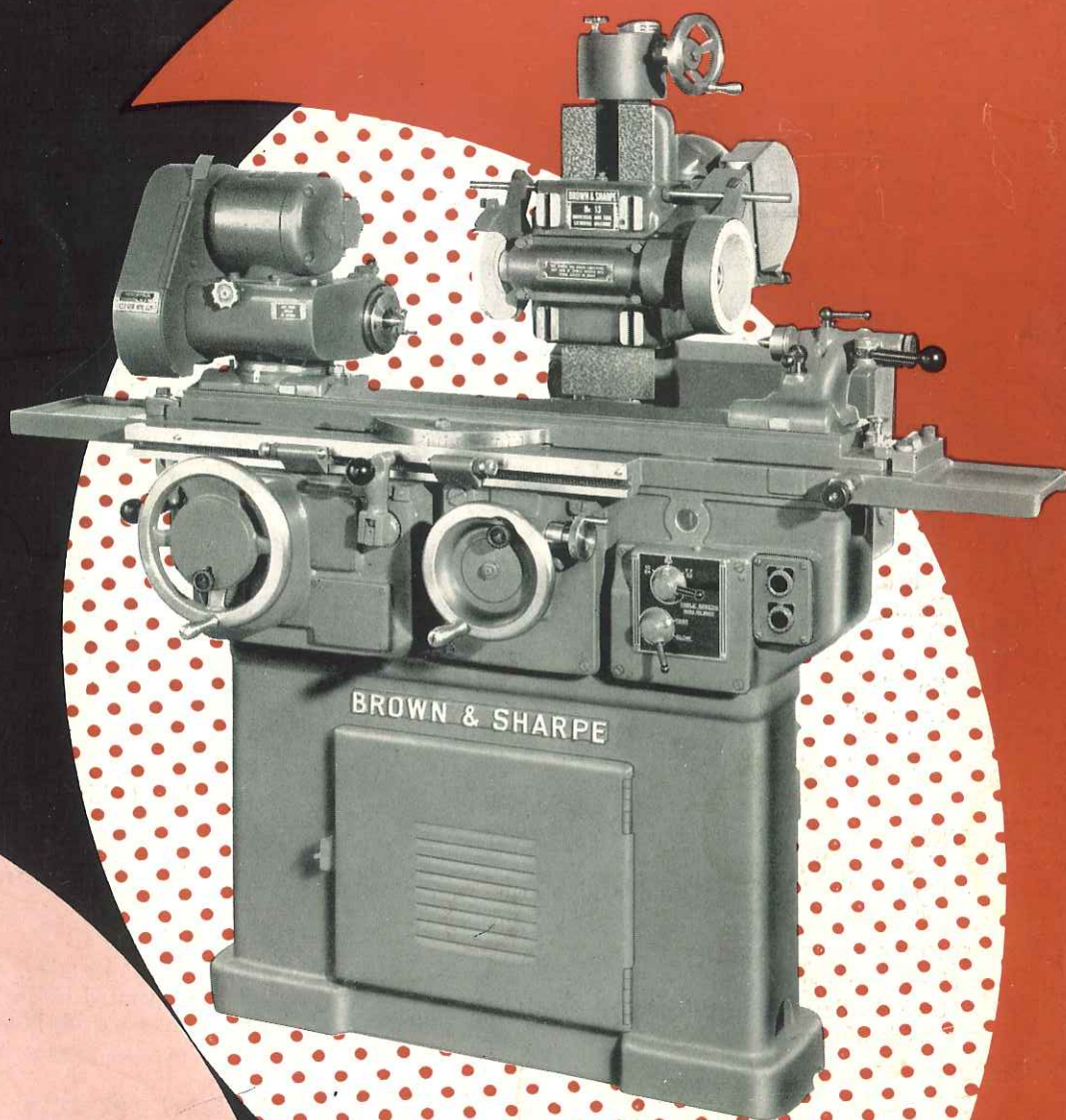




- *A General Purpose
Machine of Unusually
Broad Utility*



NO. **13**

**UNIVERSAL
AND
TOOL
GRINDING
MACHINE**

DARNALL MACHINERY CO.
315 E. Washington Blvd.
Los Angeles 15, Calif.
Richmond 7-0158



Brown & Sharpe

No. 13 Universal and Tool Grinding Machine

SPECIFICATIONS

CAPACITY

Centers swing, diameter.....	8"
Distance between centers; of headstock and footstock.....	24"
of centerhead and footstock.....	31"
Maximum longitudinal power table travel.....	22"
Maximum length of work that can be ground cylindrically.....	15"
Distance, center of work to center of wheel spindle.....	{Max. 12 $\frac{1}{2}$ " }Min. 2 $\frac{1}{4}$ "
Distance, center of wheel spindle to top of table.....	{Max. 12 $\frac{1}{8}$ " }Min. 3 $\frac{3}{4}$ "
Center rest takes work to, diameter.....	2"

SPINDLE

Removable unit type.	
Either antifriction-bearing or plain-bearing unit available as standard equipment.	
Both ends tapered to receive grinding wheel sleeves.	
Driven by V-belt from constant-speed totally enclosed motor.....	1 H.P.
Speeds.....	2730, 3600 and 5150 R.P.M.
Lubrication	
Antifriction-bearing unit.....	sealed
Plain-bearing unit.....	oil reservoir in housing

WHEEL SPINDLE SLIDE

Vertical adjustment.....	8 $\frac{3}{8}$ "
Operated by handwheel graduated to read to.....	0.0005"

SPINDLE SLIDE UPRIGHT

Transverse movement.....	10 $\frac{1}{4}$ "
Swivels. Base graduated in degrees to 110° each side of zero.	

SWIVEL TABLE

Width of T-slot.....	$\frac{1}{2}$ "
Swivels, permitting angular settings in either direction to.....	90°
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, pro- vides for accurate setting of table for tapers up to 3" per foot.	
Height, floor to top of table.....	39"

SLIDING TABLE

Traversed by hand or power.	
Power travel,	
number of changes.....	6
rates, inches per minute.....	7 $\frac{3}{4}$ ", 13", 24", 32", 54" and 100"
driven by motor on base.....	$\frac{1}{4}$ H.P.
Travel per revolution of handwheel.....	{slow, $\frac{1}{4}$ " }fast, 6 $\frac{1}{4}$ "
Table slides on one V and one flat way.	

CROSS FEED

Hand operated.	
Wide spaced graduations on handwheel read to 0.001" on work diameter.	
Small handwheel for fine feed reads to 0.0001" on work diameter.	

UNIVERSAL HEAD

Scale for vertical adjustment graduated in degrees to 90° each side of zero.	
Scale for horizontal adjustment graduated in degrees to 180° each side of zero.	
Has vertical adjustment of 4".	
Work up to 16" diameter will swing over table and with head at right angles to table, light work up to 24" diameter can be accommodated.	
Carries cutter bars, taper shank mill bushings and straddle and face mill arbor.	

HEADSTOCK

Adjustable along table.	
Swivels. Setting indicated in degrees by scale graduated to 100° each side of zero.	
Spindle mounted on preloaded precision bearings.	
Spindle nose threaded, 1 $\frac{1}{2}$ "-6-N.C., L.H., and has No. 7 B&S taper hole.	
Has both dead-center and revolving-spindle drive.	
Work speeds for both dead-center and revolving-spindle grinding (with 60-cycle A.C. motor).....	128, 195, 325 and 540 R.P.M.
Driven by motor on headstock assembly.....	$\frac{1}{8}$ H.P.
Convenient brake lever provides quick stopping.	

FOOTSTOCK

Adjustable along table.	
Spindle operated by spring lever.	
Clamp lever provided for locking spindle.	
Center has B&S taper number.....	7

ELECTRICAL CONTROLS

Conform with Machine Tool Electrical Standards.	
Push-button switch at front starts and stops wheel spindle motor and table motor, and energizes line to headstock motor switch.	
Motors protected by overload relays.	
Overload of any motor stops entire machine.	
Nonfusable disconnect switch, magnetic switches and overload relays mounted on panel in compartment on back of machine; protected by rubber-gasketed hinged cover.	
Distance, floor to bottom of compartment.....	24"

