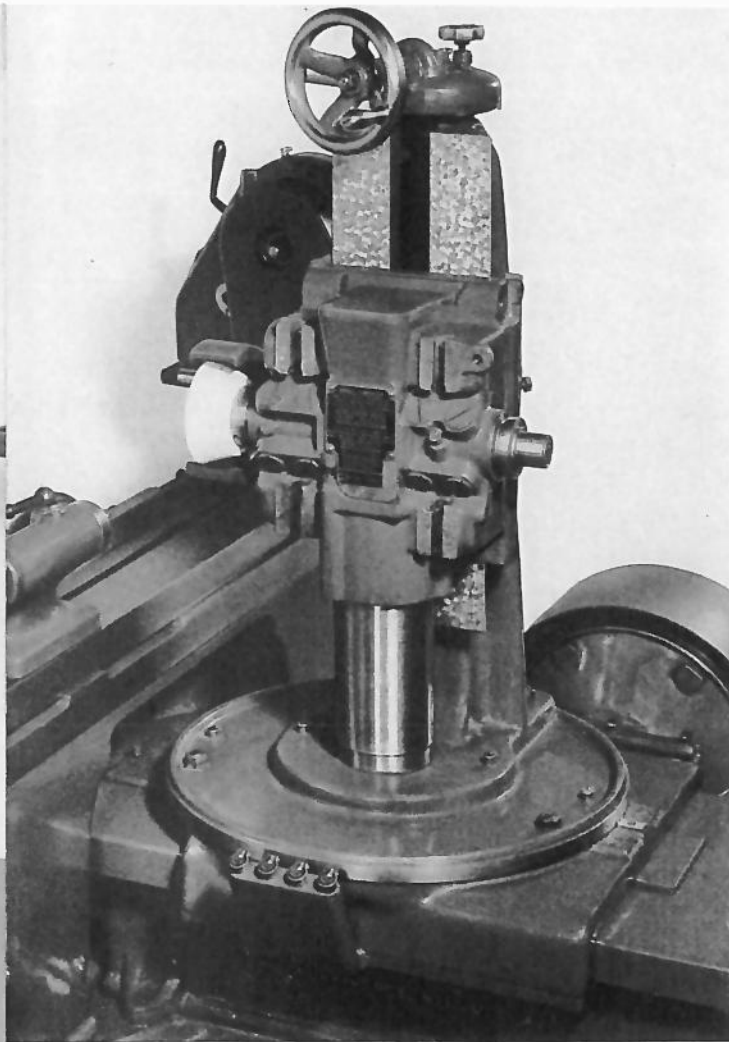
Motor-Driven Headstock Has Angular Adjustment

THE motor-driven headstock is an independent unit, adjustable along the table and removable from the machine. Its swivel construction permits angular settings to 100° each side of zero, graduations on the base showing the adjustment to degrees.

Three changes of work speed for either dead-center or revolving-spindle grinding are quickly obtained by means of change pulleys. Adjustable idler pulleys provide for proper belt tension and assure ample contact, as shown in the illustration at right (guard removed). The change between dead-center and revolving-spindle grinding is made simply by changing the belt from a set of pulleys on one end of the headstock to a similar set on the other end.

Work rotation is started and stopped by a clutch lever at the front of the headstock, the headstock driving motor running continuously while the machine is in operation. A plug and socket at the rear of the base provide for disconnecting the motor when removing the headstock from the machine.





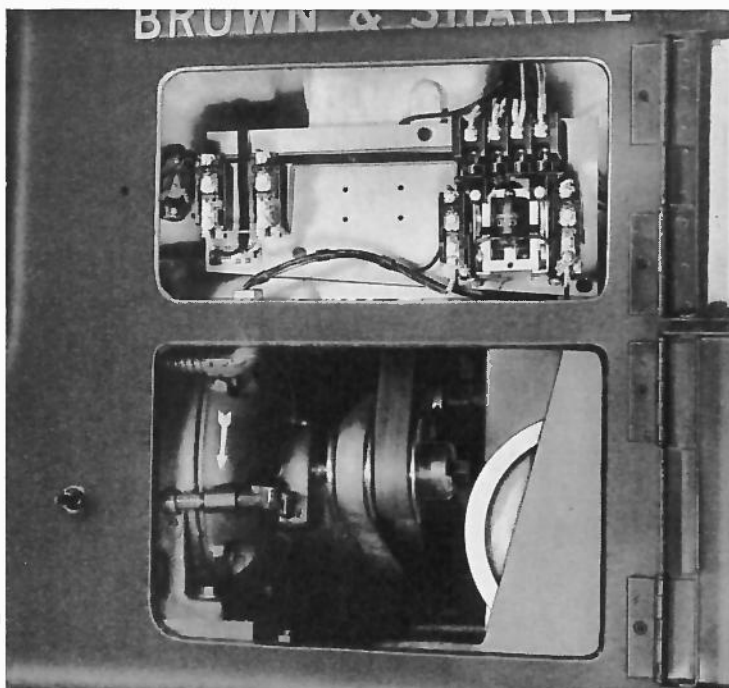
Above — Reliably accurate vertical, transverse and angular settings of the spindle are easily obtained, facilitating a wide variety of set-ups. The elevating screw handwheel may be swiveled to the most convenient operating position, regardless of the angular position of the upright.

Wheel Spindle Adjustments Give Maximum Flexibility of Set-Up

THE wheel spindle unit of this machine, permitting vertical and transverse adjustments and angular settings in the horizontal plane, offers unusual versatility and accuracy of set-up. The elevating screw handwheel, located at the top of the upright, has wide-spaced graduations reading to .0005"; and it can be swiveled to any convenient operating position and clamped in that position by the knob shown. A zero mark on the upright gives a positive means of setting the wheel spindle at center height. The upright is solidly supported by a broad scraped base on the cross slide, and can be swiveled horizontally to any angle, a scale showing the setting in degrees to 90° either side of zero.

The spindle is made of a special alloy steel with bearing surfaces hardened, ground and lapped, and runs in two long scraped bronze bushings having automatic compensation for wear. Adjustment for end play is easily accomplished, a screw driver being the only tool required. Both ends of the spindle are tapered to receive wheel sleeves; and both plain and adjustable wheel guards are furnished, and are designed to permit connection to an exhaust system. Three rates of speed are provided by change pulleys on the motor shaft, the spindle driving belt being guarded by a telescopic tube between the spindle head and the base of the upright. An idler pulley maintains the correct tension in the driving belt regardless of the position of the spindle head.

All bearing surfaces on the bed, cross slide, swiveling upright and head are accurately hand-scraped; and the whole unit is precision-built to assure the accuracy demanded by the type of work for which this machine is intended.



Main Motor Accessibly Located; Drives Wheel Spindle and Table

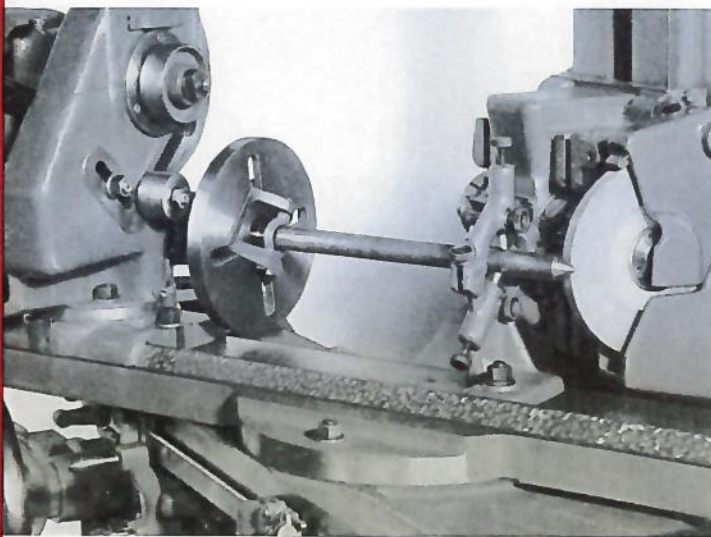
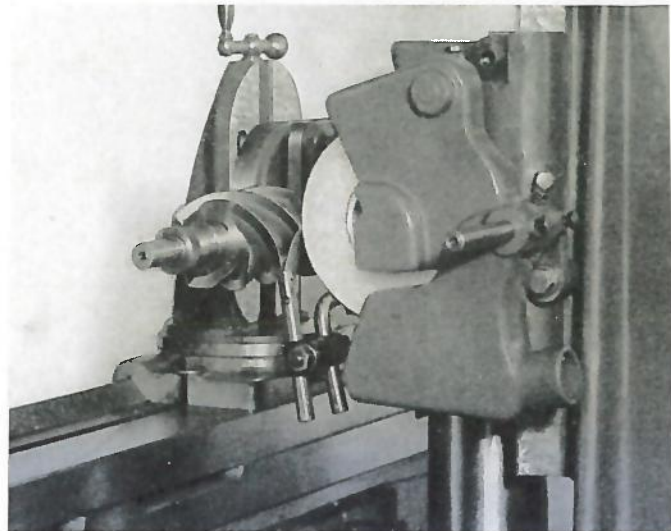
THE main driving motor is mounted on a plate in the base of the machine and provides drive by belt for both the wheel spindle and table. Three wheel spindle speeds are available by interchangeable pulleys mounted on the end of the motor shaft, the pulleys not in use being stored in the base near the motor. Correct tension in the spindle belt is maintained by an automatic belt tightener for all positions of the wheel slide. The table is driven through four-step cone pulleys, and provision is made for maintaining proper tension in this belt also. A door at the front of the base gives accessibility; and louvers provide an adequate, natural circulation of cooling air to the motor.

The electrical controls are mounted on a panel in a covered compartment in the front of the base, and are fully protected yet easily accessible.

OPERATIONS —

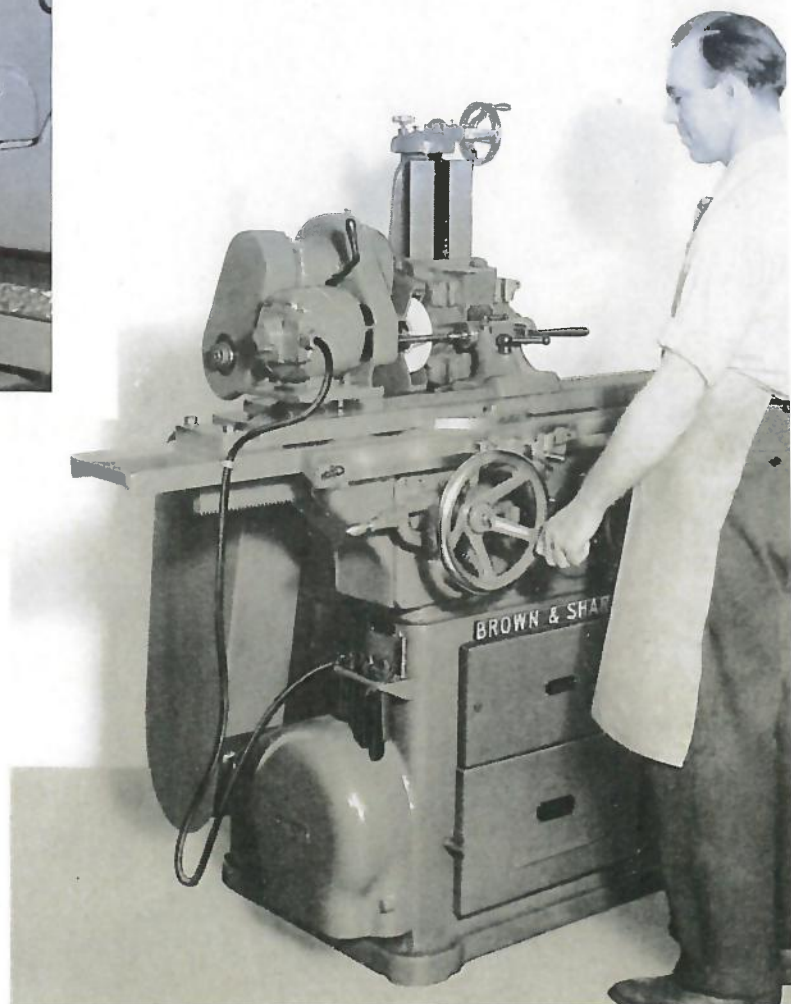
TO give some idea of the broad capabilities of this machine, typical every-day toolroom jobs are illustrated on this page and the two following. Many other types of operation are handled equally well, using only the equipment regularly furnished with the machine. Other illustrations on pages 10 to 20 indicate the variety of additional types of work that are readily done using the attachments available as extras.

