Churchill roll grinders

BUTLER NEWALL
MACHINE TOOLS

Advanced machine tools from Britain's leading manufacturer.

The Butler Newall sales organisation world wide is at your service to explain Butler Newall machine tools in more detail.

Further publications and films are usually available on most of the machines described.

Fortschrittliche Werkzeugmaschinen von Großbritanniens führendem Hersteller.

Das weltweite Vertriebsnetz von Butler Newall steht Ihnen für ausführlichere Informationen über Butler Newall Werkzeugmaschinen jederzeit gern zur Verfürgung.

Über die meisten der dargestellten Maschinen ist normalerweise auch weiteres Text- und Filmmaterial erhältlich.

Machines-outils perfectionnées due premier constructeur britannique.

L'organisation internationale des ventes Butler Newall est à votre disposition pour présenter les machines Butler Newall de manière plus détaillée.

Des publications compémentaires et des films sont généralement disponibles pour la plupart des machines décrites.

BUTLER NEWALL
MACHINE TOOLS

Butler Newall Machine Tool Company Limited
Mile Thorn, Halifax, England HX1 4JR
Telephone 0422 61641 Telex 51236
Infotec 6000 Facsimile transceiver 0422 41970

Brochure Reference No. CG-8-84
Phoenix Publicity & Print, Bradford
Printed in England

Churchill traversing wheelhead roll grinders

The Churchill traversing wheelhead roll grinders have established an international reputation amongst roll makers and users for accuracy, reliability and high productivity.

Many exclusive design features are incorporated in the machines, each of which is built to meet customers individual requirements.

All the machines are suitable for both steel and aluminium users and can be supplied with either standard or heavy duty wheelsides and worksides. They are supplied to customers' between centre requirements and standard duty machines can be supplied with either 1900 or 2500 mm swing for paper mill use.

Bed

All castings used are 'Meehanite' quality cast iron to BS1452 grade 17 (Meehanite GC275) chilled to give slideway hardness of around 200 Brinell and carefully thermally stress-relieved for long-term stability.

The heavy ribbed construction ensures accuracy and good damping characteristics. The body is designed to be firmly bolted down on to a good quality concrete foundation using levelling wedges.

The slideways are completely protected by steel telescopic slideway covers.

The wheelside bed is a single casting up to 4877 mm (192") nominal capacity, and jointed for longer machines.

Wheelhead carriage

The wheelhead carriage is a substantial cast unit moving on the wheelside body along integrally cast-in vee and flat slideways.

This movement is powered by a 5 hp infinitely variable speed d.c. reversing motor, acting through a speed reduction gearbox and final rack and pinion drive to give a smooth and vibration free traverse range between 50 - 3050 mm/min.

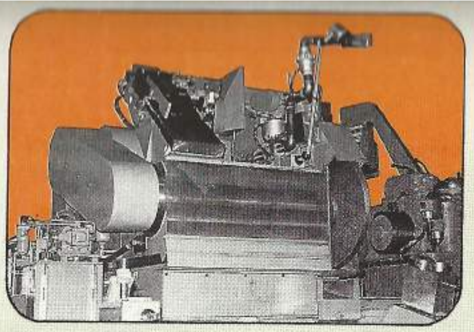
Hydrostatic oil bearing wheelhead

The hydrostatic oil bearing wheelhead is driven by a precision dynamically balanced motor through multi vee belts.

The nitralloy steel spindle is supported in bronze bearings externally fed with oil at a pressure of approximately 28 kgf/cm^2. Each journal bearing contains a number of pockets spaced around the bearing diameter, into which oil is fed, thus centralising the spindle in the bearing clearance.

The hydrostatic oil bearing has the advantage of high stability and rigidity in the no-load condition, this being an important factor in attaining workpiece finish and geometry during the spark-out period.

The rotational accuracy is also much improved over that of a hydrodynamic oil bearing due to the thickness of the oil film compensating for and reducing the effect of the small geometric inaccuracies which exist in the component parts of a spindle. The ultimate load capacity of the



bearings gives a very high factor of safety over the loads which would be encountered in practice. The volume of oil required is approximately two gallons per minute, and a safety interlock is fitted to prevent the wheelhead drive motor running without the oil supply to the bearings.

In the event of a pressure failure, the pressure switch stops the drive motor and the spindle will run down without damage using the residual oil in the bearing pockets. It has been established that the spindle will run down hydrodynamically i.e. without oil pressure supply for a considerable time and without any detrimental effect to the spindle bearings.

