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CYLINDRICAL GRINDING MACHINES
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INTERNAL GRINDING MACHINES
PRECISION MACHINE TOOL EQUIPMENT
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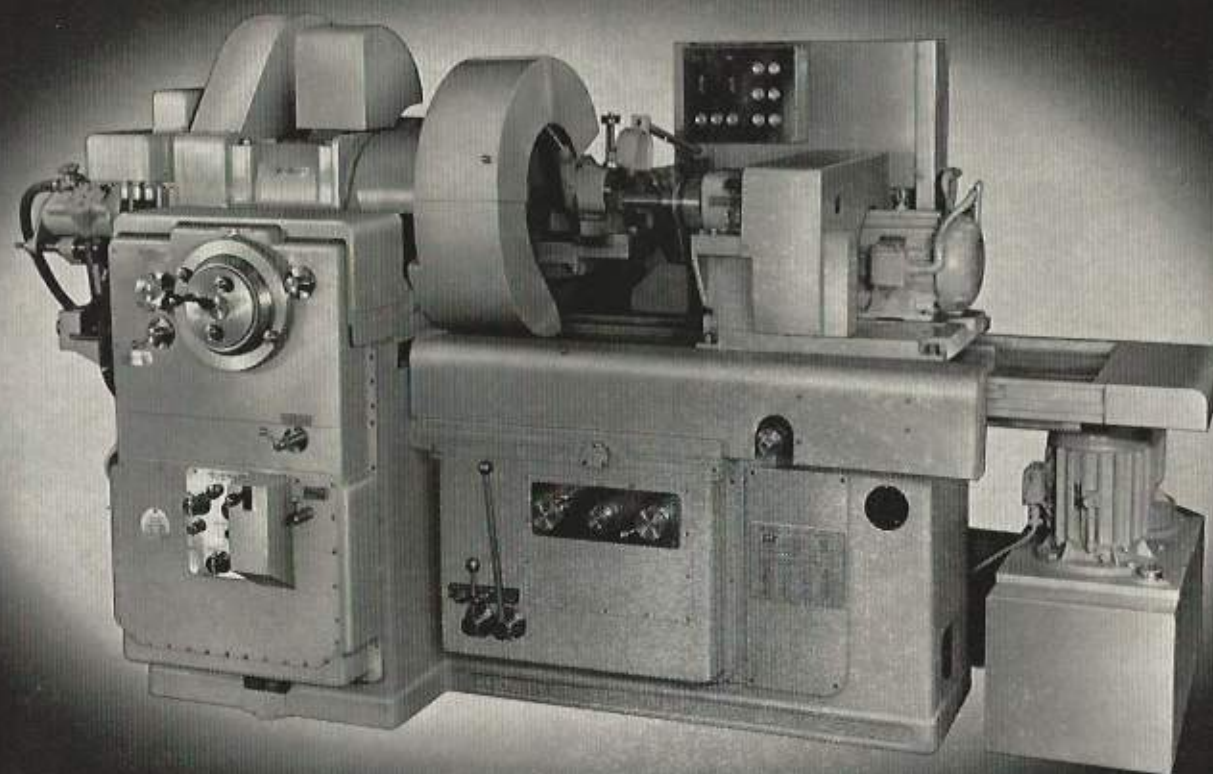
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NEWALL-KEIGHLEY type **K 4**