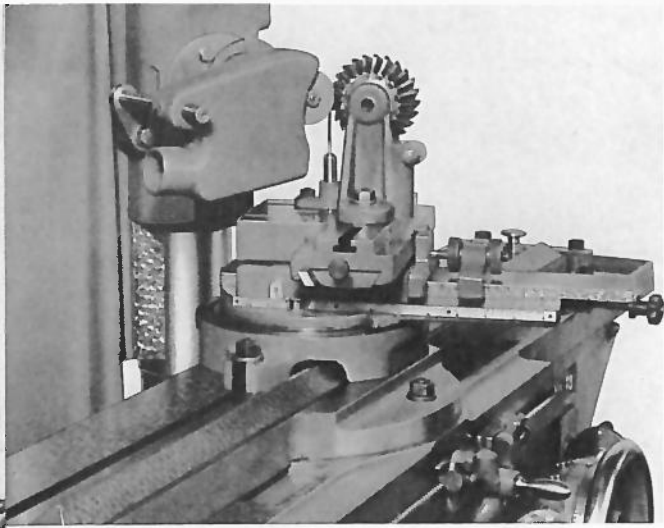
Right—Sharpening a helical milling cutter with steep helix. The wheel is dressed so that the cutting edge is rounded with a $\frac{1}{16}$ " radius, tapering back to the thickness of the wheel. The cutter is mounted on stepped collars and is free to slide on the cutter bar, which is held horizontal in the universal head with its axis parallel to the wheel spindle. The tooth rest is ground with a slight radius and is supported from the wheel spindle slide. Tooth clearance is obtained by setting the tooth rest below the wheel center.



Above—Grinding pointed end of work center. The headstock is arranged for revolving-spindle grinding with the face plate. The work driving dog is laced to the face plate to hold the work on the headstock center and to transmit the drive. The center rest is used to support the end being ground, and the table is set to the required angle. Either hand or power table travel can be used.

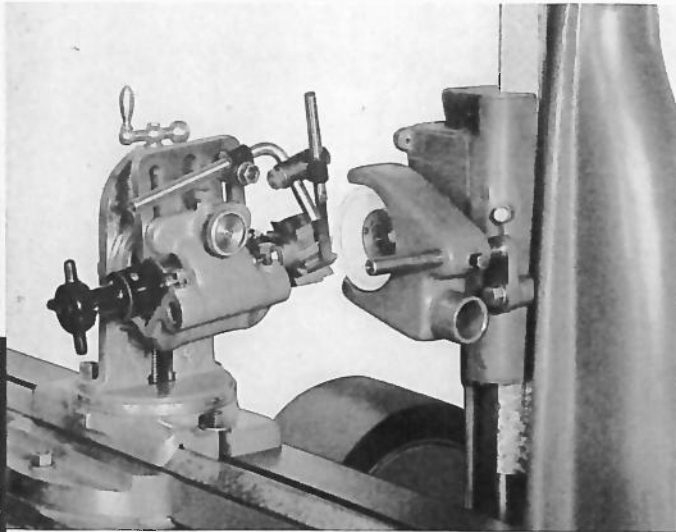
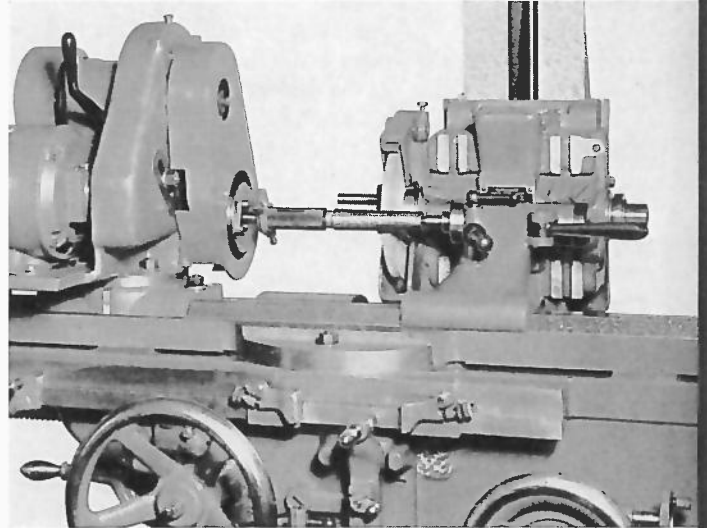
Right—A typical cylindrical grinding job. The operator finds all controls right at hand and easily manipulated; and both man and machine are protected by ample guarding.





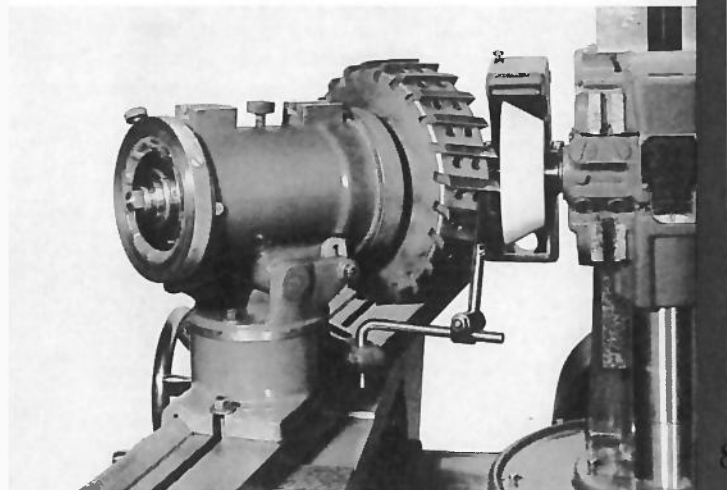
Left—Sharpening one half of an interlocking concave cutter using the Radius Grinding Attachment. A wheel arbor and small wheel are used to prevent interference with the cutter while grinding. The spindle slide upright is swiveled so that the wheel will be normal to the cutting edge of a tooth. The wheel is raised so that the proper tooth clearance will be produced. Then, the wheel is formed to the radius of the tooth. The wheel truing equipment is then removed and the cutter set up (as shown) so that the wheel contacts the cutting edge at all points as the Attachment is swiveled on its base. The cutter is now ready to be sharpened.

Right—Grinding a taper plug gage. The gage is mounted on dead centers and the swivel table is set to the correct taper. Power table travel is used for traversing the work and fine hand cross feed is used for feeding the wheel. The length of table movement is governed by means of the dogs, which have both coarse and fine adjustment.

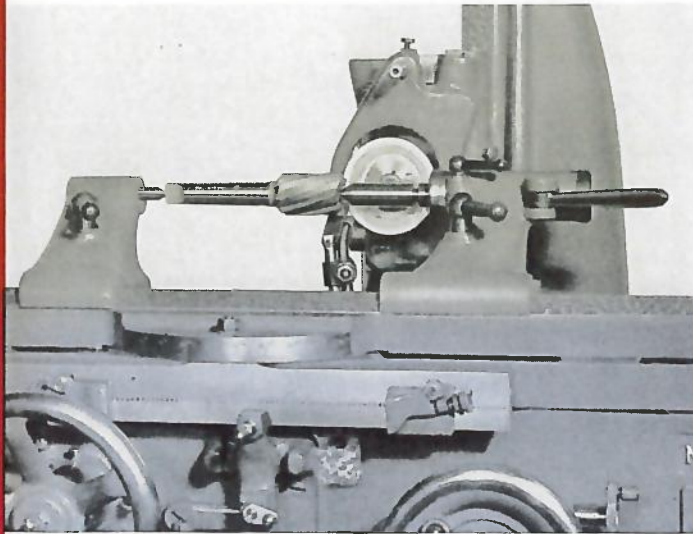
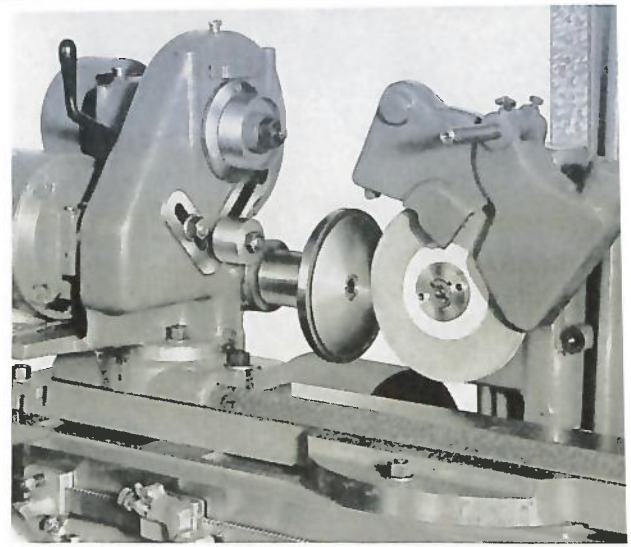


Left—Sharpening the end teeth of a shell end mill. The cutter is mounted on an arbor which is set in a taper shank mill bushing. The bushing is inserted into the taper shank mill bushing sleeve held in the universal head. The head is swiveled in the vertical plane to obtain the desired clearance angle and also may be swiveled slightly in the horizontal plane to grind the teeth low in the center of the cutter. The cutter is turned until one of the teeth is horizontal and the wheel is raised until that tooth can be ground without interference. The tooth rest is adjusted to support the tooth being sharpened. Hand table movement is used.

Right—Sharpening the tooth corners of a large face milling cutter. The cutter is mounted on a work holding arbor and the Face Mill Sharpening Attachment is swiveled to give the angle desired for the corners of the teeth. The grinding wheel spindle is set at right angles to the table ways; and tooth clearance is obtained by using the gages incorporated in the Attachment. Hand table movement is used.