The temperature rise in the oil is much less than for a hydrodynamic oil bearing spindle, and does not adversely effect the performance of the wheelhead, thus allowing the machine to be fully operational to final accuracy when starting from cold.

These spindles will perform to the same standard of accuracy over a wide range of wheel speeds, the top speed available normally being higher than the maximum speed at which available grinding wheels can be run.

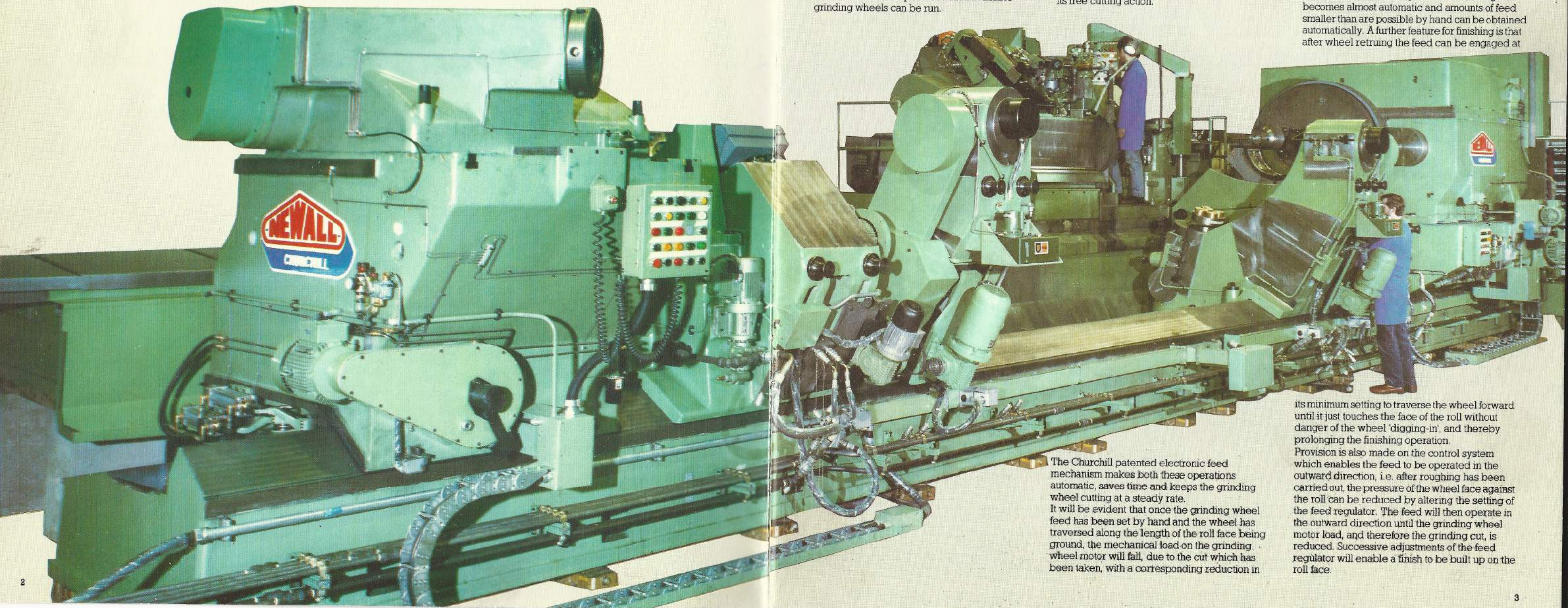
The spindle unit has been designed to run at 43 m/s (8500 ft/min). This speed is recommended as the optimum, offering an increase in production without incurring the disadvantages often associated with higher wheel speeds e.g. excessive wheel and diamond costs, special safety precautions and pressurised coolant.

Electronic feed

The machines are also fitted with the Churchill patented automatic electronic feed, by means of which the maximum use is made of the power available at the grinding wheel.

The electronic feed, which is a valuable time-saving feature for both rough and finish grinding, can be easily engaged or disengaged according to the work being ground, and by its use, less operating skill is required to manipulate the grinding wheel feed to take account of the varying conditions presented by badly worn or damaged rolls.