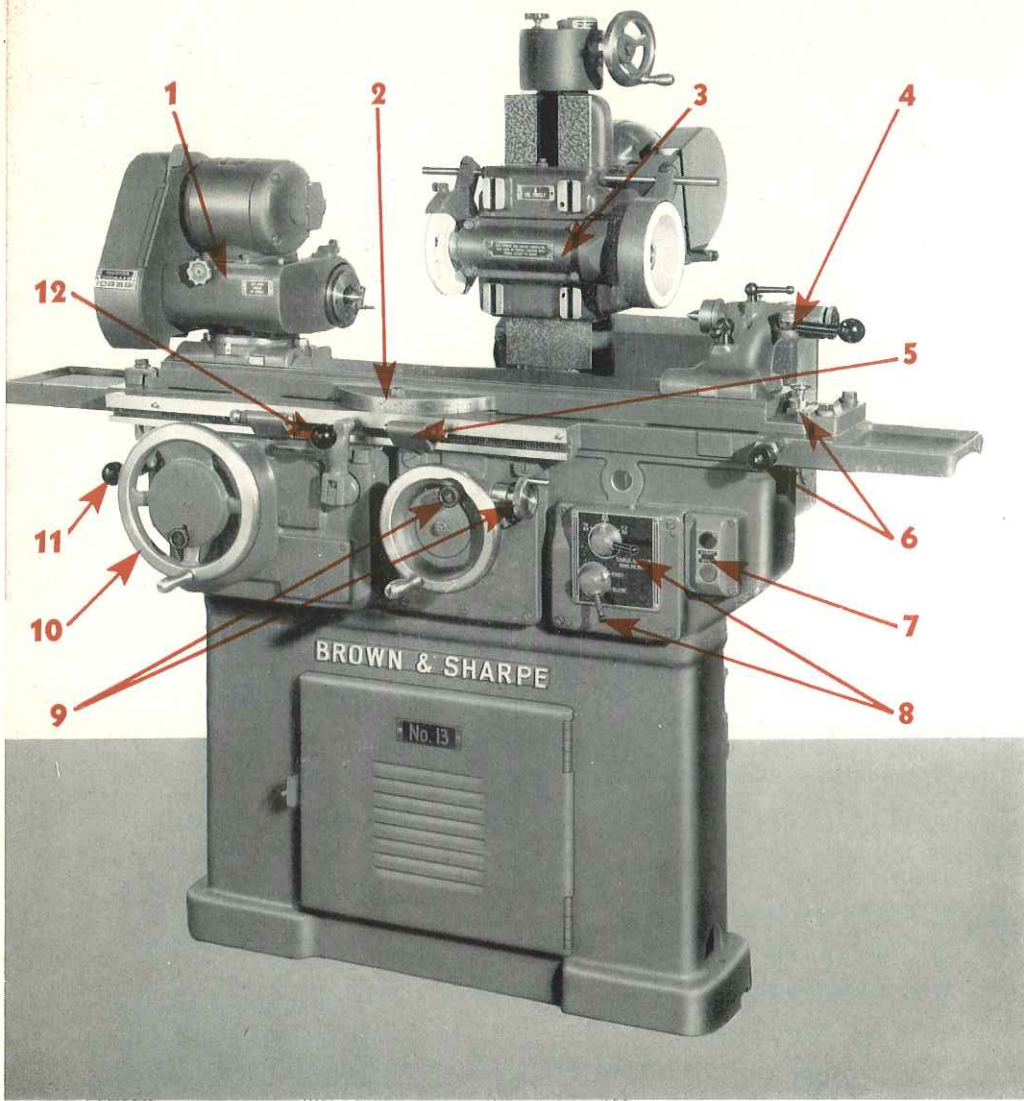
LUBRICATION

Table ways, cross slide ways, feed screw and mechanisms in base automatically lubricated by pump from oil reservoir in base. Pump runs constantly while machine is running. Sight indicator on front of base shows operation of oiling system. Oil from table ways filtered before return to reservoir. Sight gage at rear of machine shows level of lubricant in reservoir.	
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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	2900	3450	3500	71x56x69	159

Machines with handwheels graduated in millimeters, and metric screws for vertical and transverse movements, can be furnished.

FEATURES



Motor-driven headstock has both dead-center and revolving-spindle drive. Swivels on graduated base. Knob at front releases belt tension and frees spindle for truing-up work.

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

Double-ended wheel spindle carried in sturdy slide. Has vertical adjustment of 8 $\frac{3}{4}$ ". Either plain-bearing or anti-friction-bearing spindle available.

Footstock clamped in position by lever. Spindle operated by spring lever (pressure adjustable). Spindle hand clamp provided.

Table reversing dogs quickly positioned along T-slot and rack. Have fine thumbscrew adjustment.

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

Main start-stop push button conveniently located. Starts and stops wheel spindle and table motors and energizes line to headstock motor switch.

Levers provide six changes in rate of power table travel in two series; 7 $\frac{3}{4}$ ", 13" and 24" per min. and 32", 54" and 100" per min.

11 Lever may be positioned to start and stop headstock motor or to start and stop headstock motor and power movement of table. Disengages table handwheel when set for power table travel.

12 Table reversing lever; operated manually or by dogs. Has positive stop for grinding to shoulders.

10 Handwheel for hand table travel. Convenient three-position lever (not visible in this view) at side of handwheel permits quick selection of two rates of hand travel or disengagement of handwheel. Knob on front of handwheel can be moved to give play between rim of handwheel and hub; this facilitates "bumping" when it is desired to move table only slightly.

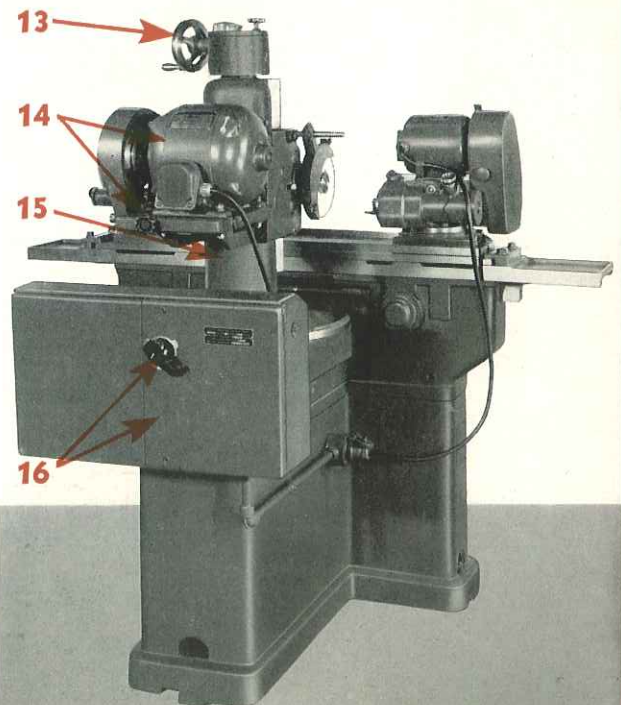
13 Elevating screw handwheel swivels to any convenient operating position. Bracket clamped by knob. Handwheel graduated to read to 0.0005".

14 Wheel spindle motor; mounted on wheel spindle slide. Knob provides belt tension adjustment.

15 Sturdy wheel spindle slide upright supported on broad scraped base. Swivels to 110° either side of zero, with settings indicated by wide-spaced graduations to degrees. Rigid clamping provided by single clamp.

16 Electrical control compartment; accommodates non-fusible disconnect switch, magnetic switches and overload relays. Compartment doors will not open unless disconnect switch lever is in "off" position.

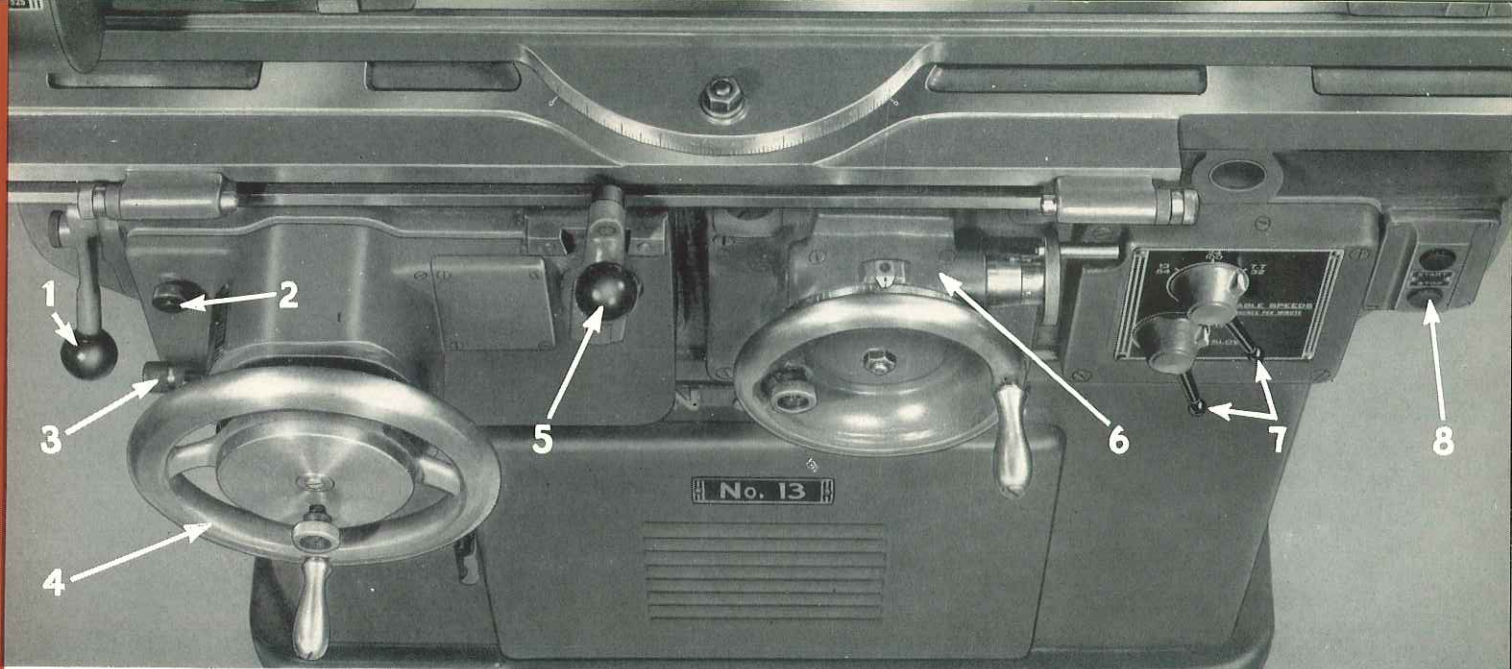
9 Fine cross feed operated by small handwheel graduated to read to 0.0001" on work diameter; engaged by knob on cross feed handwheel.



> **Wide Versatility**

> **Convenience of Operation**

> **Long-Lived Accuracy**



Above—Controls and adjustments as seen from near the operating position. Note convenient grouping. The vertical adjustment handwheel is also within easy reach from this position.

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 lever 1 at the left-front of the machine starts and stops the headstock spindle and power table movement. A plunger in the side of the lever can be used to limit the lever movement so that the headstock only is started and stopped. When the lever engages power movement of the table, the handwheel is automatically disengaged.

Knob 2 is used to shut off power to the headstock motor when it is desired to use power table travel without headstock spindle rotation.

The three-position lever 3 is used to select fast or slow hand table travel (through the adjacent table handwheel 4), or to disengage the handwheel. The lever is held in the desired position by a spring plunger arrangement, each position being clearly indicated.

A knob on front of the table handwheel 4 can be moved to give play between the rim of the handwheel and the hub. This is extremely useful for "bumping" on those operations where it is desired to move the table only a slight amount at a time.