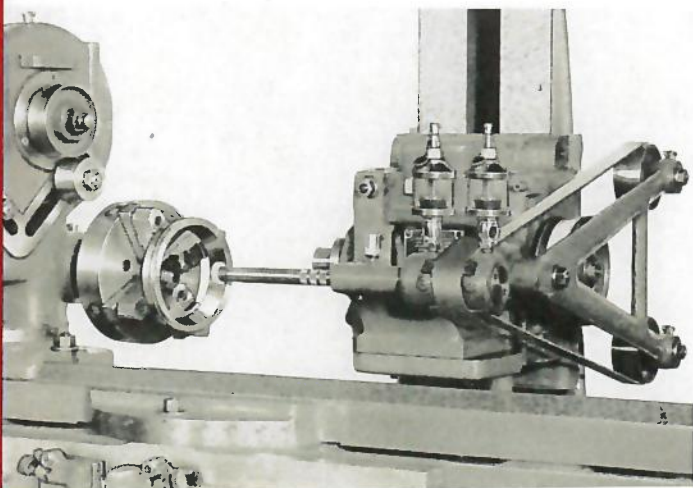
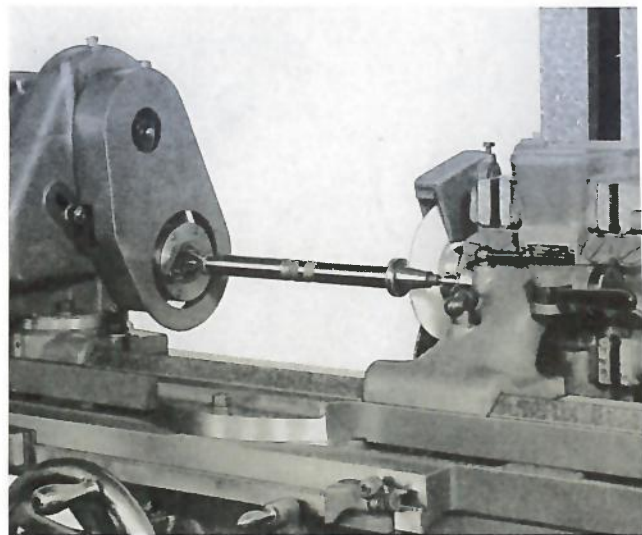


Right—Face grinding a thin disk. The headstock is arranged for revolving-spindle grinding using the face chuck. An expanding spring bushing is held in the chuck by a threaded rod which is passed through the spindle from the left end. The disk is placed on the bushing, and a screw in the center of the right end of the bushing is turned to tighten the grip on the disk. The rod is then tightened so that the bushing is drawn farther into the chuck until the disk lies flat against the chuck face. The disk can be ground flat, concave or convex by setting the headstock or table accordingly.



Left—Grinding the peripheral teeth of a spiral end mill. The end mill is supported between the center head and the footstock fitted with the reamer grinding center. The tooth rest is mounted on the wheel spindle slide. The spindle slide upright is swiveled 90° to the table and, if necessary, is then turned back just enough to allow the trailing edge of the wheel to clear the cutter during the grinding operation.

Right—Grinding face of shoulder flat and at right angles to the axis of the shaft. The table and headstock are both set at 0°. A dish wheel is used and the work is moved to and from the wheel during the grinding operation. This method requires only that the wheel be kept sharp, it being unnecessary to maintain an accurate grinding face. A concave work surface can be obtained by proper setting of the swivel table.



Left—Grinding an inside taper using the Internal Grinding Attachment. The headstock is arranged for revolving-spindle grinding using the 4-jawed chuck, and is swiveled to the correct angle for the taper of the hole to be ground. The largest change pulley is used on the motor in the base of the machine so that the Attachment wheel will run at the proper surface speed. Either power or hand longitudinal table travel can be used.

— ADDITIONAL EQUIPMENT —

Items Furnished at Extra Cost

THE variety of Additional Equipment available for use on the No. 13 Universal and Tool Grinding Machine broadens its scope to include practically every type of toolroom grinding operation.

Hob, face mill, end mill and formed cutter sharpening attachments — surface, internal, wet grinding and exhaust attachments — equipment for grinding circular forming tools — index centers — bushings — magnetic chucks — these and other advantageous units are illustrated and described in detail in the following pages.

When ordering equipment, specify the size, style and serial number of the machine.

Wet Grinding Attachment

THIS Attachment supplies and efficiently controls coolant for the wet grinding of cylindrical work up to 6" diameter. It will not accommodate surface or general cutter grinding.

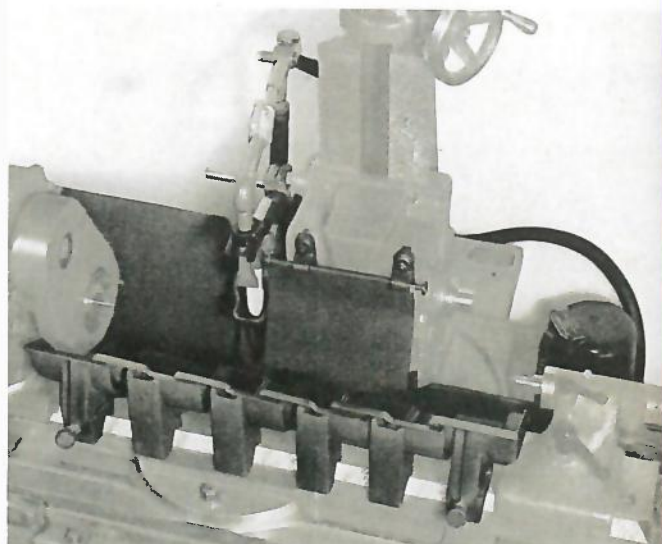
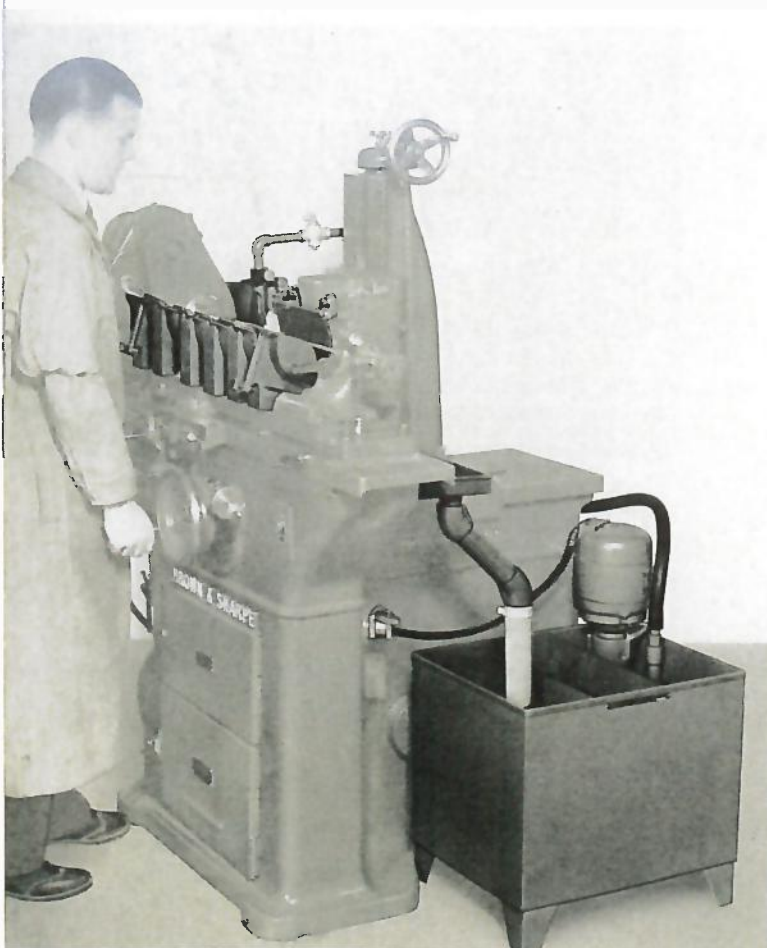
The welded steel coolant tank is a floor-type unit of 18 gallons capacity, and has a two-plate removable baffle which provides for efficient settling. Coolant is supplied by a $\frac{1}{4}$ h.p. Brown & Sharpe motor-driven centrifugal pump, designed especially for handling gritty liquids and having a totally-enclosed motor.

Coolant is delivered from the pump to the adjustable distributor through a rubber hose, and is returned to the tank from a collecting trough fastened to the rear of the bed, through an offset pipe and a flexible hose extension. A special guard for the grinding wheel insures protection to the operator and directs the water to the work with minimum splashing; while a set of adjustable overlapping water guards for the table gives further protection.

Weights (approx.): net, 165 lbs.; shipping, 255 lbs. Dimensions for shipment, 46" x 22" x 22".

Left — View of the machine equipped with Wet Grinding Attachment. Note compact arrangement. Both operator and machine are well protected against coolant splash.

Below — The work location as it appears to the operator. Note the overlapping table guards and the sheet metal guard which protects the front of the spindle housing from grit and coolant. The nozzle directs the coolant to the work with a minimum of splashing and a maximum of cooling efficiency.



Exhaust Attachment For Cylindrical Grinding

THIS motor-driven Attachment removes grit and dust-laden air from the region of the grinding operation by suction and separates out the foreign matter, leaving the air well-cleaned. It is intended for use with straight and dish wheels, and may be applied at either end of the wheel spindle, as illustrated.

The Attachment includes an exhaust nozzle, flexible suction hose, and a dust collector unit consisting of a motor-driven fan mounted on a separator tank. The dust-laden air is blown into a spiral separator where the heavier particles are removed by centrifugal force, and is then spread by a baffle in an expansion chamber so that it is slowly dispersed over the whole area of the outlet filter, where the remaining finer particles are trapped by two viscous-coated renewable filter pads. Tests show that this dust collector unit has a separating efficiency of more than 99%.

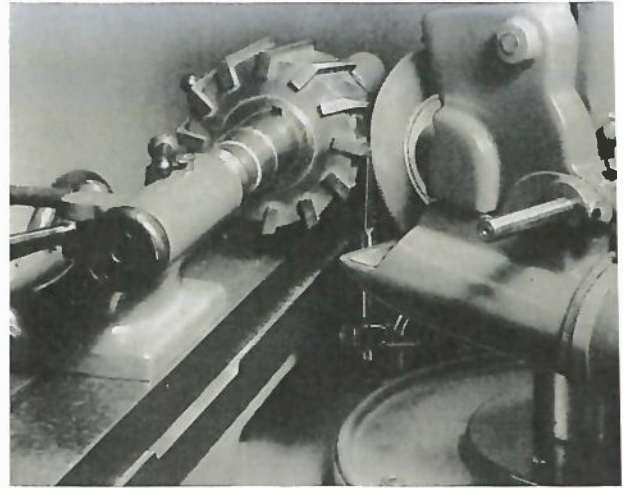
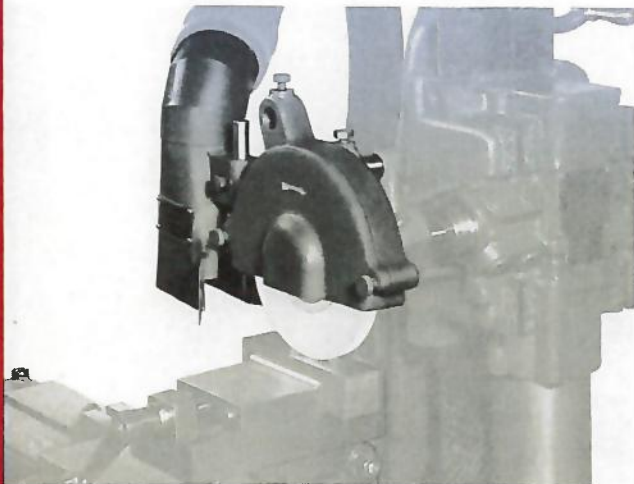
The fan is driven by a $\frac{1}{4}$ h.p. flange-type totally-enclosed motor controlled by a starting switch having overload protection. The suction hose is made of a wire helix embedded in rubber and has a fabric covering. The capacity of the Attachment with a 3600 r.p.m. motor is 300 cu. ft. per minute, giving a velocity of approximately 6000 ft. per minute through the 3"-diameter hose.