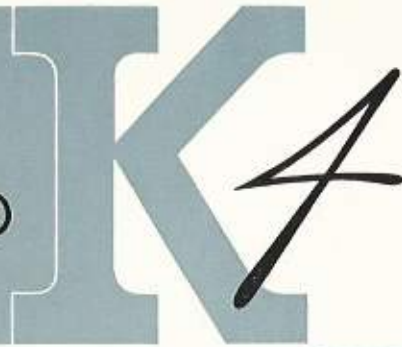
**AUTOMATIC INTERNAL GRINDING
MACHINE**



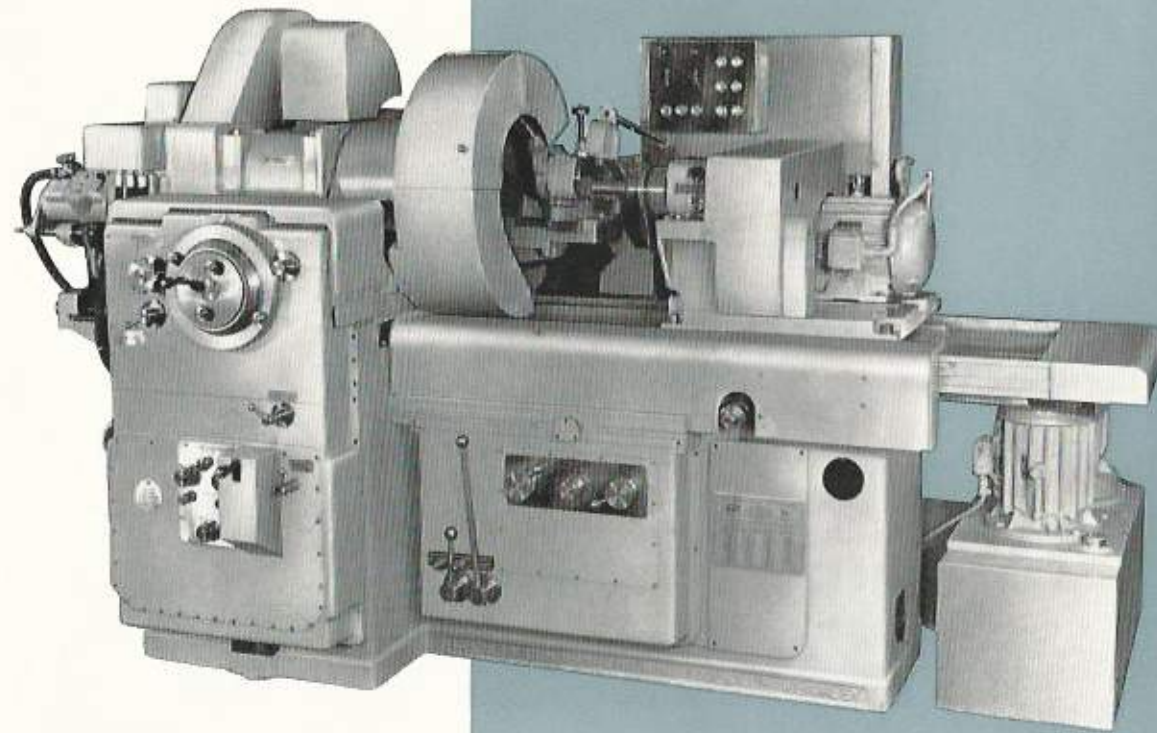
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NEWALL-KEIGHLEY



AUTOMATIC INTERNAL GRINDING MACHINE



One of a series of fine quality grinding machines in the production programme of Keighley Grinders (Machine Tools) Ltd., the model K4 Internal Grinder is a fully automatic machine designed to achieve the utmost in economy and precision.

Of extremely robust proportions, it is operated by a single lever control after initial setting up and incorporates numerous advanced features to ensure maximum machine utilization.