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. Thumb screws provide fine adjustment of the dogs. The lever may be pulled forward to allow the table to move beyond the limit set by the dogs.

The handwheel mechanism 6 operates the cross feed. The handwheel itself has wide-spaced graduations reading to 0.001" 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. The small wheel is graduated to read to 0.0001" on work diameter.

The levers 7 at the right front of the machine are for selecting the rate of power table travel. The six rates are available in two series. The lower lever selects either high or low series and the upper lever selects the rate desired.

The start-stop push button switch 8, conveniently located at the right front of the machine, starts and stops the wheel spindle motor and table motor, and energizes or de-energizes the line to the headstock motor.



Left—Close-up showing location of controls at left side of the table handwheel.



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. *Note*—Belt guard and spindle guard have been removed in above illustration.

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 0.0005"; 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 110° either side of zero.

Either plain-bearing or antifriction-bearing spindle is available. The plain-bearing spindle runs in two long scraped bronze bushings having automatic compensation for wear. Adjustment for end play is easily made. The antifriction-bearing spindle is mounted on preloaded precision antifriction bearings and has sealed lubrication. End thrust in this spindle is taken in both directions. Both ends of these spindles are tapered to take wheel sleeves. Wheel guards are furnished to provide adequate protection to both the operator and machine. Three rates of speed are provided by stepped sheaves on the spindle and spindle motor. The 1 H.P. spindle motor is mounted on the rear of the spindle slide.

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.

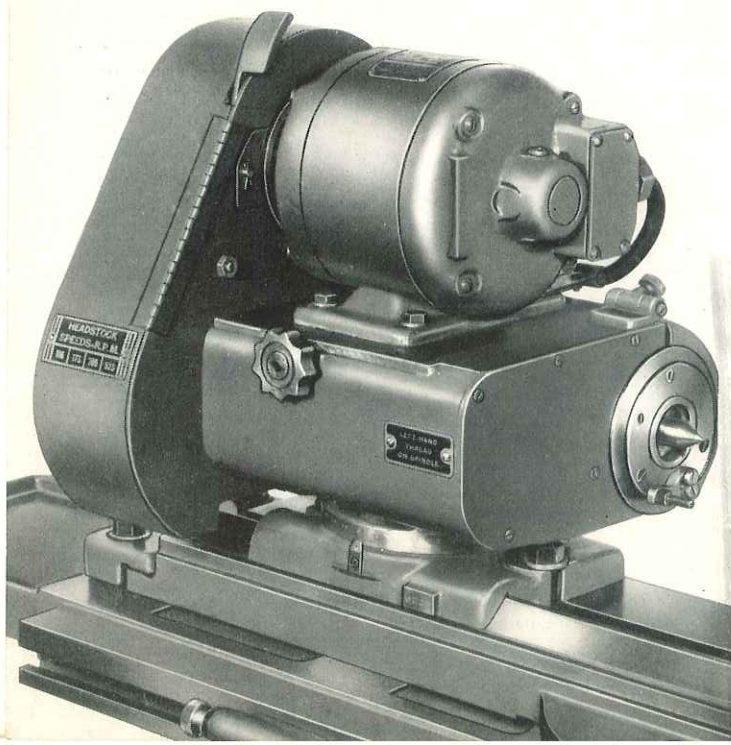
Motor-Driven Headstock Has Angular Adjustment

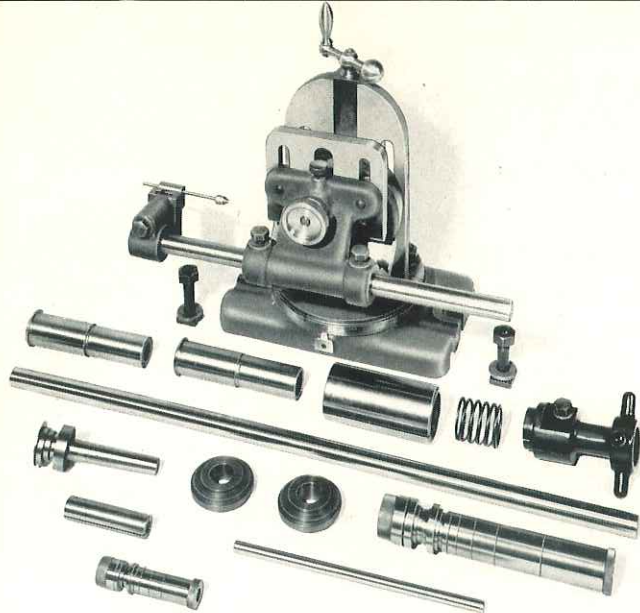
THE motor-driven headstock is an independent unit, adjustable along the table and removable from the machine. Its swivel construction permits angular settings to 100° each side of zero, graduations on the base showing the adjustment to degrees.

Four changes of work speed for either dead-center or revolving-spindle grinding are quickly obtained by means of stepped sheaves. A knob at the front loosens the belts when it is desired to turn the spindle by hand for truing up work in a chuck or for changing the work driving unit on the spindle nose. The spindle is locked for dead-center grinding by a plunger at the rear of the headstock.

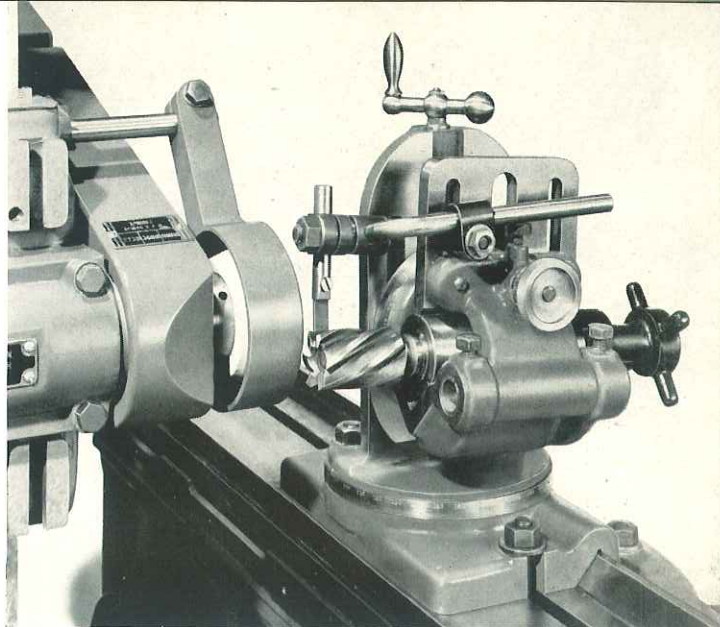
Work rotation is started and stopped by a lever at the left of the table handwheel. Quick stopping is obtained by a convenient brake lever located at the top of the belt guard.

A plug and socket at the rear of the base provide for disconnecting the motor when removing the headstock from the machine.





Above—The Universal Head and the various units used with it.



Above—A typical cutter sharpening set-up in the Universal Head.

Universal Head Facilitates Cutter Sharpening

THE Universal Head provides a very convenient means of holding most varieties of milling cutters, reamers and similar tools in accurate position for sharpening. Cutters can be held by their shanks (in bushings) or on arbors in the V-block of the swivel head, or mounted on sliding shells and carried on a cutter bar held by the head. Accurate angular adjustment in both horizontal and vertical planes is provided, and in addition the swivel head has a vertical adjustment of 4" by means of the crank at the top of the upright.

The base is solid with a large bearing surface on the swivel table of the machine, insuring a rigid support for the upright. Correct alignment is assured by the inverted V of the table top. Two T-bolts provide positive clamping.

The upright that supports the swivel head is of particularly rigid construction and has a large bearing surface on the base. The entire circumference at the base is graduated in degrees to 180° each side of zero, permitting accurate settings to any angle in the horizontal plane. Two bolts, which pass through the bearing surface, slide in a circular T-slot in the base providing rigid clamping.

The swivel head is of simple, compact construction. Provision of large bearing surfaces between the swivel, swivel plate and the upright, gives stability and resistance to vibration. A vertical adjustment of 4" is obtained by a ball crank at the top of the elevating screw. With the head at its extreme height, work up to 16" in diameter can be swung over the table; while with the head at right-angles to the table, light work up to 24" in diameter can be accommodated. The circumference of the head at the swivel bearing surface is graduated in degrees to 90° each side of zero to permit angular settings in the vertical plane. The head is clamped in both vertical and angular adjustment from the back of the upright by two T-bolts extending from circular slots in the swivel through holes in the swivel plate and vertical slots in the upright.

The V-block which is integral with the swivel head casting is adaptable to a large variety of work. The jaw plate is adjustable vertically and angularly to fit the diameter and taper of the piece being clamped, and is bolted in adjustment to the swinging top section of the jaw. The work piece is clamped by turning the large

knurled thumbscrew, the rear end of which screws into the swivel head casting (integral with the V-block). A smaller knurled adjusting screw, concentric with the clamping screw, acts as a stop for the swinging part of the jaw. On duplicate pieces, with the adjusting screw properly set, the clamping screw can be turned until the stop is reached, thus assuring a uniform clamping action. By tightening the binding screw on top of the jaw, the clamping screw is secured against loosening while grinding. An adjustable center rod is provided for supporting, locating, and taking the end thrust of centered pieces that are not clamped solidly in the V-block while grinding.

Cutters can be held in three different ways, depending upon their construction. Cutters with arbor holes are mounted on stepped collars on either of the two sliding shells. These shells are then filled with plain collars as needed and a nut on the end of the shell holds the assembly together. The shell slides on a cutter bar which passes through a sleeve that forms the pivot of the jaw (the $\frac{3}{8}$ " cutter bar is held in an adapter bushing in the sleeve). Cutters with $\frac{5}{8}$ " and $\frac{3}{4}$ " holes can be accommodated on the regular stepped collars of the $\frac{1}{2}$ " sliding shell while those with 1", $1\frac{1}{16}$ ", $1\frac{1}{8}$ ", $1\frac{1}{4}$ ", $1\frac{1}{2}$ ", $1\frac{3}{4}$ " and 2" holes can be handled on the stepped collars of the $\frac{7}{8}$ " sliding shell. Cutters with $\frac{1}{2}$ " or $\frac{7}{8}$ " diameter holes are held on the corresponding sliding shells direct, while cutters with $\frac{3}{8}$ " and $\frac{3}{4}$ " holes slide on the $\frac{3}{8}$ " and $\frac{3}{4}$ " cutter bars respectively without the use of a sliding shell.