With the dust collector unit located at the left side of the machine, the longitudinal floor space required for this Attachment is no more than that required for the table movement, although approximately 2 ft. should be allowed behind the machine for the loop in the flexible suction hose.

Weights (approx.): net, 200 lbs.; shipping, 275 lbs. Dimensions for shipment, 24" x 30" x 40" (17 cu. ft.).

Parts to Arrange Exhaust Attachment for Surface Grinding are available at extra cost. These include a special wheel guard and nozzle for the left-hand end of the wheel spindle as illustrated below.

Below—Special wheel guard and nozzle adapt the Exhaust Attachment for surface grinding.



Above—The Attachment efficiently removes grit and dust from this typical cutter sharpening job.

Below—View of Attachment complete. Nozzle can be used at either end of spindle. Upper half of wheel guard used with nozzle is furnished with the machine.

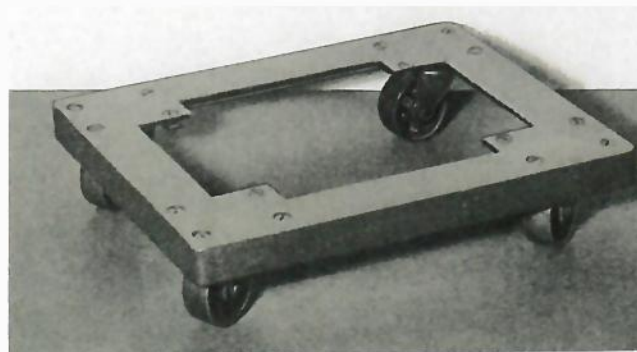


Castered Base for Use with Wet Grinding and Exhaust Attachments

STURDILY constructed of heavy steel and equipped with four 3" ball bearing swiveled casters, this base or dolly provides a ready means of moving the coolant tank, or separator tank, to other machines or to a convenient place for emptying and cleaning.

Measuring 19 $\frac{1}{2}$ " long, 15 $\frac{1}{2}$ " wide and 3 $\frac{1}{2}$ " high, it fits well into the corners formed by the feet of the tank and raises the feet $\frac{1}{4}$ " from the floor, permitting free movement without interference.

Weights (approx.): net, 22 lbs.; shipping, 25 lbs. Dimensions for shipment, 24" x 17" x 5".



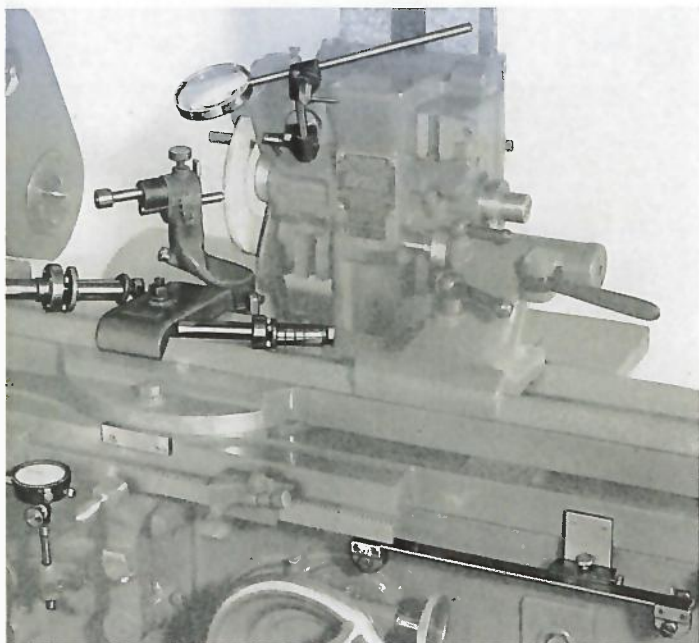
Circular Forming Tool Grinding Equipment

WHILE designed primarily for grinding screw machine circular forming tools, this equipment can be readily used in producing radial and angular forms on the periphery of cylindrical or tapered pieces, and by the addition of equipment for surface grinding, may be quickly adapted to the grinding of flat tools such as dovetail tools and flat skiving tools. The various parts can be readily applied to the machine, and are furnished either as separate units or as a complete equipment.

Unusually accurate settings, both angular and linear, are provided by the Attachment through (1) a dial indicator for short longitudinal adjustments of the table (used with the holding bracket and stop furnished on the machine); (2) a 12" scale to the right of the cross feed handwheel and a vernier secured to the sliding table, by which longitudinal readings beyond the capacity of the dial test indicator may be taken to .001"; (3) an angular vernier for the swivel table, by which the work may be set accurately to 5 minutes of arc; and (4) a similar vernier for angular adjustment of the spindle slide upright. Provided in addition to these are: two grinding wheels particularly suited for fine form grinding; a reading glass for easy viewing of the work; a radius truing device for forming the grinding wheels; a book of operating instructions; and two floating arbors with precision-ground spacing collars for accurate truing-up and grinding of the work.

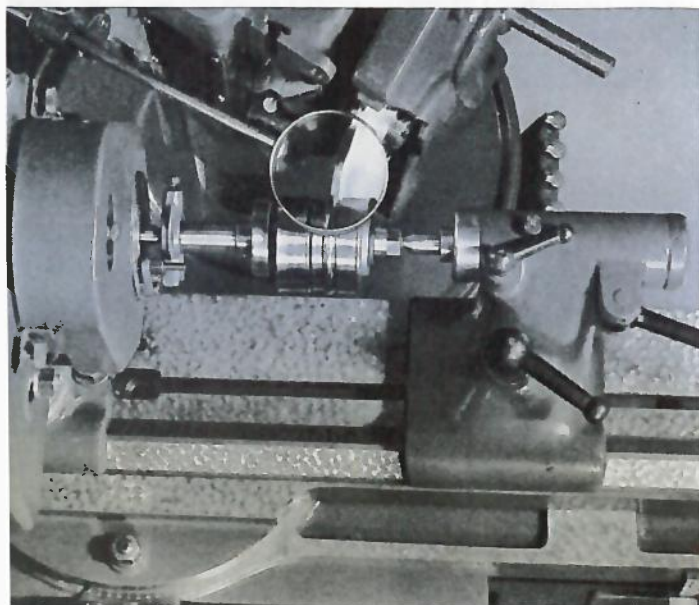
The dial indicator is admirably suited to grinding machine use, having dust guards to protect it from grit, and being graduated to half-thousandths of an inch with lines sufficiently wide-spaced to facilitate accurate estimation of even smaller fractions of thousandths. The verniers are machine-graduated, not etched, and consequently are highly accurate and easy to read. The reading glass, with an adjustable support to hold it in the desired position, enables the operator to view more closely the wheel and work during operations.

Below — Vernier for precise angular settings of swiveling upright.



Above — Circular Forming Tool Grinding Equipment installed on machine. This Equipment permits screw machine forming tools and similar work to be readily ground to form with dependable precision.

Below — Close-up of a typical forming tool grinding job as seen from the operator's position.



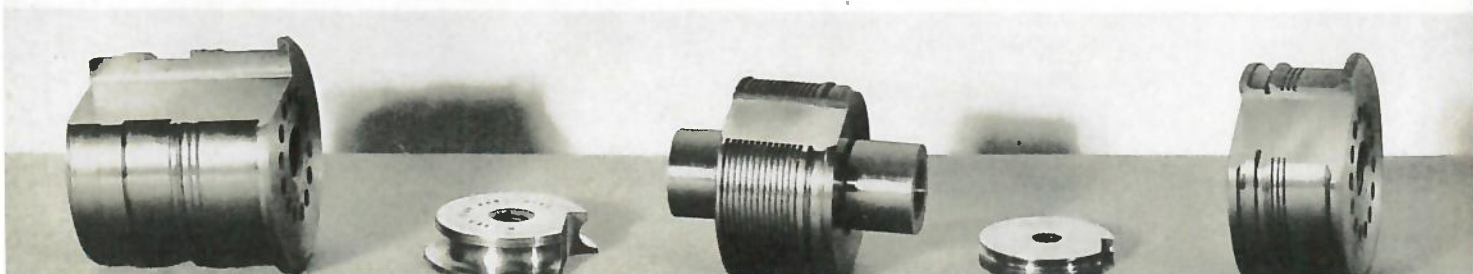
The complete equipment includes the following units. They can be furnished separately if desired.

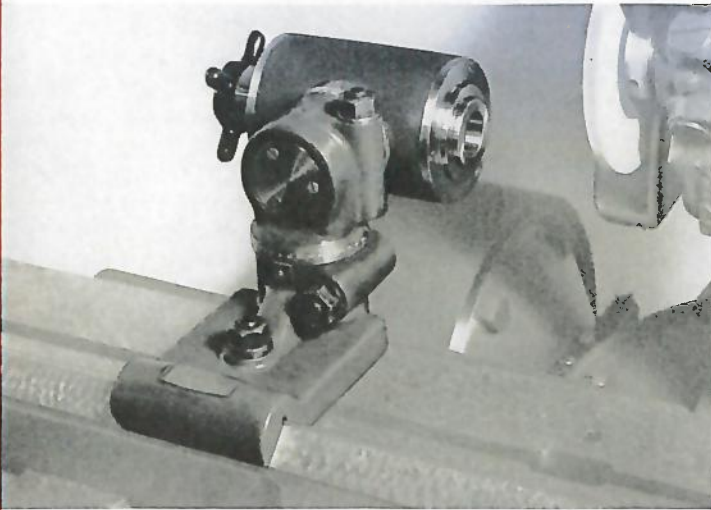
Floating Arbor (For Nos. 00 and 0 Auto. Screw Machine Tools)
Floating Arbor (For Nos. 2, 4 and 6 Auto. Screw Machine Tools)
Two Grinding Wheels (Suitable for Form Grinding)
Radius Truing Device for Grinding Wheels
Diamond (mounted) for Radius Truing Device

Table Travel Dial Indicator

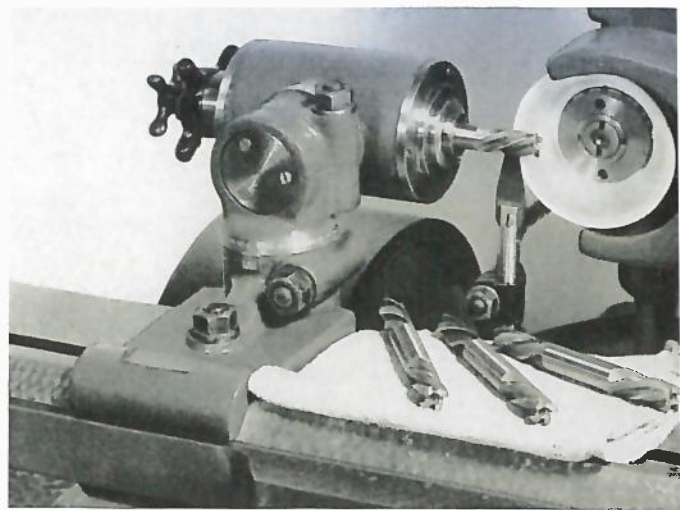
Booklet of Operating Instructions
Table Travel Scale and Vernier
Upright Vernier
Swivel Table Vernier
Reading Glass

Below — Typical outlines ground with the Circular Forming Tool Grinding Equipment.