Arranged for both gauge and diamond sizing to increase

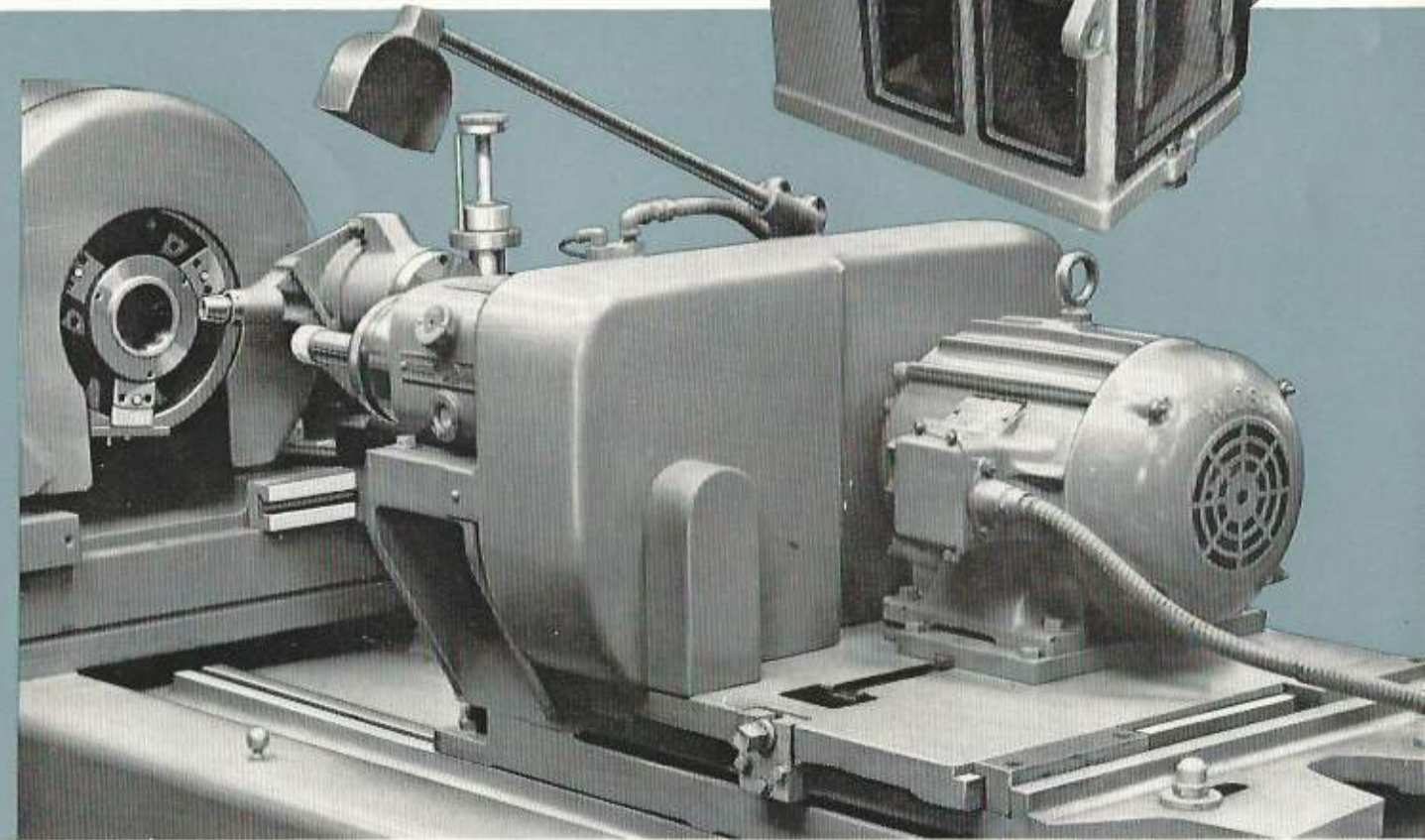
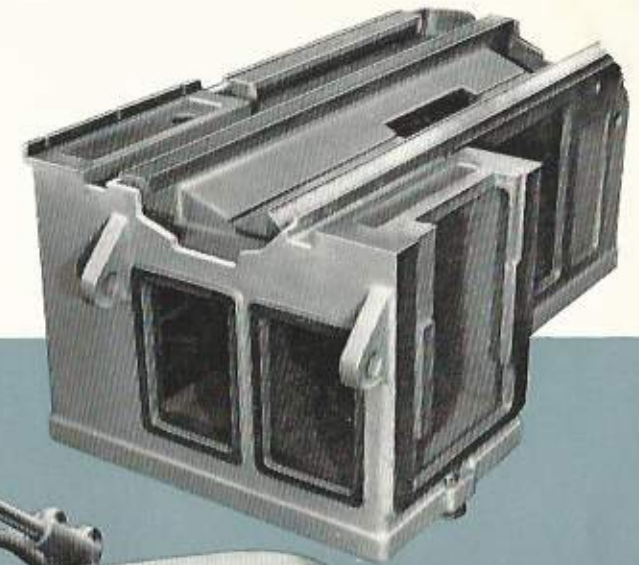
its scope of employment, the K4 permits grinding of holes from $\frac{1}{8}$ " (6 mm.) to 6" (152 mm.) diameter and to a maximum depth of 6" (152 mm.); the swivelling workhead provides for grinding taper bores up to 60° included angle.