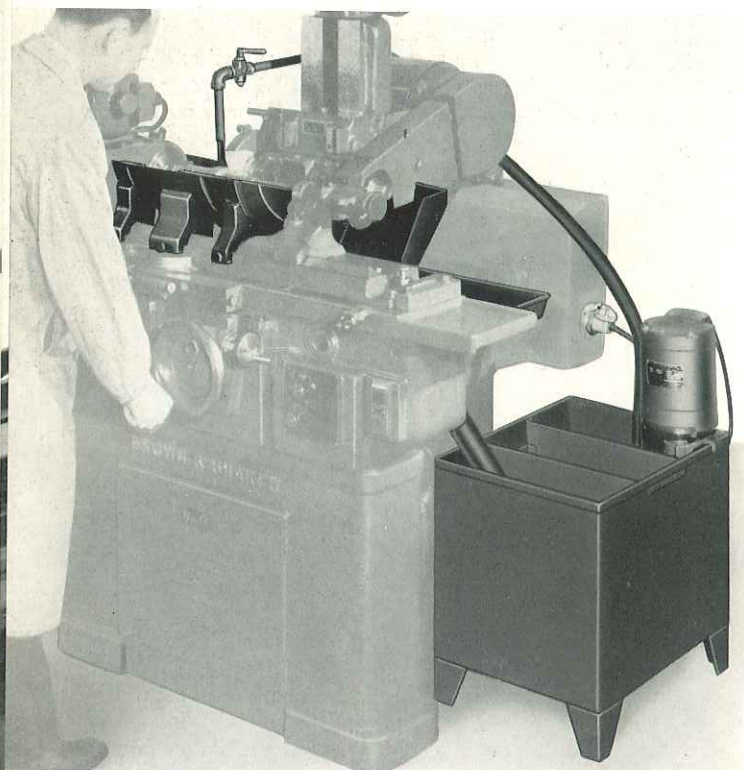
The taper shank mill bushings, handle and sleeve are used in grinding work having taper shanks, such as end mills. The assembled unit includes an outer sleeve that is clamped rigidly in the V-block and one of the tapered bushings to hold the work. The bushing is free to turn in the sleeve, but cannot move lengthwise, being held positively against the end of the sleeve by a spring. The handle, fastened to the outer end of the bushing, provides for holding the work against the tooth rest and for indexing.

Cutters with integral arbors or cutters mounted on arbors can be clamped in the V-block direct. The adjustable stop dog and stop rod mounted on the end of the stop dog rod serve to locate all duplicate pieces alike.

— ADDITIONAL EQUIPMENT —

Items Furnished at Extra Cost

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



No. 13A Exhaust Attachment

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. The Attachment can be arranged for either cylindrical or surface grinding.

Included in the Attachment is an exhaust nozzle, fittings, 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 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 approximately 96%.

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 approximately 230 cu. ft. per minute, giving a velocity of approximately 4700 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

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 $\frac{7}{8}$ " high, it fits

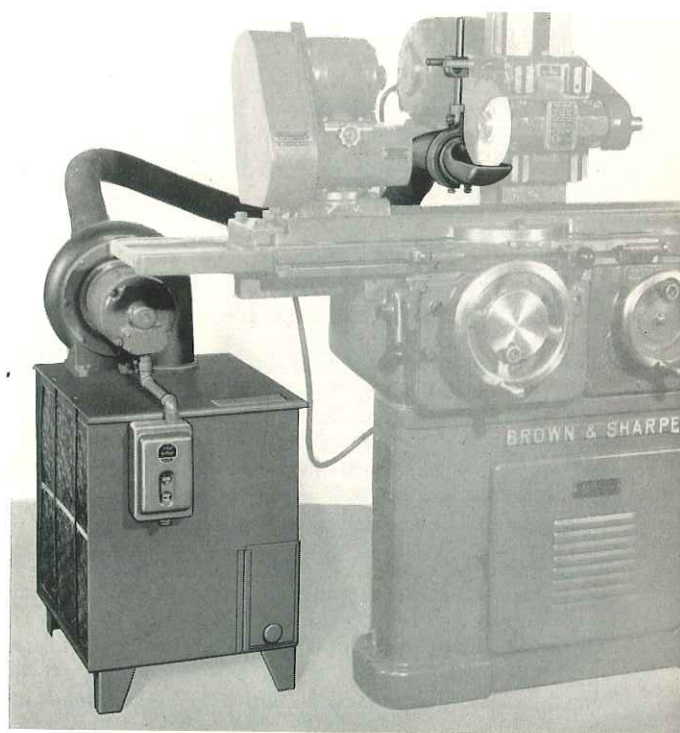
No. 13A Wet Grinding Attachment

THIS Attachment supplies and efficiently controls coolant for the wet grinding of cylindrical work up to 6" diameter. Attachment can be used with wheels mounted on either right- or left-hand end of machine spindle. It will not accommodate surface or general cutter grinding and is not intended for use with table or wheel spindle swivelled.

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 through a pipe and flexible hose extension. Water guards furnished, including a set of overlapping guards for the table, give adequate protection to both the operator and the machine.

Weights (approx.): net, 155 lbs.; shipping, 230 lbs. Dimensions for shipment, 49" x 24" x 22".



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.).

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.

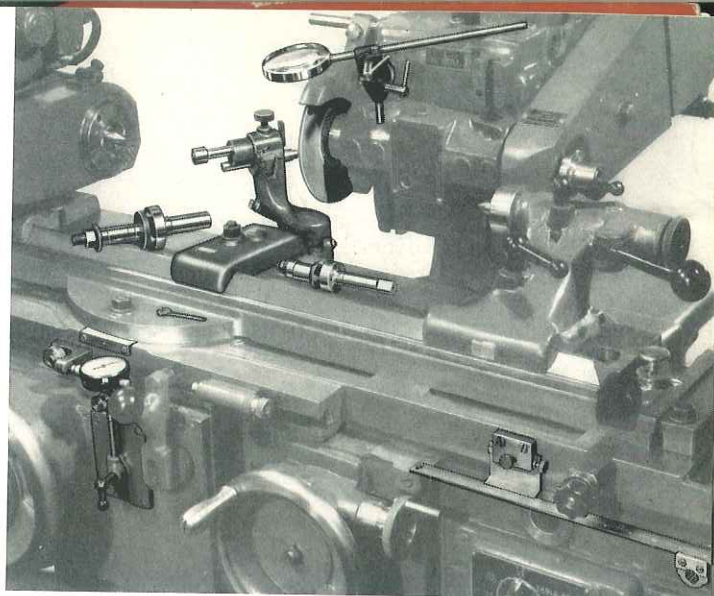
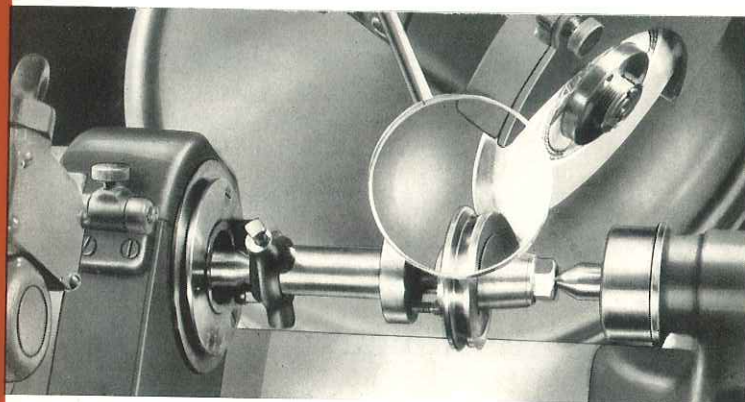
Weights (approx.): net, 22 lbs.; shipping, 25 lbs. Dimensions for shipment, 24" x 17" x 5".

No. 13A 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); (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 0.001"; (3) an angular vernier for the swivel table, by which the work may be set ac-

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



curately 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 wheel truing attachment 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.

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

Floating Arbor (For Nos. 00, 00G and 0G Auto. Screw Machine Tools)

Floating Arbor (For Nos. 2G, 4 and 6 Auto. Screw Machine Tools)

Two Grinding Wheels (Suitable for Form Grinding)

Radius Wheel Truing Attachment for Grinding Wheels

Diamond (mounted) for Radius Wheel Truing Attachment

Table Travel Dial Indicator, Holding Bracket and Stop

Booklet of Operating Instructions

Table Travel Scale and Vernier

Upright Vernier

Swivel Table Vernier

Reading Glass

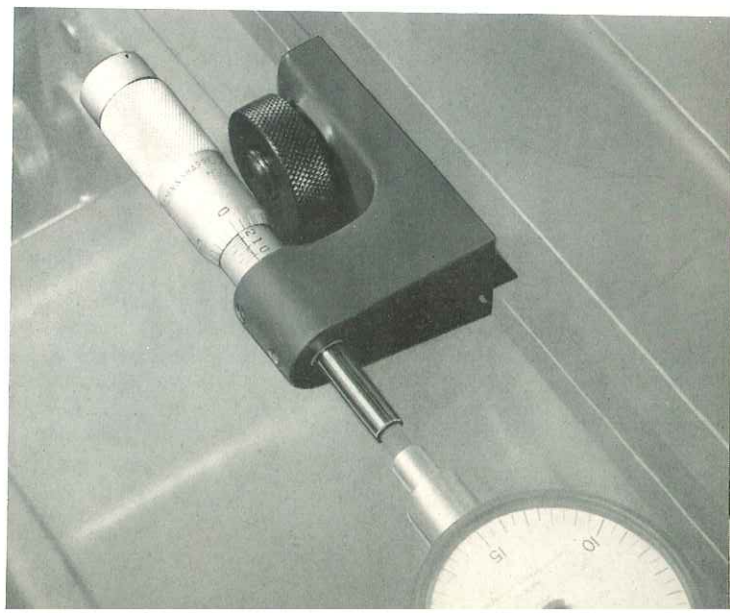
Micrometer Table Stop

THIS attachment is of particular value when used with the No. 13A Circular Forming Tool Grinding Equipment. Its use with the dial indicator furnished with this equipment permits accurate settings over a longer range than can be obtained with the indicator alone. The micrometer stop also has many useful applications, when used with a dial indicator, on machines not having the circular forming tool grinding equipment.