Above—Attachment is clamped in position by T-bolt, with base aligned by inverted V of machine table. Angular adjustments provide for sharpening both peripheral and end teeth.



Above—Double-end end mills are quickly and easily ground on this Attachment. A spring collet and draw-in bolt are used to hold this type of cutter in the Attachment spindle.

No. 13 End Mill Sharpening Attachment

DESIGNED for sharpening both the peripheral and end teeth of end mills, this Attachment is of particular value in sharpening the peripheral teeth of steep spiral end mills having straight or taper shanks. For the latter work, a knob at the rear end of the Attachment spindle makes it an easy matter to hold the tooth being ground in contact with the tooth rest while feeding the cutter across the wheel by longitudinal table movement; and mounting of the spindle on antifriction bearings provides a sensitive, free-turning unit that is of especial advantage when sharpening very small end mills having a steep spiral.

The Attachment spindle is carried in a body that can be set at an angle in both a horizontal and vertical plane, with rigid clamping provided for both adjustments. Graduations to 2° provide for angular settings to 16° either

side of zero in the vertical plane, and to 90° either side of zero in the horizontal plane, the base itself being aligned by the scraped inverted V of the table top. Zero marks 180° apart on the spindle body provide for sharpening both right-hand and left-hand cutters.

End mills having a No. 9 B & S taper shank will fit directly into the Attachment spindle; while cutters having shanks of other B & S tapers, as well as cutters with Milling Machine Standard taper shanks and straight shanks, are accommodated by stock collets and adapters regularly available at extra cost (see listing below). A draw-in bolt can be furnished at extra cost for use with spring collets for holding straight shank end mills.

Weights (approx.): net, 18 lbs.; shipping, 24 lbs. Dimensions for shipment, 12" x 10" x 9".

Adapters and Collets Most Commonly Needed for use with

No. 13 End Mill Sharpening Attachment

Cutter Adapters

No. 9 B & S-10-2—For end mills having No. 10 M. M. Std. taper shank.

No. 9 B & S-20-2—For end mills having No. 20 M. M. Std. taper shank.

No. 9 B & S-30-2—For end mills having No. 30 M. M. Std. taper shank.

These Cam Lock Cutter Adapters have No. 9 B & S taper shank, fitting the Attachment spindle.

Spring Collets with Straight Holes

Designed to accommodate straight shank end mills, these Spring Collets have a straight hole and a No. 9 B & S outside taper fitting the Attachment spindle. Spring collets are regularly available with holes of the following sizes (in inches):

Diam.	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$ *
Depth	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$

Special draw-in bolt, required for use with these Spring Collets, is available as an extra.

* $\frac{3}{4}$ " size accommodates single-end end mills only.

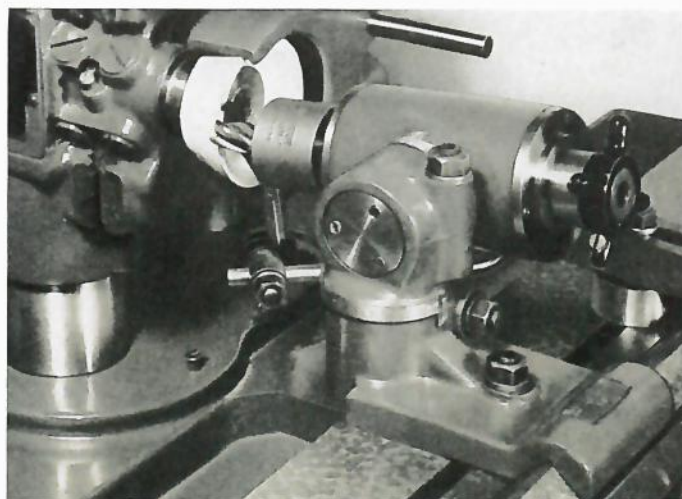
Collets

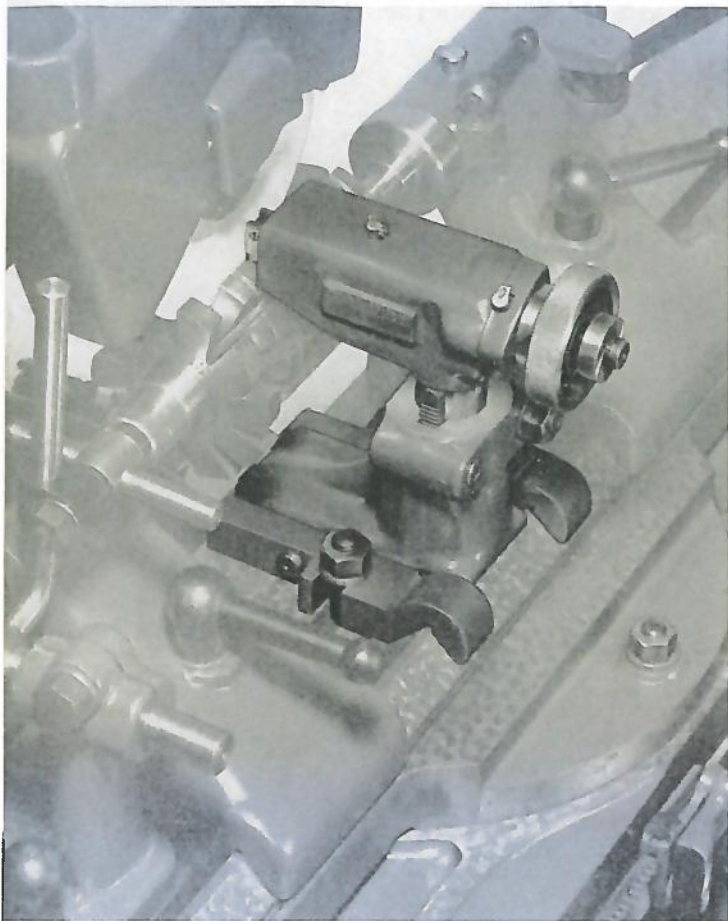
Mark K—For end mills having No. 5 B & S taper shank.

Mark RR—For end mills having No. 7 B & S taper shank.

These Collets have No. 9 B & S outside taper, fitting the Attachment spindle. Hole provided for knockout key.

Below—Sharpening end teeth of a right-hand spiral Cam Lock end mill having Milling Machine Standard taper shank. Cutter is held in regular Cam Lock adapter (see listing at left).





Above—The tooth rest assembly is adjustable vertically for cutter diameter, and transversely to grind tooth radial or with hook or drag. The tooth rest itself is of latch construction. The operator quickly indexes the cutter with one hand and traverses the table with the other, making for maximum speed of operation.

No. 13 Formed Cutter Sharpening Attachment

Through-Feed Type

THIS Attachment gives a straight cut across the entire tooth face, and provides for the efficient and accurate sharpening of formed cutters up to 6" in diameter with straight teeth. A dish wheel is used, with the wheel spindle at right angles to the table; and the cutter is supported on a horizontal arbor between the centers of the machine as illustrated, and is passed across the face of the wheel by traversing the table.

The Attachment consists of a rigid, adjustable tooth rest assembly mounted at the top of a sturdy column which is adjustable vertically to accommodate cutters up to 6" in diameter. A rack and pinion provide easy, positive adjustment, and the rack serves as a key to maintain angular alignment. The supporting bracket which carries the column is adjustable transversely along dovetail ways in a solid base; and the base, in turn, is accurately aligned by the scraped inverted V of the table top.

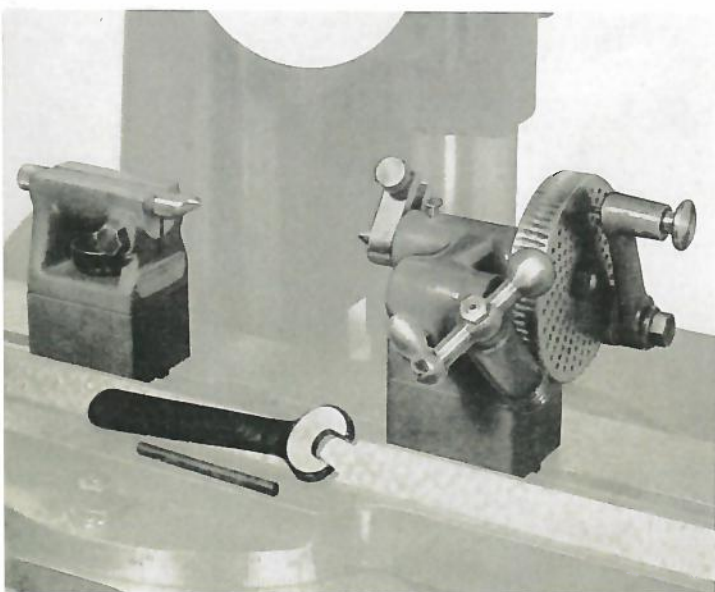
In operation, the tooth rest is located so as to touch the top of the cutter tooth close to the face being ground. The transverse adjustment of the Attachment on its base allows the tooth rest to be positioned for grinding the tooth radial or with hook or drag, while at the same time keeping the tooth rest close to its supporting body for maximum rigidity.

A knurled nut at the upper front of the Attachment advances the tooth rest slightly in order to rotate the cutter toward the grinding wheel to remove more stock. Another nut, concentric with the first one, serves as a positive stop to determine the end of this movement, facilitating the grinding of duplicate cutters to uniform size.

A wheel spindle extension for the left-hand end of the grinding machine spindle is regularly included with each Formed Cutter Sharpening Attachment. This item may be omitted when either the Surface Grinding Attachment for our No. 13 Universal and Tool Grinding Machine or the Indexing Equipment for our No. 10 Cutter and Tool Grinding Machine* is at hand, using the spindle extension furnished with either of these Attachments instead.

Weights (approx.), Attachment complete: net, 13 lbs.; shipping, 22 lbs. Dimensions for shipment, 12" x 10" x 8".

*A different wheel spindle nut and spindle clamp nut are required when the extension furnished with this Indexing Equipment is used.



Index Centers

THESE are our regular 4 $\frac{3}{4}$ " Index Centers furnished with raising blocks which adapt them for use with this machine.* They are convenient when grinding taps, reamers, formed cutters and work of a similar nature.

Indexing is rapid and accurate. A spring-loaded locking pin (see illustration) and six rows of holes in the face of the combined index plate and worm wheel provide for indexing all divisions from 2 to 14, and all even numbers from 18 to 28. The worm wheel can be turned by worm, or the worm can be thrown out of mesh and the wheel turned by hand. Ratio of worm to worm wheel, 75:1.

Centers swing 8" diameter. Combined base length with centers together, 8 $\frac{1}{2}$ ".

Weights (approx.): net, 16 lbs.; shipping, 24 lbs. Dimensions for shipment, 13" x 9" x 7".

*Raising Blocks can be furnished separately.