When a roll comes from the mill with the face scored it is often necessary to grind for a considerable period of time, in order to remove the score. This requires that as the grinding proceeds, the operator has to observe when the cut dies away and to add a forward feed to the grinding wheel by hand, using his judgement as to the amount of feed applied. Further in the course of roughing out the roll, the grinding wheel eventually wears or glazes, thus reducing its cutting action. At this point the grinding wheel is fed forward by hand, in order to assist in breaking up the wheel face, which then presents a new surface on the periphery of the wheel and restores its free cutting action.



The Churchill patented electronic feed mechanism makes both these operations automatic, saves time and keeps the grinding wheel cutting at a steady rate.

It will be evident that once the grinding wheel feed has been set by hand and the wheel has traversed along the length of the roll face being ground, the mechanical load on the grinding wheel motor will fall, due to the cut which has been taken, with a corresponding reduction in load current. This current is directly proportional to the horse power output of the motor, and therefore, to the power absorbed by the grinding wheel. The electronic feed is designed to compensate for this and ensures that the cut taken by the grinding wheel is kept constant at a selected amount during either roughing or finishing of the roll.

Having been set at the desired amount, the grinding wheel automatic feed operates immediately the grinding wheel motor load falls, whether due to the removal of metal from the roll face or to wheel wear. It is not necessary, therefore, for the operator to observe the fall in current on the grinding wheel motor ammeter, or loss of cut on the grinding wheel, as the feed is operated automatically to move the wheel forward an amount sufficient to restore the mechanical load on the motor to its original setting. This set value of load on the motor can, at any time, be easily regulated by means of a control knob to any value between that required to drive the wheel spindle light (i.e. without any cut) and the maximum grinding load.

Should the surface of the roll not be truly cylindrical at any point, a delay action can be switched into circuit. This avoids any application of the automatic feed during a momentary drop in grinding wheel motor load during that portion of a revolution in which the wheel is not cutting, and prevents the forward feed taking place due to the consequent momentary change in load current.

The automatic electronic feed is ideal for finish grinding. When it is necessary to retrue the wheel before finishing, the feed regulator can be adjusted to a low value and as the finish is built up, can be reduced in stages down to a setting as small as 0.025 mm. The process of finishing then becomes almost automatic and amounts of feed smaller than are possible by hand can be obtained automatically. A further feature for finishing is that after wheel retruing the feed can be engaged at its minimum setting to traverse the wheel forward until it just touches the face of the roll without danger of the wheel 'digging-in', and thereby prolonging the finishing operation.

Provision is also made on the control system which enables the feed to be operated in the outward direction, i.e. after roughing has been carried out, the pressure of the wheel face against the roll can be reduced by altering the setting of the feed regulator. The feed will then operate in the outward direction until the grinding wheel motor load, and therefore the grinding cut, is reduced. Successive adjustments of the feed regulator will enable a finish to be built up on the roll face.

Cambering mechanism

The gear-driven cambering mechanism is mounted at the rear of the grinding carriage and is driven by a pinion permanently meshed with a fixed rack, fastened to the wheelside body and extending over the full traverse length of the machine.

The traverse motion of the carriage drives the shaft carrying the formed cam through a system of reduction gears, incorporating change gears which are selected to use the working arc of the cam dependent on roll face length to be ground. This increases accuracy of cambering on shorter rolls while allowing small cambers on long rolls, without any need to change cams. The complete gearing system is fitted with a hydraulically operated backlash eliminator which reverses at each carriage directional change, and has fine adjustment to ensure that there is no displacement of camber form on reversal.

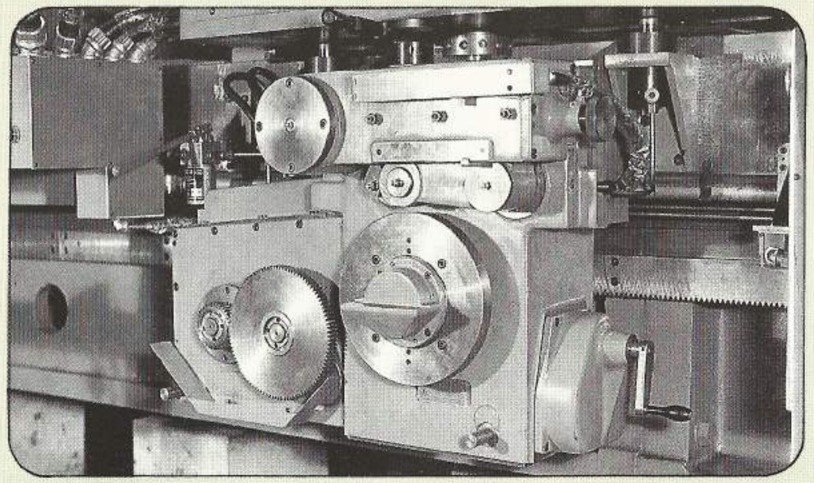
The centre line of the camber form is fully adjustable. With the wheel set at roll face centreline, the cam is manually positioned at centre using a built-in level. The change gears are then fitted and locked up at this setting. A range of change gears is supplied to suit the machine length capacity.