The unit is adjustable along the T-slot in the front of the machine table and is clamped in position by a knurled nut. The micrometer stop has a range of 1" with settings indicated in thousandths of an inch.

Using the micrometer stop in conjunction with the dial indicator permits extremely accurate shoulder grinding and easy positioning of the table for any number of accurately spaced grinding operations on the work piece. Also, the grinding wheel can be dressed at any time during the grinding operation and the table returned accurately to the proper position to resume grinding.

Weights (approx.): net, 2 lbs.; shipping, 3 lbs. Dimensions for shipment, 4" x 3" x 3".



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 $\frac{5}{8}$ "-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 18½" diameter. Its sturdy construction assures the rigidity necessary to support the heavier cutters.

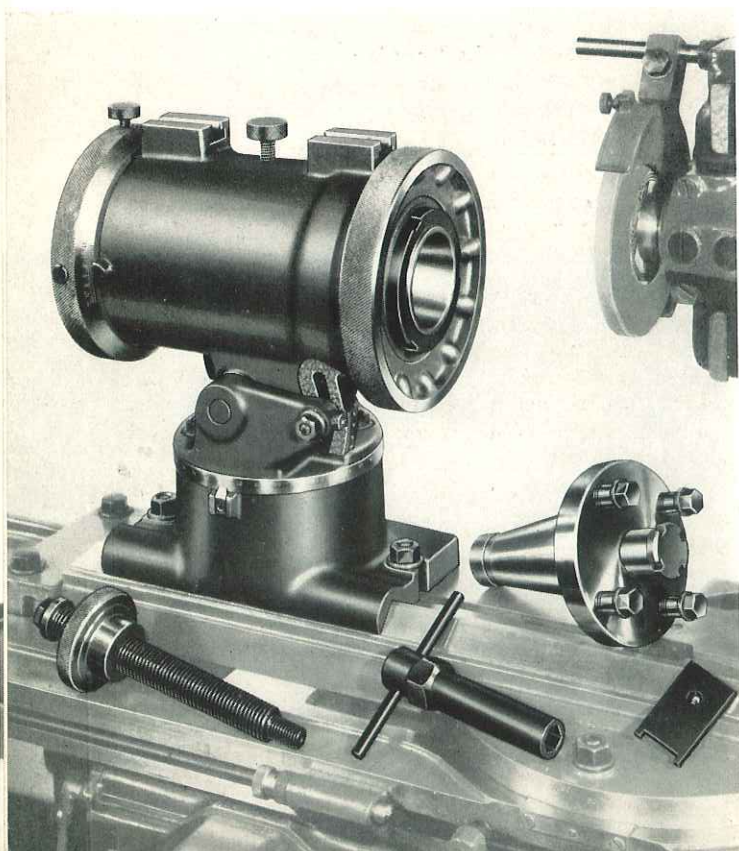
The spindle, mounted in antifriction bearings, is exceptionally free-moving and accurate, and may be clamped by means of a thumbscrew. A No. 12 B & S taper hole is provided in one end and a No. 50 Milling Machine Standard taper hole in the other, thus suiting the Attachment for a wide range of work.

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 $\frac{5}{8}$ "-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".

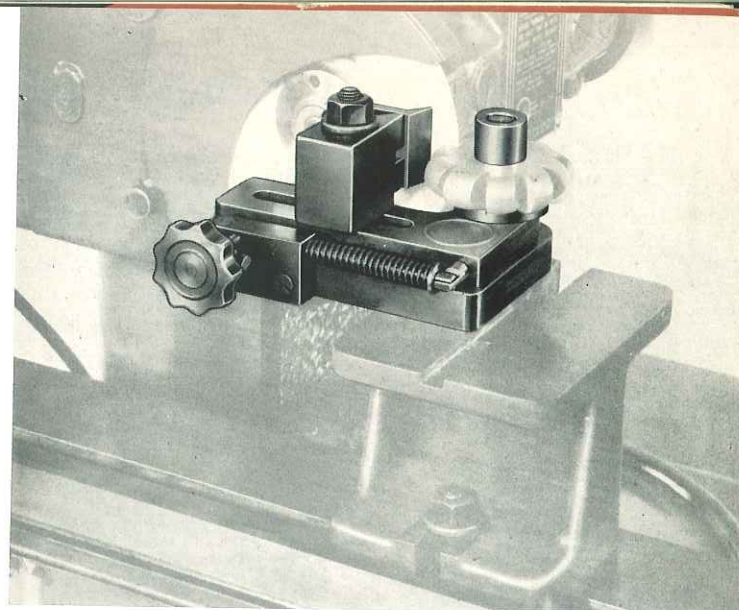


No. 13A Formed Cutter Sharpening Attachment In-Feed Type

FORMED cutters 2" to 6½" in diameter with straight teeth may be sharpened rapidly and accurately with this Attachment. A dish wheel is used, with the wheel spindle set at right angles to the table; and the cutter is supported on its side in a horizontal plane and advanced into the edge of the wheel by feeding the table (see illustration at right). Since the inner edge of the tooth face area thus ground has a curvature caused by the circumference of the 6"-diameter wheel, this Attachment is generally recommended for sharpening cutter teeth of not more than 1½" in width.

Essentially, the Attachment consists of an adjustable tooth rest assembly and a body for supporting the cutter, mounted on a base plate which is bolted to the top of the tool rest regularly furnished with the machine. The upper part of body turns on a pivot extending through the base plate; and the cutter is placed on a vertical stud or on a bushing slipped over the stud (depending on size of hole in cutter). The tooth rest is carried by a block which is adjustable on the Attachment body to accommodate cutters of various diameters and rake angles.

In operation, the tooth rest is located so as to touch the top of the cutter tooth close to the face being ground. The block which carries the tooth rest is adjusted transversely on the Attachment body, allowing the tooth rest to be positioned for grinding the tooth radial or with hook or drag, while at the same time maintaining rigid support for the tooth rest. When the cutter is turned clockwise the



tooth rest pivots to allow the cutter tooth to pass by, thus allowing the operator to quickly index the cutter with one hand while feeding the table with the other.

A knob at the front turns the Attachment body on its pivot in order to rotate the cutter toward the grinding wheel to remove more stock. An adjustable positive stop permits taking two or more grinds with the wheel on those teeth that have an abnormal amount of stock to be removed and also permits producing duplicate diameters on cutters that are used in a gang.

The vertical stud for locating the cutter takes cutters with ⅝" holes, and bushings regularly furnished accommodate cutters having ⅜", 1" and 1¼" holes.

Weights (approx.), Attachment complete: net, 8 lbs.; shipping, 12 lbs. Dimensions for shipment, 10" x 8" x 7".

No. 13A 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.

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 this 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".



Radius Grinding Attachment

THIS Attachment is designed for grinding convex cutter teeth up to $4\frac{1}{2}$ " radius, concave cutter teeth up to 2" radius, the radii on the corners of cutter 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

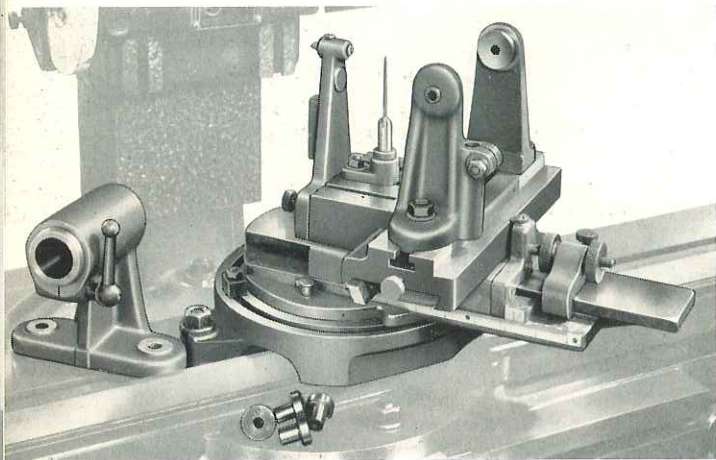
base being set by the scale on the swivel, graduated to 64ths of an inch.

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 work slide scale, 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 6 bushings, 2 each for $\frac{3}{8}$ ", 1" and $1\frac{1}{4}$ " cutter holes, and the diamond (mounted).

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



Index Centers

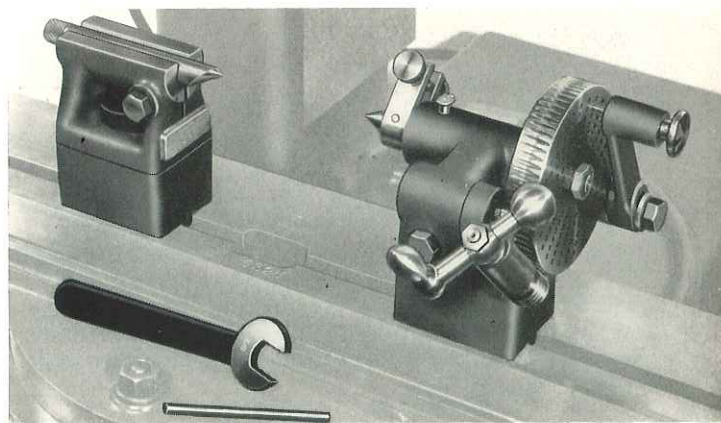
THESE are our regular $4\frac{3}{4}$ " Index Centers furnished with raising blocks which adapt them for use with this machine.* They are convenient when grinding taps, reamers, formed cutters and work of a similar nature.