No. 13 Formed Cutter Sharpening Attachment

In-Feed Type

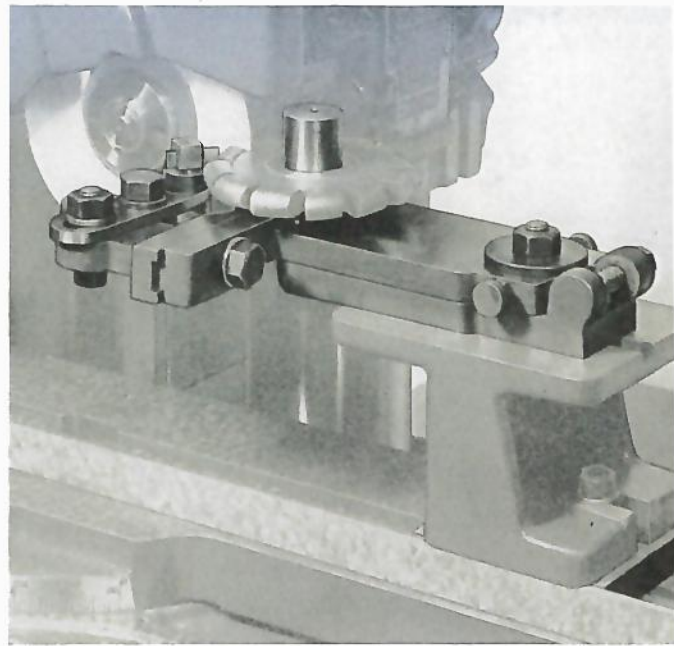
FORMED cutters 2" to 6½" in diameter with straight teeth may be sharpened rapidly and accurately with this Attachment. The cutter, held as shown, is fed into the dish wheel by table feed; and the arc of metal left by the circumference of the 6"-diameter wheel generally limits the tooth width to 1½".

Essentially, the Attachment consists of an adjustable tooth rest assembly and a body for supporting the cutter, mounted on a base plate which is tongued for alignment and bolted to the top of the tool rest regularly furnished with the machine. The upper part or body turns on a pivot extending through the base plate; and the cutter is placed on a vertical arbor which is inserted in a hole concentric with the pivot. The tooth rest assembly is carried by a bracket at the left end of the Attachment body, the tooth rest itself being adjustable vertically as well as for cutter diameter.

In operation, the tooth rest is located so as to touch the top of the cutter tooth close to the face being ground, and is clamped very rigidly in position. The bracket which carries the tooth rest assembly is adjustable transversely on the Attachment body, allowing the tooth rest to be positioned for grinding the tooth radial or with hook or drag, yet at the same time maintaining rigid support for the tooth rest. The operator quickly indexes the cutter with one hand and feeds the table with the other, making for maximum speed of operation.

A knurled thumbscrew at the front turns the Attachment body on its pivot in order to rotate the cutter toward the grinding wheel to remove more stock. A similar thumbscrew at the rear serves as a positive stop to determine the end of this movement, facilitating the grinding of duplicate cutters to uniform size.

A wheel spindle extension for the left-hand end of the grinding machine spindle is regularly included with each



Formed Cutter Sharpening Attachment. This item may be omitted when either the Surface Grinding Attachment for our No. 13 Universal and Tool Grinding Machine or the Indexing Equipment for our No. 10 Cutter and Tool Grinding Machine* is at hand, using the spindle extension furnished with either of these Attachments instead. The Attachment also includes a raising block for the tool rest, and three cutter arbors to take cutters with ⅝", 1" and 1½" hole.

Weights (approx.), Attachment complete: net, 10 lbs.; shipping, 14 lbs. Dimensions for shipment, 14" x 8" x 6".

*A different wheel spindle nut and spindle clamp nut are required when the extension furnished with this Indexing Equipment is used.

Radius Grinding Attachment

THIS Attachment is designed for grinding convex cutter teeth up to 4½" radius, concave cutter teeth up to 2" radius, convex and concave outlines on the corners of teeth, and similar operations.

The work slide has a crosswise adjustment on the work slide base, which in turn has a lengthwise adjustment on the swivel. The swivel turns on a stud in the swivel base.

A diamond mounted in a detachable bracket at the front of the work slide is used to dress the wheel to the outline to be ground (either convex or concave), the work slide base being set by the scale on the swivel, graduated to 64ths of an inch.

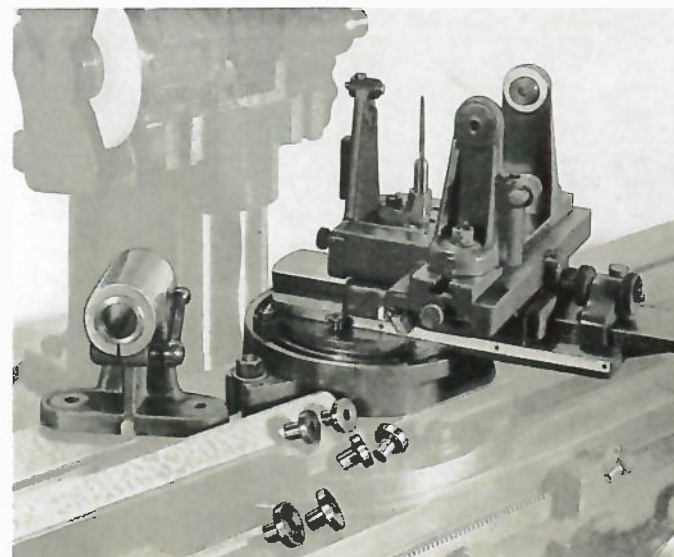
A hole-type cutter is mounted on two bushings in the work holders, and the work slide and work slide base are adjusted until the cutting edge of a tooth contacts the wheel at all points as the swivel is turned. Adjustable swivel stops are provided. A spring washer holds the cutter steady on the bushings while grinding, yet allows indexing. When grinding, the cutter is fed into the wheel by turning a knurled screw which moves the work slide base.

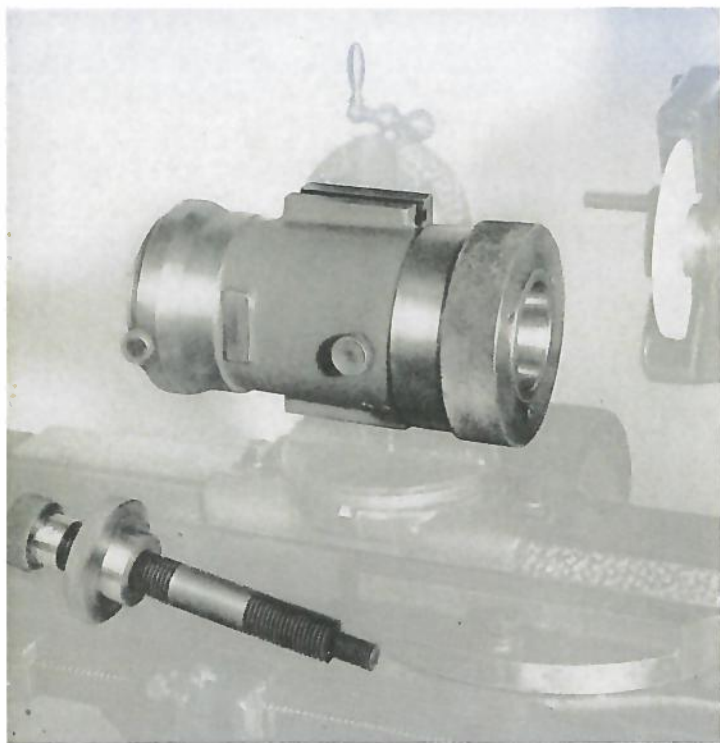
The taper shank holder is used instead of the work holders when corners of teeth of cutters with taper shanks are to be ground to a radius. The bushing in the holder has a No. 10 B & S taper hole. The holder is offset either side of the Attachment center an amount equal to the distance from the radius center to the cutter axis, by means of the scale on the back of the work slide, graduated to

64ths of an inch. The maximum distance the holder can be offset either side is 2".

The work holders take cutters up to 5" in length, and both the taper shank holder and the work holders take cutters up to 8" in diameter. Included in the equipment are 8 bushings, 2 each for ⅝", 1", 1½" and 1¾" cutter holes, and the diamond (mounted).

Weights (approx.): net, 65 lbs.; shipping, 80 lbs. Dimensions for shipment, 20" x 12" x 7".





Above — The Taper Holding Attachment in position. No. 12 B & S and No. 50 M. M. Std. taper holes are provided, one in each end, so that a wide variety of cutters may be held for grinding. The draw-in bolt shown is regularly furnished with the Attachment.

Taper Holding Attachment

USED on the universal head in place of the swivel head, the Taper Holding Attachment holds all varieties of cutters up to 8" diameter, with taper shanks or on arbors. It is particularly suited for sharpening shell end mills up to 6" diameter and face milling cutters up to 8" diameter.

To provide for clearance on end or side teeth when grinding with a cup wheel, the swivel face of the Attachment, by which it is mounted on the universal head upright, is graduated on its circumference in degrees to 30° each side of two opposed zero marks. Clearance on peripheral teeth is set by means of an integral clearance gage located at the left end of the Attachment spindle, which reads to 15° each side of zero by degrees.

The Attachment spindle is mounted in ball bearings and can be clamped by means of a thumbscrew. It has a No. 12 B & S taper hole in one end and a No. 50 Milling Machine Standard taper hole in the other, and may be turned end for end, thus suiting the Attachment for a wide range of work.

A draw-in bolt is furnished; threaded, 1"-8-N.C., r.h. and $\frac{3}{8}$ "-11-N.C., r.h. Arbors, collets and adapters listed in our catalogs are available at extra cost for handling a variety of styles and sizes of cutters.

Weights (approx.): net, 45 lbs.; shipping, 62 lbs. Dimensions for shipment, 8" x 8" x 16".

No. 13 Face Mill Sharpening Attachment

THIS Attachment is designed primarily for grinding the periphery, sides and corners of teeth of face milling cutters up to 18 $\frac{1}{2}$ " diameter. Its sturdy construction assures

the rigidity necessary to support the heavier cutters.

The spindle, mounted in antifriction bearings, is exceptionally free-moving and accurate, and may be clamped by means of a thumbscrew. A No. 12 B & S taper hole is provided in one end and a No. 50 Milling Machine Standard taper hole in the other, thus suiting the Attachment for a wide range of work.

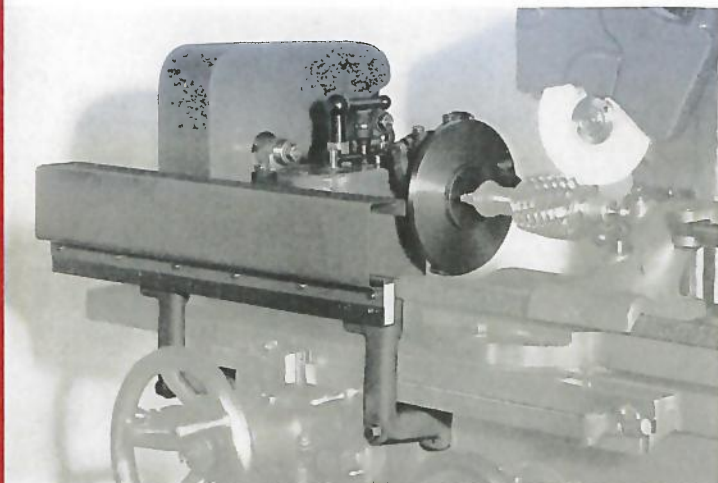
To provide for clearance on side teeth when grinding with a cup wheel, the spindle body has an angular adjustment in a vertical plane to 15° each side of zero, by scales reading to degrees. Clearance on peripheral teeth is set by means of an integral clearance gage (shown at left end of Attachment spindle), graduated in degrees to 15° each side of zero.