The cam rotation imparts lift, via a double lever arrangement, to the wheelhead infeed slide, which is pivoted on sturdy taper roller bearings at its front end. This tilting action adds the required camber form to the wheelhead infeed as described above.

The upper arm of the double mechanism has an adjustable effective length allowing the total crown or concavity of the roll to be pre-set. Camber charts also supplied allow any intermediate camber to be selected within a given cam range.

Cams suitable to customer's requirement will be supplied for either convex or concave forms up to a maximum of 10 mm (0.4") on diameter. The cambers required should be specified at time of order.

The Churchill standard cam produces a parabolic form on the roll profile. This is also closely similar to a 70° sine curve. Other profiles can be generated using special cams optionally available.



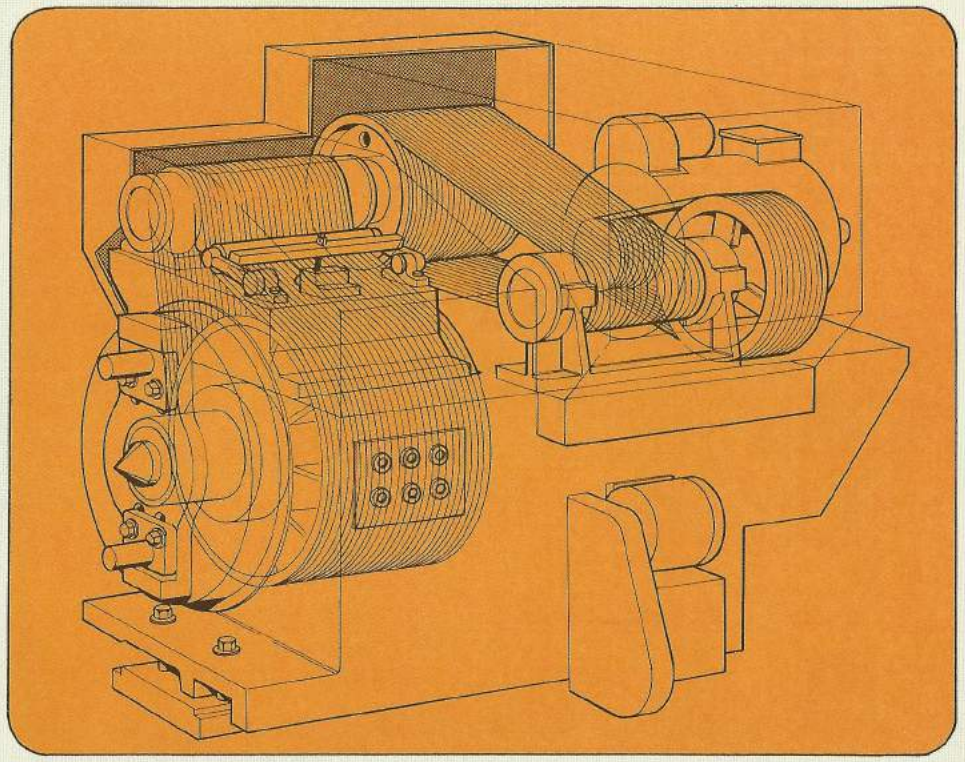
Workhead—belt drive or chain drive

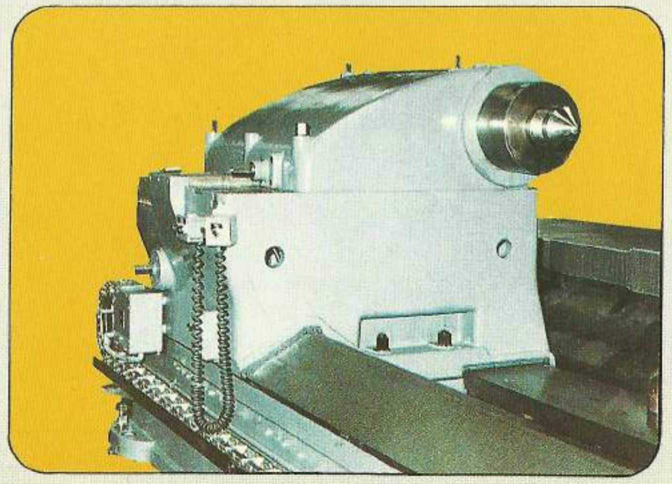
The substantial fully enclosed workhead is of the 'dead' centre type and is powered by an infinitely variable d.c. motor. Transmission to the faceplate is initially by multi 'Vee' belt drive to the first countershaft and thereafter by inverted tooth chain via a two speed reduction gearbox.

Provision is made for belt and chain tension adjustment.

Uniform torque is applied to the roller by a self-aligning work driver which compensates for axial displacement in the setting of the roll on journal rests or inequalities in the carrier plate when rotating between centres.