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; have reversible tongues for T-slots $\frac{1}{2}$ " or $\frac{9}{16}$ " wide. Combined base length with centers together, $8\frac{1}{2}$ ".

*Raising Blocks can be furnished separately.

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

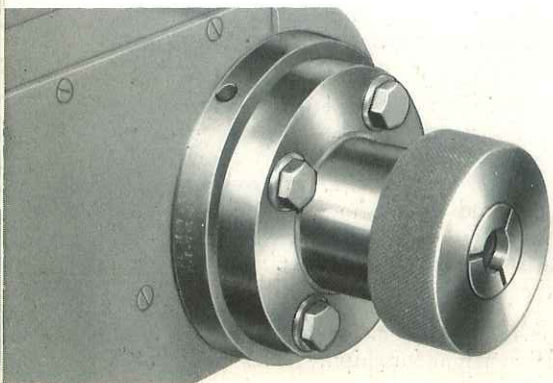


No. 351 Spring Chuck

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. 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, $\frac{1}{16}$ " to $\frac{1}{2}$ " by 64ths; $\frac{1}{2}$ " to $\frac{3}{8}$ " by 32nds; $\frac{1}{16}$ ", $\frac{3}{4}$ " and $\frac{1}{8}$ ".



Headstock Draw-In Collet Attachment — Wrench Operated

THIS attachment fits into the headstock of the machine and provides for holding bushings, long rods and similar work by means of a Rubber-Flex* collet. Work pieces up to $\frac{3}{8}$ " diameter can extend through the headstock spindle.

Opening and closing of the collet that holds the work is controlled by a wrench applied at the nose of the attachment. Provision for positioning the collet for accurate centering is provided.

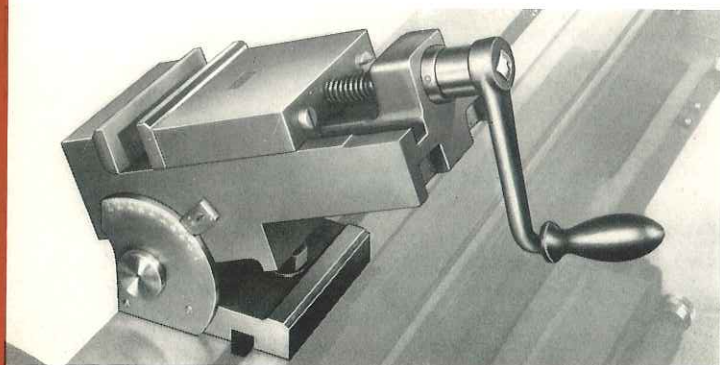
Six Rubber-Flex collets furnished, each having a range of $\frac{1}{8}$ ", accommodate work from $\frac{1}{4}$ " to 1" diameter. A collet accommodating work from $\frac{1}{16}$ " to $\frac{1}{8}$ " diam., and collets for pieces of limited length up to $1\frac{3}{8}$ " diam., can be obtained from industrial distributors.

Weights (approx.): net, 26 lbs.; shipping, 38 lbs.
Dimensions for shipment, 18" x 10" x 9".

*Manufactured by the Jacobs Manufacturing Co.



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 $1\frac{1}{16}$ " deep, and open 2". Distance from bottom of base to top of jaws with vise horizontal is $4\frac{7}{16}$ ".

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

No. 13A Surface Grinding Attachment

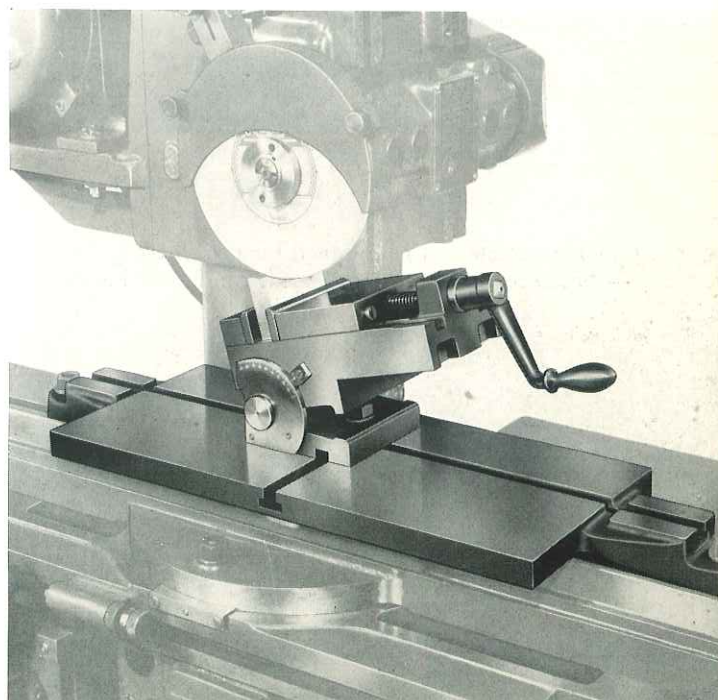
ADAPTABLE to all varieties of surface grinding consistent with the nature of the machine, this Attachment includes an adjustable vise as described above, a large table plate and a wheel spindle extension.

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 setting. The removable jaws are of tool steel, hardened and ground, $4\frac{1}{8}$ " wide and $1\frac{1}{16}$ " deep, and open 2". Distance from bottom of base to top of jaws with vise horizontal is $4\frac{7}{16}$ ".

The table plate has a working surface $18\frac{1}{2}$ " x $6\frac{1}{2}$ " 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 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".

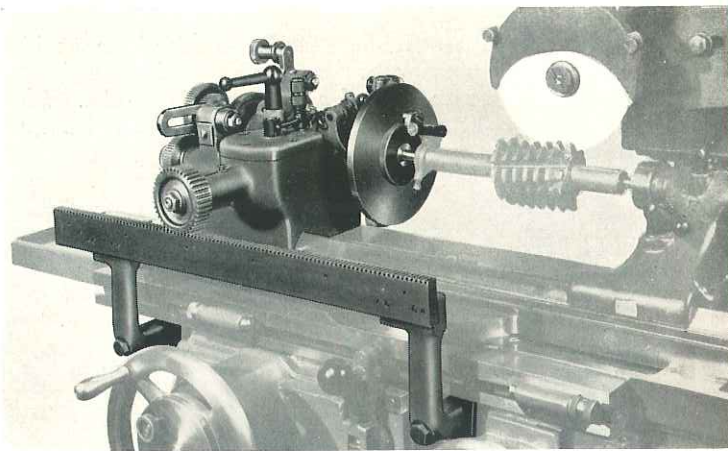


No. 13A Hob Sharpening Attachment

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 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

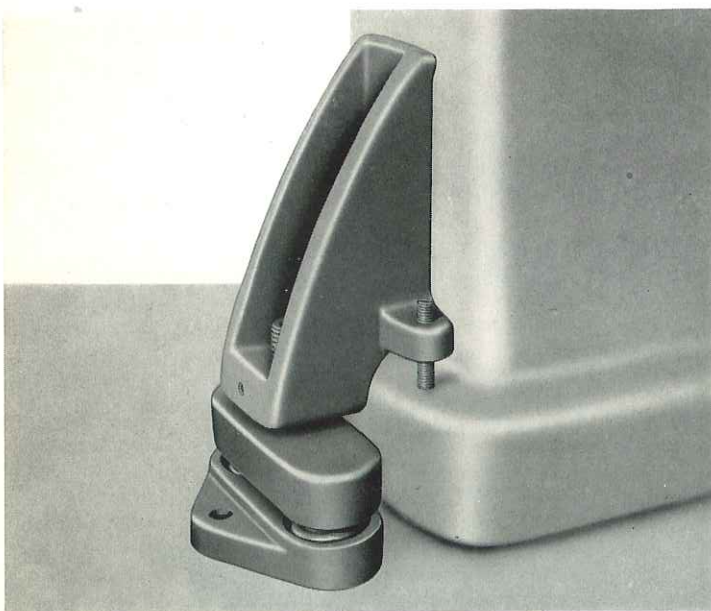


Above — Attachment with guards removed.

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.

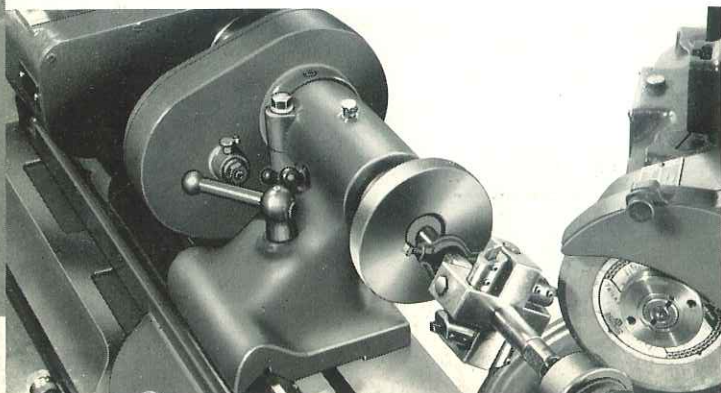
The equipment furnished includes one right-hand and one left-hand wheel spindle extension, two index plates, change gears, and a table of gears and spirals.