The high standard of workmanship and superior quality materials employed in manufacture have resulted in the production of a machine unexcelled for accuracy, component finish and productive capacity.

MACHINE BED

Exceptionally sturdy and scientifically designed to prevent distortion, the robust construction of the bed ensures rigidity of the entire machine.

The slideways, handscraped to high precision limits, are widely spaced to give positive support to the table and wheelhead.



The sturdily constructed wheelhead assembly.

TABLE

With the surface forming a coolant tray and tee-slotted to provide endwise positioning of the wheelhead, the table slides on accurately scraped vee and flat guide-ways automatically lubricated from a separate oil reservoir.

In addition to a rapid traverse of 420 ins. (10.68 metres) per minute, independent adjustable speeds for roughing, finishing and dressing are also provided.

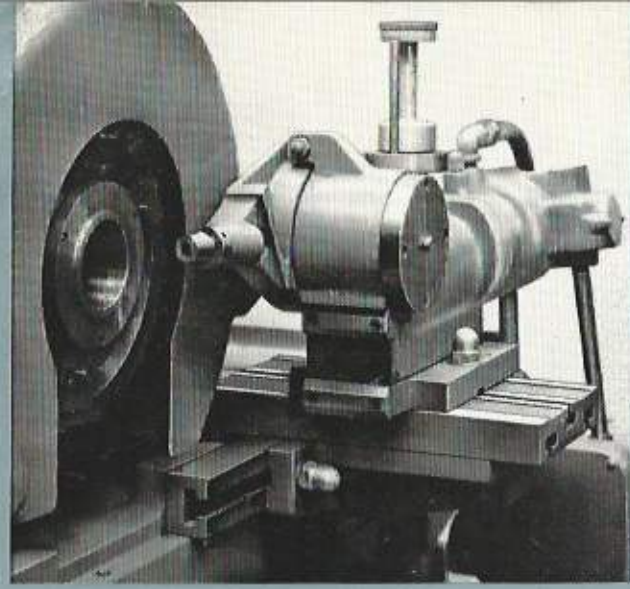
Minimum and maximum table strokes are $\frac{1}{16}$ " (0.8 mm.) and 6" (152 mm.) respectively, these, together with traverse speed, being controlled by grinding and dressing stroke dogs and an adjustable cam on the front of the table.

WHEELHEAD

The standard wheelhead consists of a generously proportioned base plate and bracket suitable for the mounting of interchangeable wheel spindles.

Drive is by an endless cotton band from a 3 h.p., 3,000 r.p.m. motor, giving a range of spindle speeds from 5,000 to 20,000 r.p.m. Belt tension is adjusted by a jockey pulley.

An alternative wheelhead with swivelling base for use with tapered quills and incorporating a layshaft providing spindle speeds up to 28,000 r.p.m. is available as special equipment.



WHEEL DRESSER

Of completely new design, the hydraulically-operated dresser is mounted on compound slides to contend with all diameters and lengths of work within the machine capacity. A micrometer adjustment completely eliminates backlash and the dresser is so designed that coolant, swarf, etc., do not affect its accuracy. A servo-mechanism actuated by a cam on the machine table controls movement of the dresser arm; this method ensures that travel of the diamond is positively regulated by movement of the table.

WORKHEAD

Mounted on the feed cross slide, the workhead has a swivel movement of 30° for taper work and is arranged to accommodate gauge sizing equipment. Designed to support heavy fixtures, it has a 3" (75 mm.) bore flanged spindle running in high precision, double-row taper roller bearings.

Work speeds up to 1,000 r.p.m., and in a range to suit user requirement, are obtained by pick-off pulleys. A hydraulic chuck or fixture operating mechanism is built into the spindle to provide a push or pull action over a 2" (50 mm.) stroke.