The cone angle is 60°.





Tailstock

The tailstock is cast in two parts, the top portion having cross-over adjustment for alignment corrections. Both castings are of heavy box section.

The non-rotating barrel is advanced and retracted by motor driven direct screw thrust.

The centre is located in a No. 7 Morse taper bore and has a 60° cone.

Roll journal rests

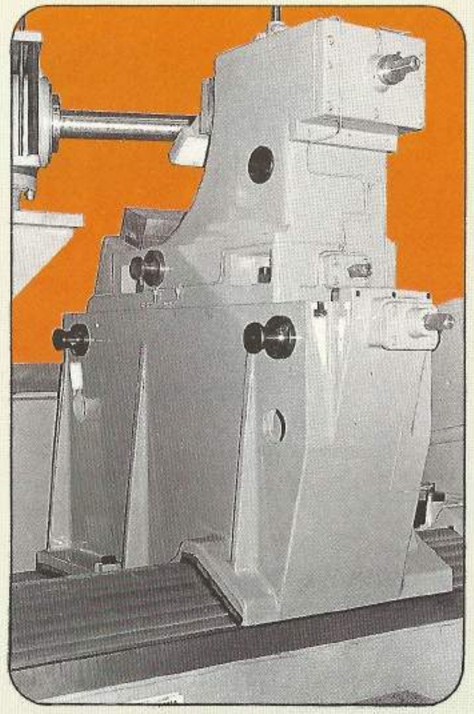
The roll journal rests are of rigid cast construction with wide support on the body ways for maximum dispersal of the work load.

The upper and lower bearing pads are designed to minimise surface wear under the weight of the heaviest rolls and are quickly interchangeable and independently adjustable. The bearing seats are of white metal moulded onto a dove-tail form.

Each pad which is motorised has an approximate adjustment range of 50 mm (2") on diameter but it is advisable to order bearing sets for a nominated diameter to obtain maximum wedge support behind the pads.

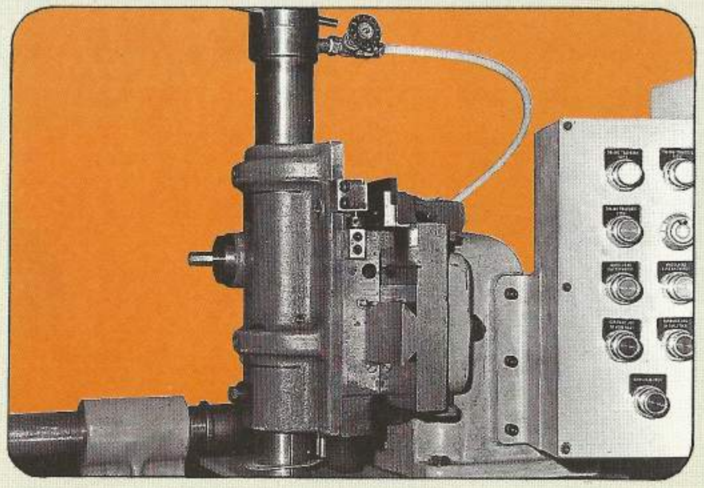
The entire rest may be moved by means of a d.c. motor to any desired position within the length grinding capacity of the machine.

Each roll bearing diameter has individual lubrication by oil pads mounted on adjustable holders which swing clear for roll removal.



Wheel dressing

The tailstock or wheelhead mounted dressing device is of sturdy and reliable construction and has the facility for either straight tapered or crown wheel forming.