The spindle body and swivel bracket are mounted on a substantial base which is aligned by the inverted V of the table. Graduations in degrees on the circumference of the swivel bracket to 90° each side of two opposed zero marks permit setting to any angle in the horizontal plane.

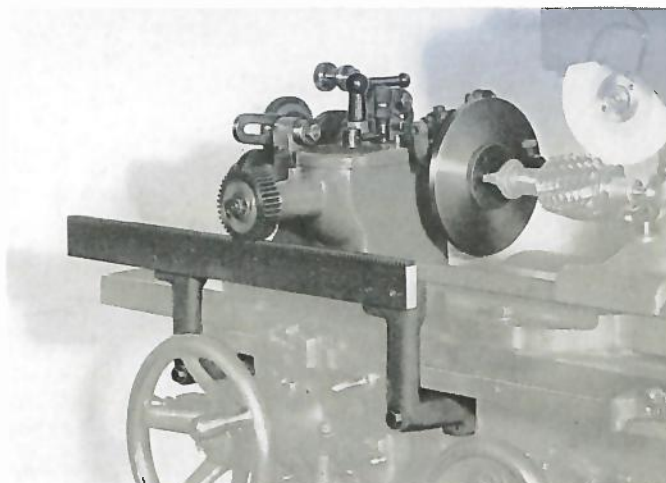
Included in the equipment furnished are a work holding arbor (No. 50 Milling Machine Standard taper), a draw-in bolt (threaded, 1"-8-N.C., r.h. and $\frac{3}{8}$ "-11-N.C., r.h.), four cutter holding screws and an arbor screw and wrench. Additional arbors, collets and adapters listed in our catalogs are available at extra cost for handling a variety of styles and sizes of cutters.

Weights (approx.): net, 88 lbs.; shipping, 112 lbs. Dimensions for shipment, 19" x 17" x 11".





Above — Hob Sharpening Attachment complete.



Above — Attachment with guards removed.

Hob Sharpening Attachment

IT is only by precise mechanical means that a spiral-grooved hob can be accurately sharpened so that the correct lead of the grooves will be preserved and the teeth ground radial and equidistant. Equipped with the Hob Sharpening Attachment, the No. 13 Universal and Tool Grinding Machine is well adapted for sharpening right-hand, left-hand and straight-grooved hobs up to 8" diameter and 12" length. With the gears furnished, the Attachment accommodates spiral-grooved hobs with leads from a recommended minimum of 4.019" to the maximum of 383.93".

The Attachment consists of a spindle driven through a combination of change gears by means of a small pinion, the teeth of which mesh with those of a fixed rack fastened to the bed of the machine, as shown in the illustration above at right. When the table is moved longitudinally, the driving pinion revolves, causing the spindle to turn in such a ratio to the table movement that the correct lead of the grooves is maintained and each tooth is ground an equal amount. When the table is reversed, the hob is brought back to the starting position, the spindle turning in the opposite direction. A selective lever provides for the proper direction of spindle rotation when grinding hobs with right-hand or left-hand spiral grooves. For

grinding straight-grooved hobs, a change gear is removed and the spindle clamped.

The work is driven by an index plate, which is mounted on but not fastened to the spindle. The work driving dog is clamped to the index plate, which in turn is driven by means of a spring-loaded index pin carried on an adjustable arm which is fastened to the spindle. Holes in the two index plates furnished provide for sharpening hobs of from 2 to 20 grooves.

Grinding wheels of the dish type are used with this Attachment. The wheel is mounted on a special spindle extension which is furnished with the Attachment, and after being set to grind the face of the teeth radial, its position is not changed. Adjustment for stock removal is made by means of a knurled nut which rotates the index pin and plate with relation to the Attachment spindle, thereby advancing the hob tooth toward the grinding wheel.

The equipment furnished includes one right-hand and one left-hand wheel spindle extension, two index plates, change gears, and a table of gears and spirals.

Weights (approx.): net, 115 lbs.; shipping, 160 lbs. Dimensions for shipment, 34" x 18" x 11".

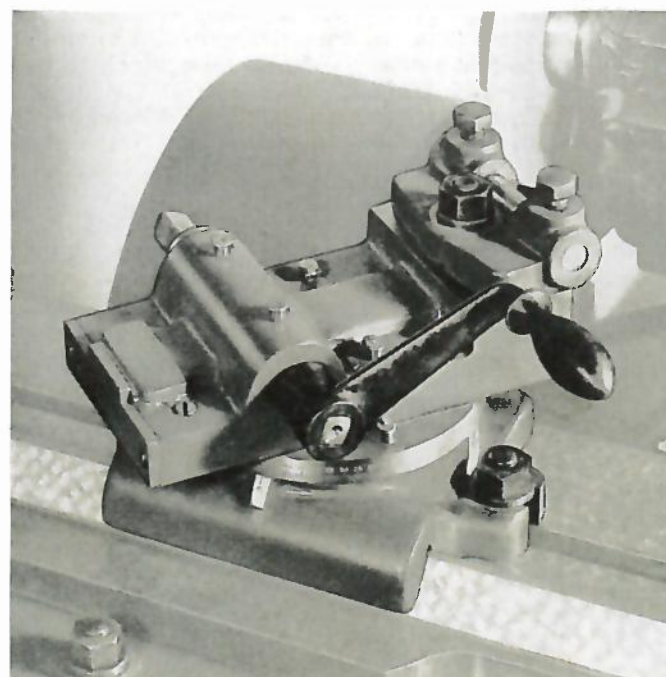
Angle Wheel Truing Attachment

PARTICULARLY useful on work that requires the grinding wheel to be frequently redressed at the same angle, this Attachment provides an accurate and simple means of forming the wheel to any angle or combination of angles and will duplicate the dressing quickly and accurately when needed during the job.

The swivel can be turned to any angle and the setting read from either of two zero marks on the base, the scale being graduated in degrees to 45° each side of four zeros which are 90° apart. The swivel is clamped in position by a screw, and carries the slide, which has a longitudinal movement of 1½" by crank from either side. The bracket on the end of the slide can be swiveled and carries the diamond tool holder with the diamond end at either side. Diamond is not furnished.*

Weights (approx.): net, 25 lbs.; shipping, 33 lbs. Dimensions for shipment, 6" x 7" x 13".

*Diamond (mounted) can be furnished at extra cost.



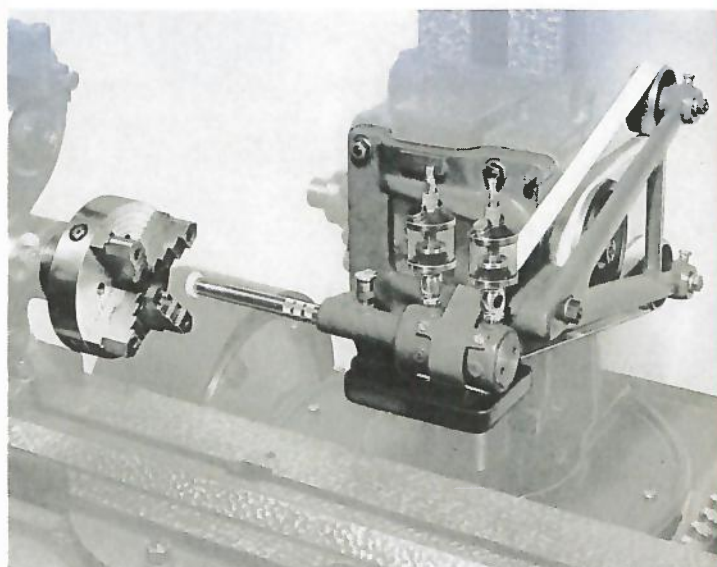
Additional Equipment, Cont'd.

Internal Grinding Attachment

THIS Attachment includes a knee which is fastened to the front of the wheel slide by four bolts. The knee carries a belt-tightener arm provided with two idler pulleys, and a regular Brown & Sharpe internal grinding fixture such as is listed and stocked for Brown & Sharpe Universal Grinding Machines. The internal grinding fixture spindle is driven by an endless canvas belt from a pulley on the machine spindle as shown at right.

The spindle of the fixture is of comparatively small diameter, and is supported at the outer end by an adjustable bronze bearing carried by a pair of telescopic tubes of sufficiently large diameter to give the required rigidity. The outer bearing supports the spindle close to the grinding wheel, and is adjustable for wear simply by loosening a clamp screw and screwing the outer telescopic tube onto the inner one. The spindle pulley runs on two ball bearings which take the pull of the belt, reduce friction to a minimum, and prolong the life of the fixture. Provision is made for excluding dust from all bearings.

Equipment furnished includes an Internal Grinding Fixture* (see table below); 4" 4-jawed chuck, jaws inde-



pendent and reversible; and two grinding wheels.

Weights (approx.): net, 55 lbs.; shipping, 72 lbs.
Dimensions for shipment, 20" x 12" x 10".

Internal Grinding Fixtures

No. of Fixture	Distance from Bottom of Stand to Center of Spindle, Inches	Length that can be Ground, Inches	Minimum Diameter of Hole that can be Ground, Inches	Diameter of Hole in Wheel, Inches	Speed, Revolutions per Minute
†01	3	1½	¼	¾	22500
02	3	3¾	½	1	18000
*03	3	5½	¾	1	15700
04	3	6	1¼	1½	15000

*No. 03 Fixture furnished unless otherwise specified.

†To permit grinding smaller holes, the No. 01 Fixture differs in design from the others and is provided with three wheels and wheel arbors of various lengths.

Magnetic Chucks

THE Nos. 510 and 618 Rectangular Model Magnetic Chucks (Permanent Magnet Type)* provide a quick, easy means of holding a variety of ferrous work for surface grinding, and for bench work and inspection purposes as well. The chuck uses no electric current; hence wiring, switches, generators etc. are not required. The special-alloy permanent magnets maintain their strong holding power indefinitely, and the chuck can be left "on" as long as desired without heating. Amount of holding power is controlled by the lever shown. Auxiliary top plates

are available to permit holding smaller work than can usually be held on a magnetic chuck.

Illustration shows a No. 618 Chuck mounted on the table plate of the Surface Grinding Attachment (described on page 20).

No.	Working Surface, Inches	Magnetic Surface (Approx.), Inches	Net Weight, Lbs. (Approx.)	Height of Chuck, Inches	Shipping Weight, Lbs. (Approx.)
510	5½ x 10½	3½ x 7½	41	3½	50
618	6½ x 18½	4½ x 14½	87	3½	104

Magnetic Chuck Table Plate, taking chucks from 5" x 10" to 6" x 18" capacity, can be furnished at extra cost for use with magnetic chucks only. The top of the plate is ¾" above the top of the machine table, clearing the inverted V of the table top; and the front edge is beveled to fit against the V. Weights (approx.): net, 24 lbs.; shipping, 30 lbs.

Electromagnetic Chucks and controlling equipment are also available. Information on application.

Magnetic Chuck Generator, for use with electromagnetic chuck, is also available. Information on application.