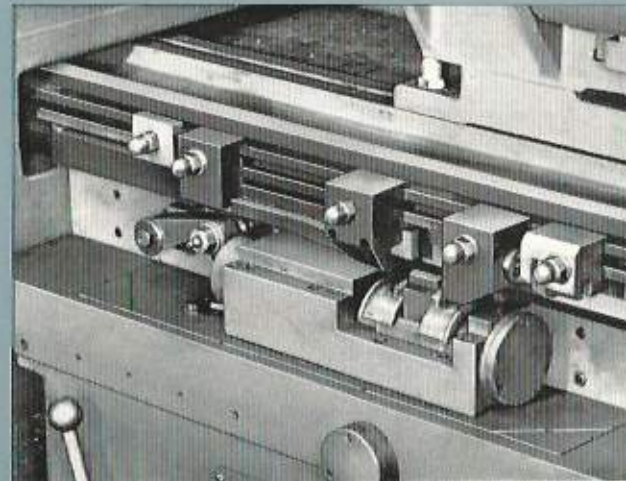
A dial indicator is offered as additional equipment to facilitate fine setting of the workhead swivel.

AUTOMATIC FEED

Continuous and entirely independent of table traverse, the cross feed is operated by a cam and roller mechanism and is positioned by a screw and nut; the screw also serves to provide wheel wear compensation, which is adjustable from 0 to 0.006" (0.15 mm.) on diameter.

Operated hydraulically, the feed cam controls rough and finish grind feed rates; automatic locking is applied during the dressing feed stroke.

Arrangement of dogs and adjustable cam for control of table stroke.



A multiple diamond dressing sequence permitting a number of dressing cycles to take place during rough grinding can be incorporated as additional equipment.

A range of cycles to suit all requirements is obtainable through adjustment of the feed control knobs.

A feature of the K4 machine is that automatic feed may be engaged or disengaged at any time during the grinding cycle.

GAUGING MECHANISM

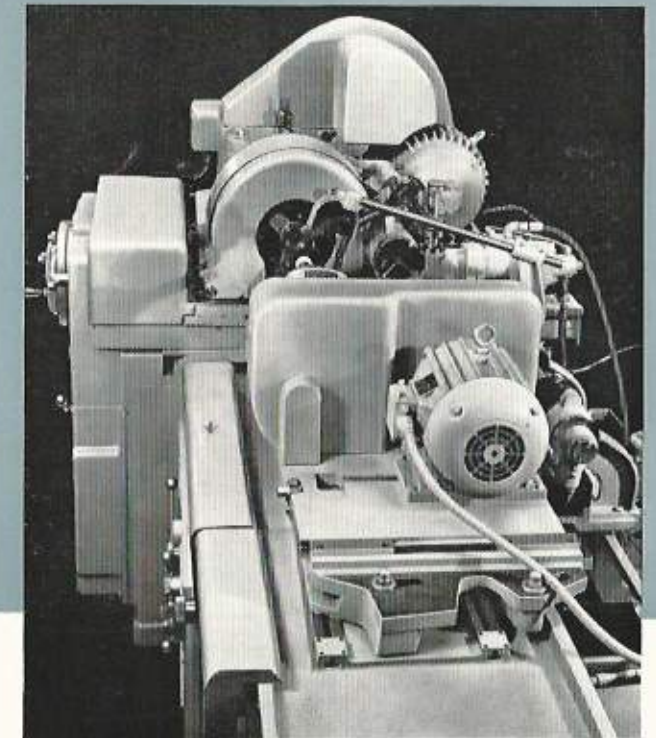
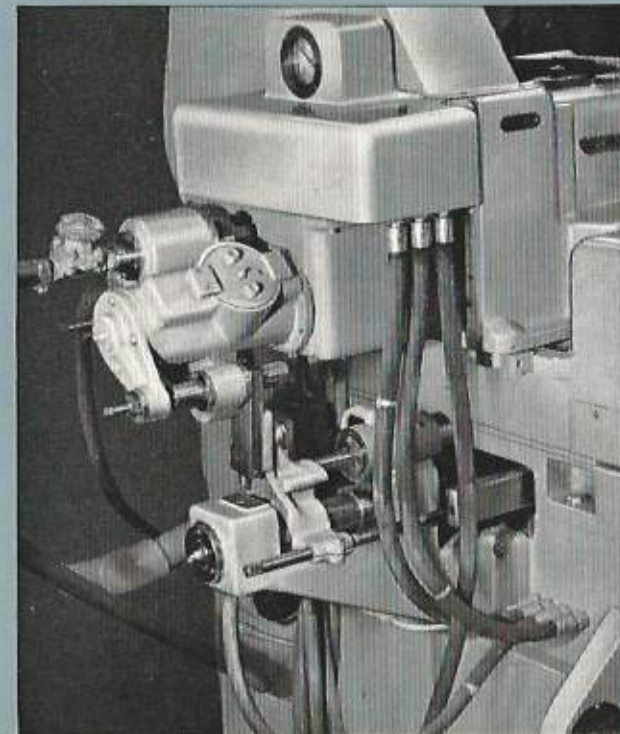
This hydraulically-operated assembly is mounted on the left-hand end of the machine base. The following cycles apply, depending on which type of equipment is ordered with the machine.