Radius truing

A radius-truing device can be supplied for forming a radius on the corner of the grinding wheel in cases where radii between the journal and the roll end have to be ground. The device is mounted on the tailstock.

Centre grinding attachment

Accurate journal grinding depends to a great extent upon carrying the roll on true centres, concentricity of which is ensured by the use of this attachment. It is a separate motor-driven unit and the spindle head can be adjusted to the required angle. Feed is applied in the normal manner by moving the wheelhead forward.

Grinding wheel balancing

Balancing of grinding wheels is essential to the successful operation of roll grinding machines.

Balancing systems are supplied to suit individual customer's requirements.

A conventional free-standing disc-type balancing stand is available on which the grinding wheel and collet assembly can be statically balanced off the machine by means of adjustable balance weights mounted in the collet.

More sophisticated aids to wheel balancing on the machine, usually of proprietary manufacture can be supplied.

Swarf clearance

In grinding rolls to a high degree of accuracy and finish, the separation of swarf from the grinding coolant is of primary importance. If the grinding debris, both metal and wheel particles, is re-circulated with the coolant, the grinding wheel becomes clogged and the surface of the roll tends to 'pick-up'. A great deal of heat is also generated as a result of dragging the swarf past the ground surface. In order to obtain full efficiency it is essential that the re-circulated coolant is clean and free of grinding swarf. To this end Churchill roll grinding machines are suitably arranged so that the used coolant flows through an efficient clarifier unit to ensure that only clean coolant is re-circulated.

Electrical equipment

The design of the whole of the electrical equipment, both motors and control gear, has been the result of close co-operation between ourselves and the electrical manufacturers in order to fulfil the exacting requirements of roll grinding machines. The motors throughout are specially built and tested to ensure that the very high degree of precision dynamic balance, and freedom from vibration necessary for this work, is obtained in service.

In heavy duty machines of this type, instrumentation, convenience of operation and accessibility for maintenance are of vital importance and special attention has been given to these requirements. All electrical controls are housed in a control panel mounted on the wheelhead feed assembly adjacent to the operator's platform. All operations, including speed adjustments of the workhead, wheelhead and carriage traverse, are carried out by means of push buttons, and indicating lights are provided to show which motors are running. In the wheelhead and carriage lubricating systems, pressure switches are provided and any failure in the pressure system to these parts of machine, causes the corresponding motor to stop and the indicating light shows the location of the lost pressure. Tachometer indicators are embodied in the control desk to indicate the operating speeds of the workhead, wheelhead and carriage traverse. Multiple scales are used on these indicators so that the supervisory staff have a direct indication of the speeds being used. The following calibrations are provided:

WHEELHEAD – r.p.m. scale and surface speed of wheel for various diameters.
WORKHEAD – r.p.m. scale and surface speed scale for a particular roll diameter.
CARRIAGE TRAVERSE – a single calibrated scale gives the speed range covering each gear ratio of the carriage drive.

The controls for the electronic automatic feed equipment are mounted adjacent to the wheelhead ammeter, which is also housed in the desk so that the effect of adjustments in the feed control on the grinding wheel motor load can be readily observed.

In addition to the push buttons housed in the control desk, a pendant type of push button is hooked to the desk from which it can be removed and held in the operator's hand whilst on the carriage platform. This push button enables him to move to a convenient position whilst carrying out any of the following operations:

'Inching' of roll.
'Inwards' and 'outwards' power traverse of the wheelhead.
'Inching' of the carriage to the right or to the left.

The main control gear consists of a heavy duty contactor type sheet steel cubicle, which can be mounted adjacent to the machine and which includes all the necessary automatically operated starting equipment with remote-operated speed regulators for the variable speed motors. This cubicle is provided with a main interlocked isolating switch for disconnecting the a.c. and d.c. electrical supplies from the machine. The push button control circuits are all designed for use on a low voltage for reasons of safety and reliability. Where no direct current supply is available on site, the machines are supplied with rectifying equipment. This method of conversion has been chosen as there are no rotating parts and the equipment operates on an a.c. supply with high power factor and efficiency with the minimum of maintenance.

Automatic roll grinding

Automatic grinding cycle

At the completion of roll alignment, the main wheelhead carriage moves from its parked position behind the tailstock to a point where the wheel is suitably aligned with the end of the roll face. Rapid infeed of the grinding wheelhead to within close proximity of the roll face takes place, being slowed to a grinding feed until contact is made between the grinding wheel and the roll face. Feed continues until a relatively light cut has been achieved at which point the wheelhead infeed is stopped.