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



Low Speed Revolving Spindle Auxiliary Headstock

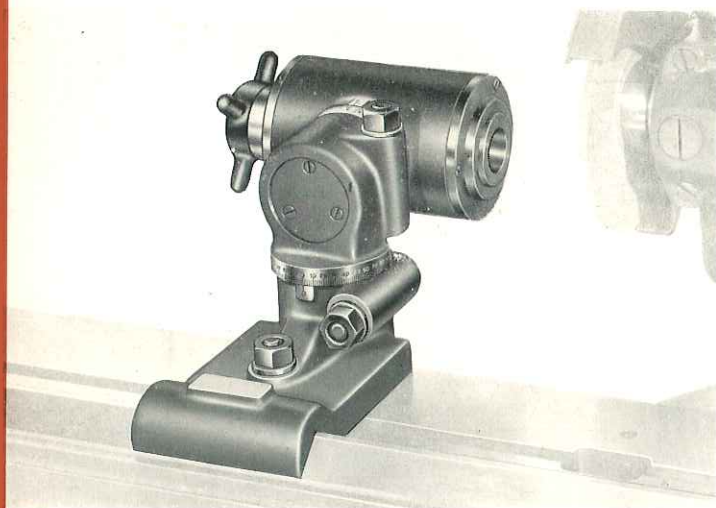
THIS Attachment is designed for use where speeds $\frac{1}{12}$ of the regular headstock speeds can be used to advan-



tage. The Attachment consists of a gear-driven spindle, with means of adjustment for wear, mounted in a bronze bearing and enclosed in a sturdy casting. The spindle can be locked to facilitate changing work driving units. When in use the Attachment is clamped on the machine table at the right of the regular headstock and is driven by its work driving pin. Use of this unit reduces the length capacity of the machine by approx. $11\frac{1}{2}$ ".

The front end of the spindle is threaded, $1\frac{1}{2}$ "-6-N.C., R.H. It has a No. 7 B&S taper hole; and the straight hole through the spindle is $\frac{7}{16}$ " in diameter. This Attachment should be fitted to the machine at our factory.

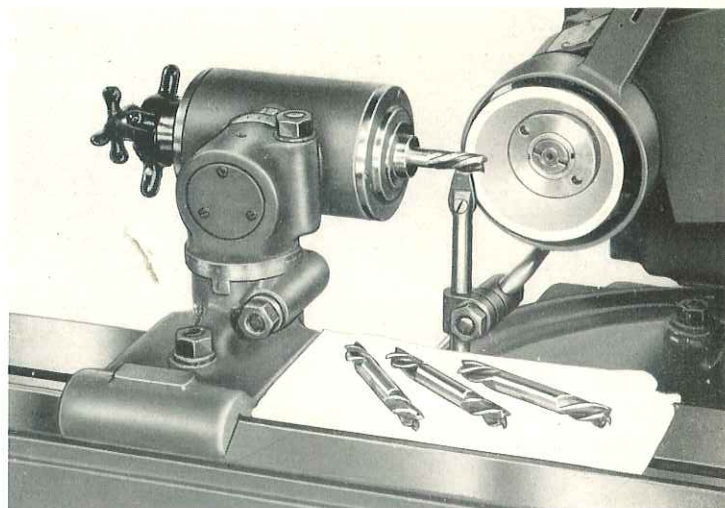
No. 13 End Mill Sharpening Attachment



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.

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



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.

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 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 (described in detail in Brown & Sharpe catalog) Most Commonly Needed for use with No. 13 End Mill Sharpening Attachment

Cutter Adapters

No. 9 B & S-10-1—For end mills having No. 10 M. M. Std. taper shank.

No. 9 B & S-20-1—For end mills having No. 20 M. M. Std. taper shank.

No. 9 B & S-30-1—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.

Collets

Collet for end mills having No. 5 B & S taper shank.

Collet 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.

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	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$

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.

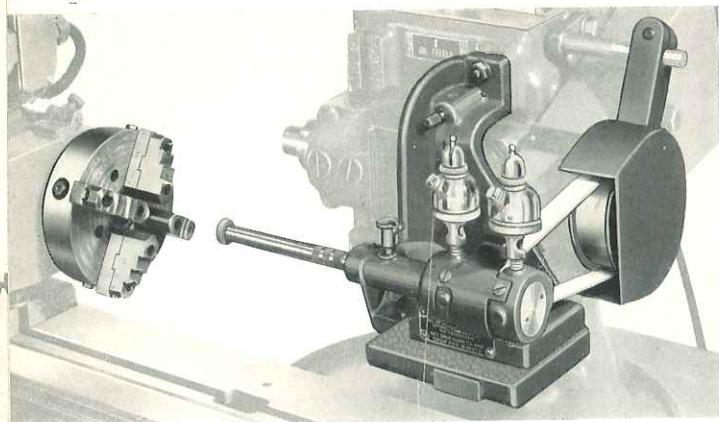
Bushings

ALL varieties of cutters having Nos. 10, 20 and 30 M. M. Std. taper shanks are conveniently held by means of these bushings for sharpening in the universal head of the machine. Each bushing is available separately.



No. 13A Internal Grinding Attachment

Plain Bearing Type



THE spindle of this 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 independent 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
†01A	3	1½	¼	¾	22500
02A	3	3¾	½	¾	18000
*03A	3	5¼	¾	¾	15700
04A	3	6	1½	¾	15000

*No. 03A Fixture furnished unless otherwise specified.

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

No. 13A 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 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 below. 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 above.

Wheel arbors and grinding wheels are furnished at

extra cost, stock sizes being listed below. 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.

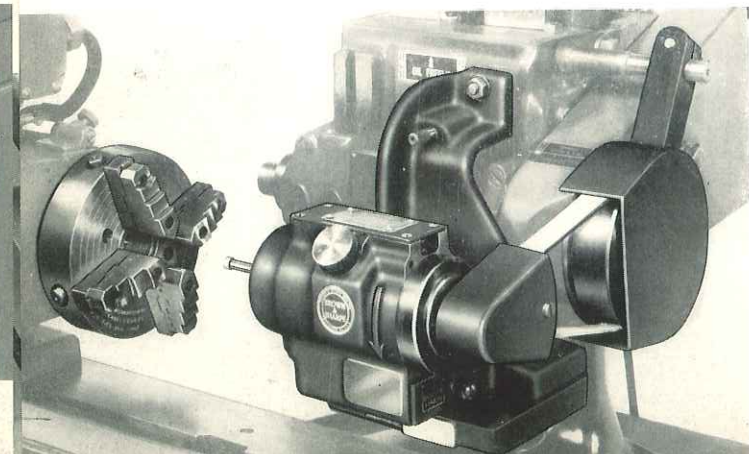
Wheel Arbors and Grinding Wheels

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
3330	1	¼	¾ x ¼ x ¾
3331	1½	¼	¾ x ¼ x ¾
3332	1	5/16	¾ x ¼ x ¾
3333	1½	5/16	¾ x ¼ x ¾
3334	1	¾	¾ x ¼ x ¾
3335	1½	¾	¾ x ¼ x ¾
3336	1½	7/16	¾ x ¼ x ¾
3337	2	7/16	¾ x ¼ x ¾

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



Electralign

THIS electronic arrangement permits quick, easy and precise settings of the swivel table when grinding straight shafts or exact tapers. Detailed specifications on request.

Electralign-Comparator Selector

THIS unit is for use with the Electralign when using Brown & Sharpe electronic calipers for external or internal measurements. Detailed specifications on request.

Continuous Radius and Tangent Wheel Truing Attachment

THIS is our regular Continuous Radius and Tangent Wheel Truing Attachment* furnished with a stand† which adapts it for use with this machine.

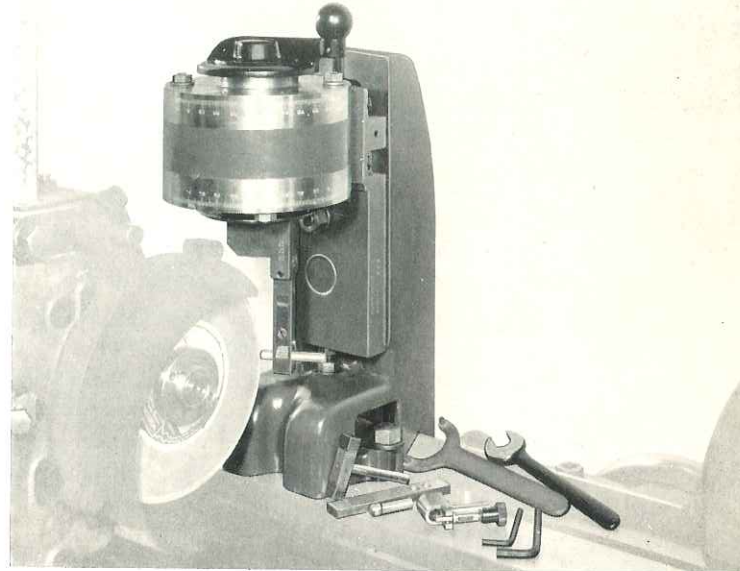
The attachment is designed to form, with one continuous movement of the diamond, accurate radii on grinding wheels with accurate tangents at either or both sides of the radii. Convex radii up to $\frac{1}{2}$ " with tangents to $\frac{5}{8}$ " in length in any direction from parallel to the side of the wheel to 110° away from the side, can be formed; concave radii from $\frac{1}{32}$ " to 1" (larger radii with diamonds having longer holders than one furnished), having tangents up to $\frac{5}{8}$ " long in any direction from 70° to 180° away from the side of the wheel, can also be formed. The angles of the tangents are independent of each other (on a concave shape having a radius over $\frac{3}{8}$ " the included angle must be 90° or more).

Concave radii less than $\frac{5}{32}$ " and all concave radii $\frac{3}{8}$ " or less having the included angle of the tangents less than 90° require diamond tools other than the one furnished.

This attachment is not recommended for use where coolant may enter its bearings.

*Detailed specifications available on request.

†Stand can be furnished separately.