(a) *Single Gauging*—Throughout the roughing period of the grinding cycle the gauge is withheld from contact with the bore, which it only attempts to enter during the finish grinding operation. This design feature reduces wear of the mechanism, and maintains gauging accuracy over a prolonged period.

(b) *Double Gauging*—When this system is employed, the first diameter on the gauge attempts to enter the bore during the rough grinding cycle. Immediately the bore receives the gauge, the roughing cycle automatically ceases and the dressing cycle is introduced. This is followed by finish grinding, when the second step on the gauging member effectively controls bore diameter.

The oscillating mechanism of the gauging unit is mounted on circular ball slides to provide extremely sensitive operation.

Detail of the hydraulically-operated gauging mechanism.

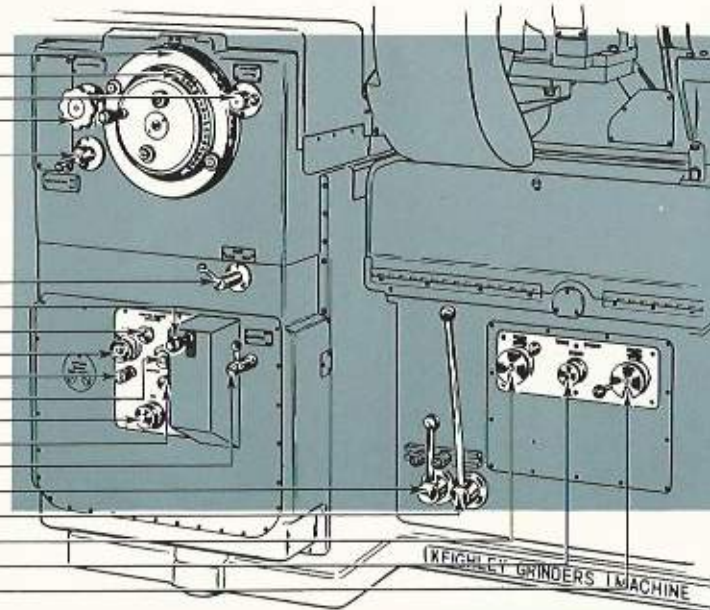


End view of the machine from an elevated position emphasizes the general sturdy proportions of the table and wheelhead slides. To ensure maximum possible rigidity of the spindle, the width between the base slideways is greater than the height of the spindle centre from the table-ways. The scraped Vee and flat-ways are of extremely generous proportions to give adequate support to the table and wheelhead unit.