*Brown & Sharpe Magnetic Chucks of the Permanent Magnet Type are for sale only in the United States of America, its Territories and Canada.



Internal Grinding Attachment Ball Bearing Type

RAPID and accurate stock removal during the course of an unusually long life is assured by the design of this sturdy Internal Grinding Attachment.

The tapered, removable-unit-type spindle unit is carried in a sturdy body casting, supported by a knee which is bolted to the front of the wheel slide. The spindle is mounted on two double-row, self-aligning ball bearings, preloaded to compensate for any expansion due to heating, and is driven smoothly at 27,000 r.p.m. by an endless canvas belt from a pulley on the machine spindle, as illustrated at right. Lubricating oil is filtered before it reaches the bearings, and after it has passed it is caught in a tray which can be removed and emptied. There is adequate protection against oil leakage and dust.

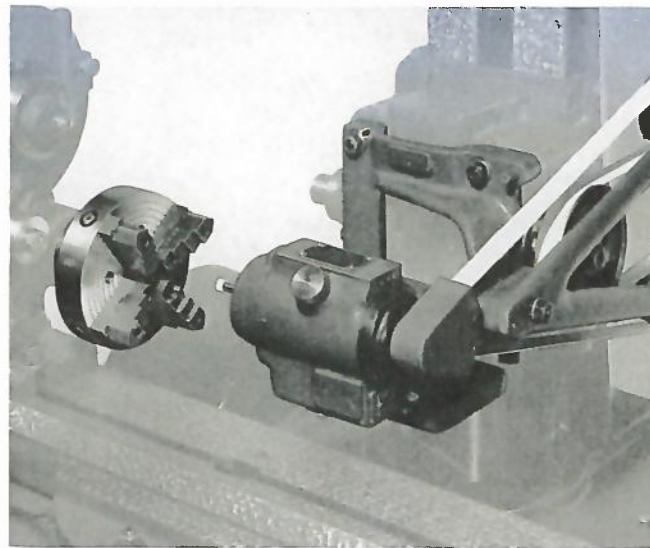
Except for the wheel spindle pulley, the equipment used for driving the spindle and supporting the spindle body is the same as that furnished with the Internal Grinding Attachment described on the preceding page.

Wheel arbors and grinding wheels are furnished at extra cost, stock sizes being listed at right. The arbors are interchangeable, and each is seated by a taper and held in the spindle by its threaded end. The exacting limits and fine finish demanded of this equipment require extreme accuracy in the taper fit between spindle and wheel arbor; therefore, we strongly recommend that all wheel arbors, both stock and special, be furnished by us to assure the utmost in precision and finish.

Included in the equipment is a 4" 4-jawed chuck, with jaws independent and reversible.

Weights (approx.): net, 95 lbs.; shipping, 115 lbs. Dimensions for shipment, 24" x 12" x 10".

Spindle unit, body and wheel spindle pulley can be furnished separately as a unit without the rest of the Attachment.



Wheel Arbors and Grinding Wheels

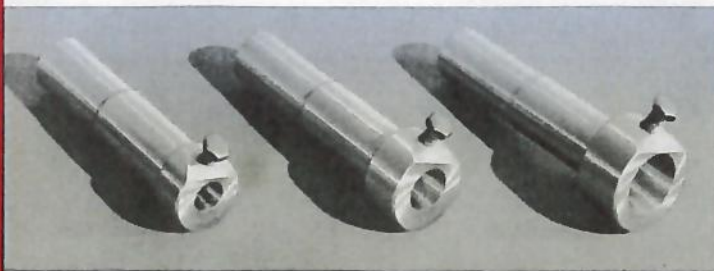
Furnished at extra cost
One Grinding Wheel furnished with each Wheel Arbor

Arbor Number	Length that can be Ground, Inches*	Min. Diam. of Hole that can be Ground, Inches	Grinding Wheels
			Size, Inches Diam. x Thick. x Hole
3003 3005	1 1½	¼	¾ x ¼ x ¾
3103 3105	1 1½	⅝	¾ x ¼ x ¾
3203 3205	1 1½	¾	¾ x ¼ x ¾
3303 3305	1½ 2	⅞	¾ x ¼ x ¾

*This dimension is from back face of wheel to shoulder on arbor.

Bushings

ALL varieties of cutters having Nos. 10, 20 or 30 M. M. Std. taper shanks are conveniently held by means of these bushings for sharpening in the universal head of the machine. Their precision-ground taper hole and outside diameters assure accurate alignment of the work and smooth rotation for indexing. Each bushing is available separately.

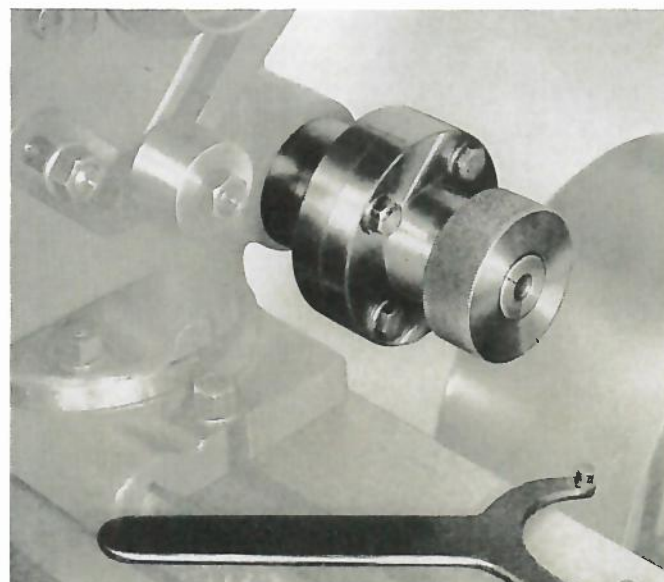


No. 350 Spring Chuck

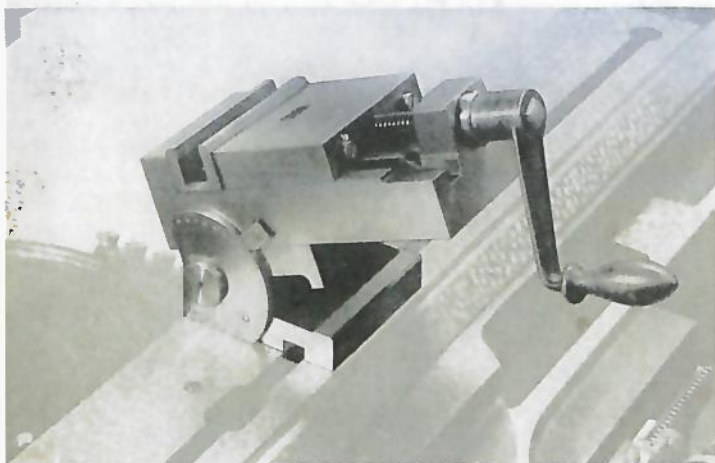
THE Spring Chuck provides for holding bushings, long thin rods, valve needles and similar parts by means of a collet, with the work pieces extending through the headstock spindle of the machine.

The left-hand member is threaded to fit the headstock spindle, and is tightened in position with the pin wrench furnished. The right-hand member, which carries a No. 11G Spring Collet, is adjustable with relation to the left-hand member so that work can be accurately centered. The collet is held in place and closed concentrically by the knurled nut. Spring Collet (shown in illustration) is not included with the Chuck.

No. 11G Spring Collets can be furnished at extra cost. Round, ⅛" to ⅜" by 64ths; ½" to ⅝" by 32nds; ⅞", ¾" and 1⅜".



Additional Equipment, Cont'd.



No. 1 Adjustable Vise

THIS vise has tongues for aligning on either the machine table or the tool rest furnished with the machine. Thus, it may be used with the jaws either parallel with, or at right angles to the table T-slot. The vise proper is mounted on a hinged base and can be set and clamped at any angle in the vertical plane up to 90°, a dial graduated to degrees indicating the setting.

The removable jaws are of tool steel, hardened and ground, 4 $\frac{1}{8}$ " wide and 1 $\frac{1}{8}$ " deep, and open 2". Distance from bottom of base to top of jaws with vise horizontal is 4 $\frac{7}{8}$ ".

Weights (approx.): net, 23 lbs.; shipping, 27 lbs.
Dimensions for shipment, 13" x 7" x 6".

Surface Grinding Attachment

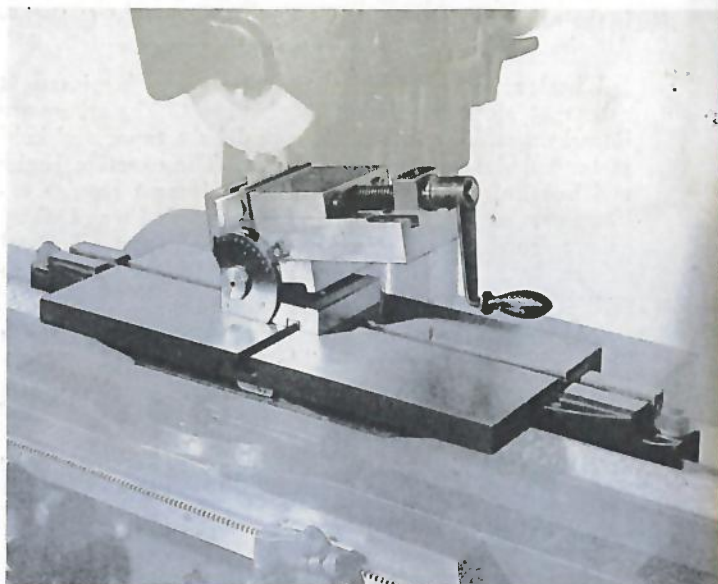
ADAPTABLE to all varieties of surface grinding consistent with the nature of the machine, this Attachment includes a No. 1 Adjustable Vise, a large table plate and a wheel spindle extension.

The vise is mounted on a hinged base and can be set and clamped at any angle in the vertical plane to 90°, a dial graduated to degrees indicating the settings. The removable jaws are of tool steel, hardened and ground, 4 $\frac{1}{8}$ " wide and 1 $\frac{1}{8}$ " deep, and open 2". Distance from bottom of base to top of jaws with vise horizontal is 4 $\frac{7}{8}$ ".

The table plate has a working surface 18 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ ", which is 1 $\frac{3}{4}$ " above the machine table when the plate is in position. Two T-slots, $\frac{1}{2}$ " wide, are cut at right angles in the working surface, as shown. (This table plate can also be used for mounting magnetic chucks to 6" x 18" capacity.)

The wheel spindle extension is supported in a self-aligning phosphor bronze bearing which is carried in a bracket that bolts to the wheel spindle slide, and allows the wheel to be used over the entire surface of the table plate.

Weights (approx.): net, 68 lbs.; shipping, 80 lbs.
Dimensions for shipment, 24" x 9" x 9".



Equipment Cabinet

THIS cabinet is conveniently arranged to hold the standard equipment of the machine, and some of the Additional Equipment, in as little space as is practicable. Sturdily constructed of metal throughout except for the wooden brackets and pins for supporting the equipment, it is finished all over in machine tool gray and is practically fireproof. Durable chromium-plated handles are provided on each door, and a 3-way lock gives adequate protection when desired. The cabinet is 48" high and requires a floor space 42" x 15".

Weights (approx.): net, 165 lbs.; shipping, 240 lbs. Dimensions for shipment, 50" x 46" x 18".