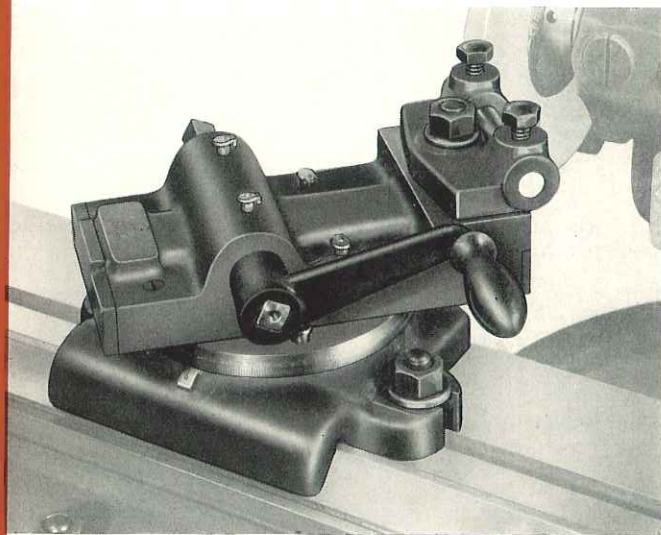
Angle Wheel Truing Attachment

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 $1\frac{5}{8}$ " 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.

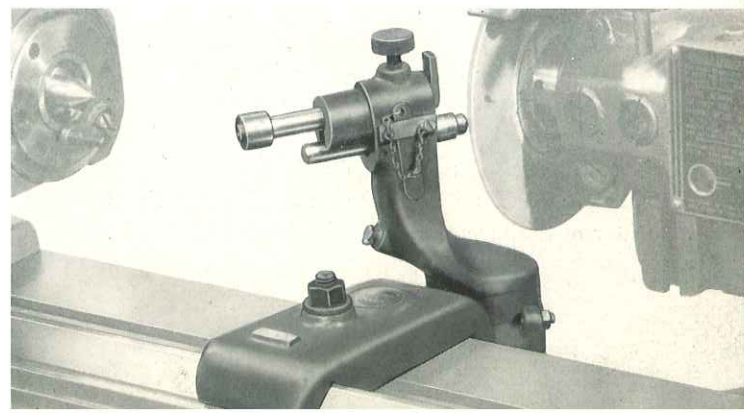


Radius Wheel Truing Attachment

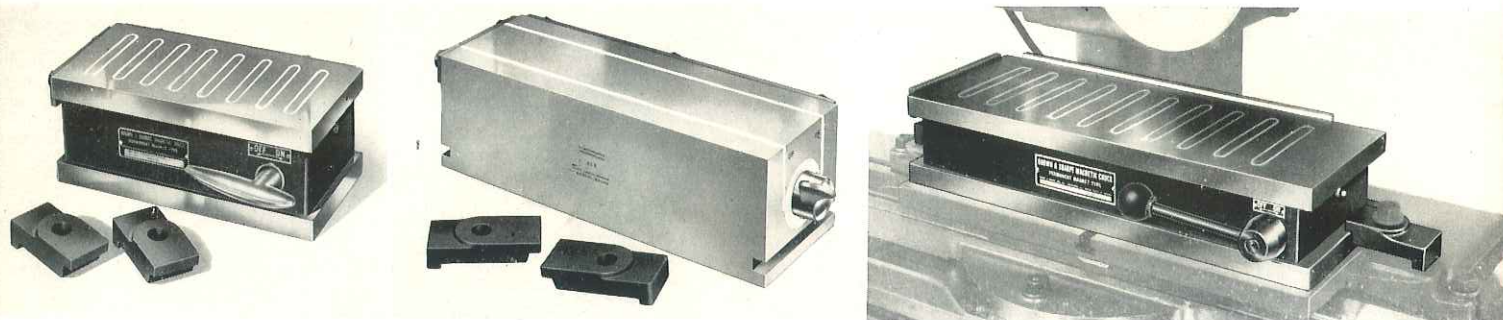
THIS Attachment provides an efficient and accurate means of forming radii on grinding wheels. With its use, convex and concave radii up to 1" can be formed.

Weights (approx.): net, 16 lbs.; shipping, 28 lbs. Dimensions for shipment, 16" x 13" x 7".

Diamond (mounted) can be furnished at extra cost.



Magnetic Chucks



Above—The No. 408 chuck (left) is small and handy, having close pole spacers that make it particularly well adapted to the holding of small work pieces. The No. 412 (middle) has two line pole spacers and is useful for holding rows of small parts as well as for parts of moderate size. The No. 618 (right) will accommodate larger work and is here shown mounted on the table plate of the Surface Grinding Attachment (described on page 13).

Rectangular Models (Permanent Magnet Type).

These chucks 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 an easily operated lever. Auxiliary top plates, for the two larger size chucks, are available to permit holding smaller work than can usually be held on chucks of these sizes.

No.	Working Surface, Inches	Magnetic Surface (Approx.), Inches	Height of Chuck, Inches	Net Weight, Lbs. (Approx.)	Shipping Weight, Lbs. (Approx.)
408	4 x 8	3 x 6½	3⅝	26	31
412	4 x 12	4 x 12	4	54	60
510	5⅝ x 10⅝	3⅞ x 7½	3⅝	41	50
618	6⅝ x 18⅝	4½ x 14⅞	3⅝	87	104

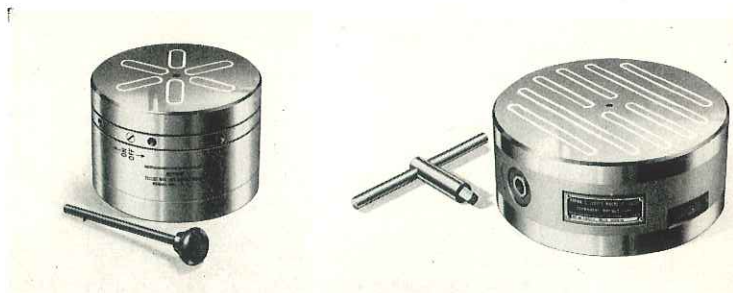
Magnetic Chuck Table Plate, taking chucks from 4" x 8" to 6" x 18" capacity, can be furnished at extra cost for use with magnetic chucks only. The top of the plate is ¾" above the top of the machine table, clearing the inverted V of the table top; and the front edge is beveled to fit against the V. Weights (approx.): net, 24 lbs.; shipping, 30 lbs.

Electromagnetic Chucks (rectangular models) and controlling equipment are also available. Information on application.

Rectifier, for use with electro-magnetic chuck, is also available. Information on application.

Rotary Models (Permanent Magnet Type). These rotary model chucks have all the Permanent Magnet Chuck advantages and can be used for a variety of grinding operations. They are mounted on the headstock spindle by means of the Chuck Adapter Pulley listed at right. In the center of the face of each chuck is a ¼" 28 N. F. tapped

hole for attaching a locating button. The holding power of these chucks can be regulated by the control ring on chuck No. 5R and by the removable handle on chuck No. 7R. This feature is especially useful when setting up. Strength of holding is controlled by amount handle or ring is turned. On the No. 5R a 30° turn of the control ring holds or releases the work. The ring, which can be operated in any position the chuck may stop, is turned by a removable pin furnished.



Above—Rotary chuck No. 5R shown at left, No. 7R shown at right.

No.	Working Surface, Diameter, Inches	Magnetic Surface, Diameter, Inches (Approx.)	Thickness, Inches	Net Weight, Lbs. (Approx.)	Shipping Weight, Lbs. (Approx.)
5R	5	4	3⅜	17	22
7R	7	6½	3	24	30

Chuck Adapter Pulley for mounting chucks No. 5R and No. 7R on headstock spindle of machine can be furnished at extra cost. Weights (approx.): net, 5½ lbs.; shipping, 6 lbs.

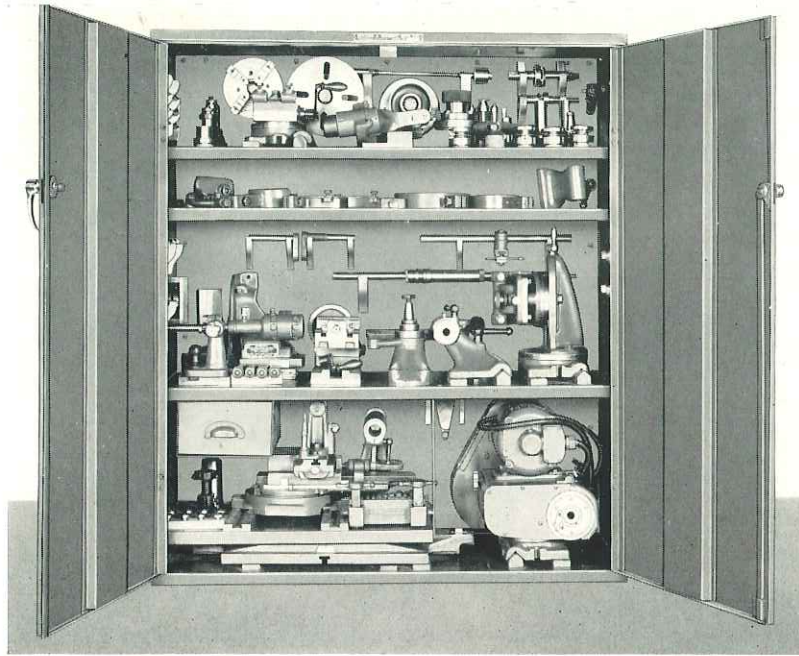
Brown & Sharpe Magnetic Chucks of the Permanent Magnet Type are for sale only in the United States of America and its Territories, unless purchased with a new machine as original equipment.

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".



Grinding Machine Engineering Service

Among the many departments maintained to provide service for our customers is one developed solely to solve grinding problems. Our engineers have at their disposal an abundance of data and a wealth of experience acquired through years of operation on many kinds of grinding work, both in our own shop and in others where our machines are at work. Because of this fund of information and experience we are especially fitted to design correct grinding methods for any particular job to which our machines may be applied.

Layouts and fixtures produced by this Service have helped many manufacturers to faster and better grinding with Brown & Sharpe machines. Do not hesitate to call on this Service in connection with your requirements.

The Brown & Sharpe Mfg. Co., established in 1833, today has a modern equipped foundry, heat-treating and metal fabricating divisions and occupies over 1,900,000 square feet of floor space, or approximately 43½ acres.