- Automatic Feed Dial
- Feed Compensation Dial
- Hand Pick Feed
- Wheel Wear Compensation Adjustment
- Wheel Wear Compensation Engagement

- Chuck Operation
- Cycle Trip
- Feed Accelerator
- Roughing Feed
- Feed Locking
- Fine Feed
- Feed Stop
- Feed Locking
- Short Cycle
- Table Traverse (Hand)
- Automatic Cycle
- Table Traverse (Finishing Speed)
- Table Traverse (Dressing Speed)
- Table Traverse (Roughing Speed)



FEATURES

- Heavy, rigid construction.
- Extra wide, scraped slideways.
- Fully automatic grinding cycle.
- Workhead swivel movement 30°.
- Work spindle speeds up to 1,000 r.p.m.
- Double row taper roller bearings for work spindle.
- Cross-slide mounted on anti-friction rollers.
- Automatic stop and start of workhead.
- Hydraulic table traverse, steplessly variable.
- Automatic plunge feed.
- Wheelhead with swivel movement supplied to request.
- Automatic control of coolant flow.
- Electrical switchgear enclosed in separate cabinet.
- Exceptionally simple control system.

GRINDING CYCLE

Operation of the cycle starting lever causes the work-table to move in at rapid traverse speed until the grinding wheel enters the bore, when the rate is reduced to grinding speed and the table reciprocates on a stroke adequate to cover entire length of the bore. At this stage roughing feed begins, a predetermined size is reached and the wheel backs away from the bore.

Continuing the automatic cycle, the wheel then leaves the bore and table speed is reduced for dressing immediately the rear edge of the grinding wheel approaches the diamond position. To ensure that the wheel is fully trued, dressing takes place during both outward and inward strokes and the diamond automatically retracts, the wheel re-enters the workpiece and regains contact with the bore. Table reciprocation at a lower speed continues and fine feed is engaged.

The foregoing description is applicable when either gauge or diamond sizing is in use. Completion of the cycle when diamond sizing is as follows:

When finish size is reached, the feed dial retracts, thereby backing the wheel away from the bore; return of the table at maximum traverse rate takes place and the wheel guard is automatically lowered.

Alternatively, if single gauge sizing is in operation, the cycle is completed in the following manner:

On finish size being approached, the gauging mechanism operates to allow the gauge to make contact with the rear end of the bore, which it enters as size is achieved. The gauge is then retracted automatically, the feed dial retracts, the table returns to the loading position and the wheel guard is lowered.

Additionally, the machine can be equipped for double gauge sizing. This feature enables gauging to be introduced during both the rough and finish grinding operations.

In either case, automatic wheel wear compensation takes place at the conclusion of each grinding cycle.

HYDRAULIC EQUIPMENT

Including control circuit, the K4 is operated entirely by hydraulic pressure, fed from a 35-gallon (157 litre) tank. A feature of outstanding importance is the accessibility for servicing, both table and cross feed units being covered by inspection plates capable of quick release.

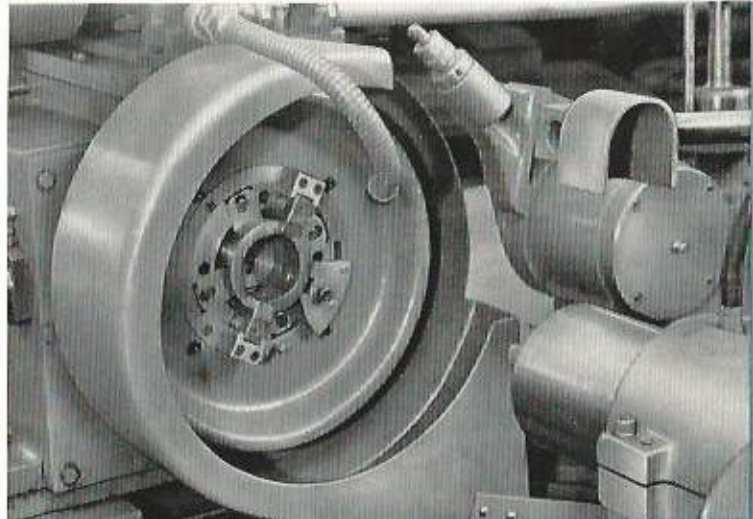
COOLANT SUPPLY

Contained in a 30-gallon (135 litre) movable tank located at the rear of the machine, coolant is supplied to the work by a delivery pump powered by a ½ h.p. motor.