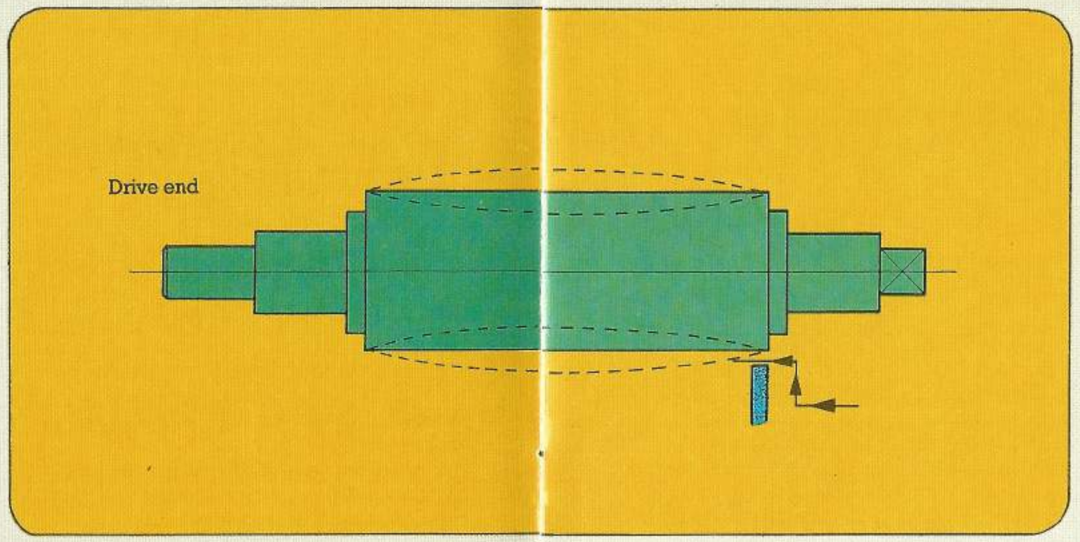
The carriage moves automatically towards the centre of the roll with an amplifier in the circuit detecting any significant increase or decrease in the cut.

Roll-shape sensing

Normally, a strip mill roll requiring regrinding will be worn in the centre, leaving the ends high. There may be instances, however, where a roll may require the camber reducing, and hence in this case the centre of the roll would be high.

This means that the machine has to sense the shape of the worn roll and grind accordingly. If then, on traversing the carriage, the amplifier detects a significant decrease in the cut, this indicates that the roll is low in the centre and end-diameter grinding is automatically selected.

If, however, the cut increases significantly, this indicates that the roll is high in the centre, and centre grind in automatically selected.