ELECTRICAL EQUIPMENT

The fully automatic control gear, including correct overload devices, is assembled in a separate cabinet, which is easily accessible for maintenance purposes, and is impervious to penetration by oil or water.

Details of the precision dynamically balanced motors employed are included in the specification given in this brochure.



APPLICATIONS

In addition to the standard machine, the K4 is available tooled specifically to customers' requirements, where large scale production to close tolerances is demanded.

The photograph reproduced on the left details the workholding arrangement with component *in situ* of one of a series of K4 machines devised for automatically grinding to a high order of accuracy, workpieces with internal cam forms.

The illustration on the right depicts the workholding fixture of one of a number of units supplied for grinding con-rod

SPECIFICATION

capacity

	English	Metric
Swing over table (straight work)	26"	660 mm.
Swing inside water guard	16"	456 mm.
Maximum grinding depth	6"	152 mm.
Minimum diameter of hole ground	$\frac{1}{4}$ "	6 mm.
Maximum included angle ground (Diamond sizing only)	6°	152 mm.

wheelhead

Spindle speeds (Standard head)	5,000 — 20,000 r.p.m.
" (Special head)	5,000 — 28,000 r.p.m.
Swivel movement (Special head)	7°
Wheel wear compensation on diameter	0-0.006" 0-0.15 mm.

workhead

Speeds. To suit component	Up to 1,000 r.p.m.
Swivel	30°
Diameter of spindle flange	9 $\frac{5}{8}$ " 244 mm.
Bore of spindle	3" 75 mm.
Feed per turn of crossfeed positioning handwheel (on dia.)	0.060" 1.5 mm.
Maximum power crossfeed (on dia.)	0.042" 1.0 mm.

table

Maximum travel	24"	610 mm.
Maximum grinding stroke	6"	152 mm.
Minimum stroke	$\frac{1}{32}$ "	0.8 mm.
Rapid traverse speed	420	10.68
	ins./min. metres/min.	
Grinding speeds steplessly variable	To 360	9.14
	ins./min. metres/min.	

drives

Wheelhead Motor	3 h.p. — 3,000 r.p.m.
Wheelhead Motor (Alternative to order)	5 h.p. — 3,000 r.p.m.
Workhead Motor	1½ h.p. — 1,450 r.p.m.
Hydraulic pump motors (2)	2 h.p. — 1,450 r.p.m.
Coolant pump motor	$\frac{1}{4}$ h.p.

dimensions

Floor space required	98" × 64"	2.49 × 1.62 metres
Centre of workhead spindle to floor	46"	1168 mm.
Nett weight of machine	9,968 lbs.	4521 kg.

STANDARD EQUIPMENT

Set of spanners. Set of Allen keys.
20 gallons hydraulic oil. 1 gallon spindle oil.
Set of jack screws and foundation bolts.
Standard rotary diamond dresser.

EXTRA EQUIPMENT

Drawbar chuck and chuck operating mechanism.
Spare set of jaws. Coolant filter.
Hopper feed. Automatic face grinding equipment.

Spindles:

Type KGS.	I42	28,000 r.p.m.
"	I43	24,000 "
"	I44	20,000 "
"	I45	17,000 "
"	I46	15,000 "
"	I48	10,000 "
"	I48A (Solid quill)	8,100 "
"	I59 (Sleeve type)	8,500 "
"	I60 (Sleeve type)	8,500 "
"	I71A (Sleeve type)	5,000 "

In addition, high frequency electric, hydraulic, or air-driven spindles are supplied if speeds in excess of those listed above are required.

RESEARCH & DEVELOPMENT

All illustrations, text and specification given in this brochure are correct at the time of printing, but due to the policy of Keighley Grinders (Machine Tools) Ltd. to continually improve its products, modifications may occur in machines produced after publication.

big-end bores. As a guide to output potential, the following times relate to production of components with a finish bore diameter of 2.394 to 2.3945 in., a depth of 1.515 in., and requiring 0.014 in. stock removal.

Rough grind	15 seconds
Wheel dressing	7 seconds
Finish grind	7 seconds
Load and unload	25 seconds
Total floor to floor time	54 seconds