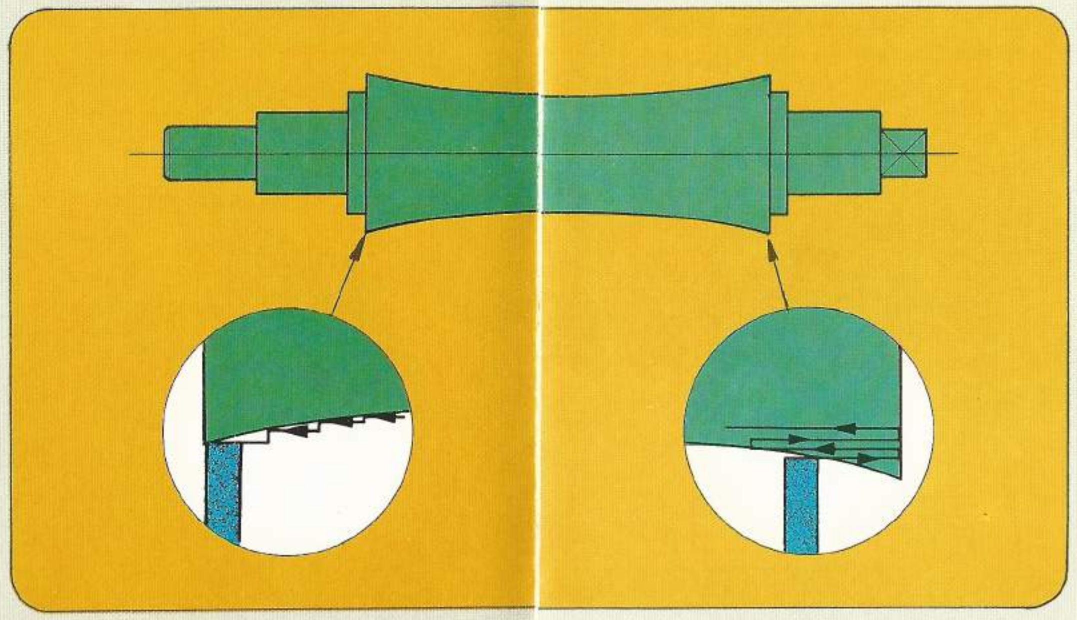
End-diameter grind

Assuming the selection of end-diameter grind due to the cut being lost in the worn region, the carriage then reverses and traverses back towards the end of the roll. During this pass towards the end of the roll, the maximum cut possible is maintained, the wheelhead feeding forward automatically to compensate for wheel wear when necessary.

On reaching the end of the roll, the carriage dwells for a pre-set period before reversing and traversing towards the centre of the roll again. At commencement of this inward pass, a pre-set timed infeed is applied to establish a further cut. No compensation for wheel wear is applied during this pass since the object is to once more sense when the wheel has passed into the low worn region of the roll, at which point it again reverses and traverses back towards the end of the roll.

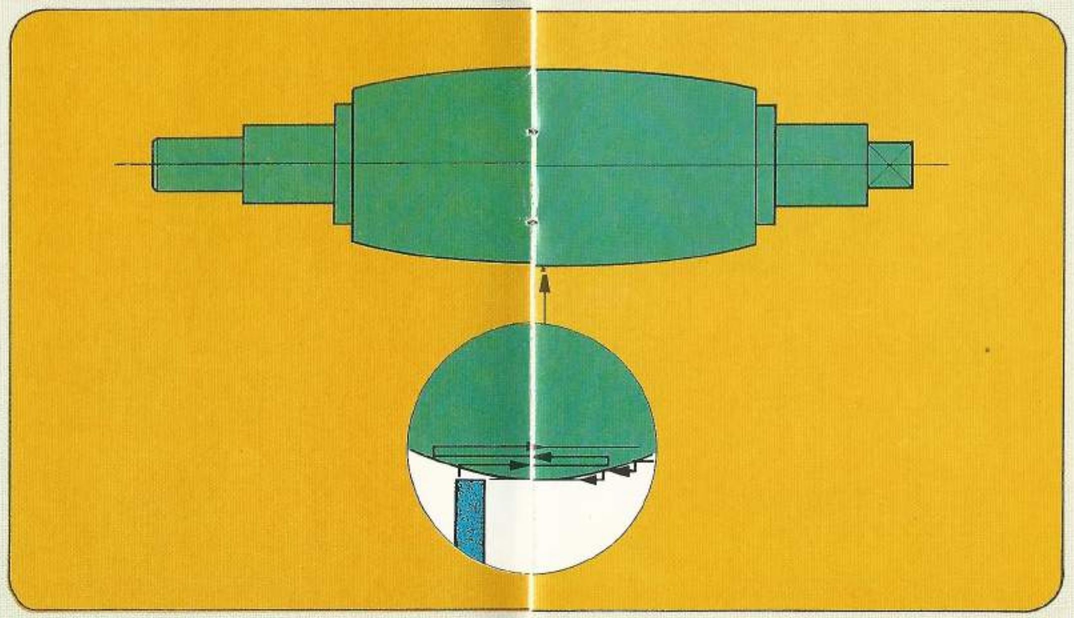
This sequence is repeated as often as is necessary to reduce the end of the roll to the worn centre, and hence at this point the wheel will arrive at the centre of the roll barrel. It is important to note that the number of end diameter grinding passes required to grind down the ends of the roll is dependent only on the amount by which the roll was worn in the mill, and the number of these passes will therefore vary from roll to roll, but will always be the minimum necessary to grind the ends down.

On reaching the centre of the roll-face, the carriage traverse continues towards the other end of the roll, and an amplifier in the circuit retracts the wheelhead in progressive steps to avoid excessive build-up of cut as the wheel traverses into the high end of the roll. On reaching the other end of the roll, the same procedure as for the first end is carried out and the required roll shape is thus obtained.



Roll-centre grind

Conversely, during the roll-shape sensing stage, should the load increase as the carriage traverses towards the centre of the roll indicating that the roll centre is high, the carriage stops and the wheelhead automatically retracts until the load decreases to a pre-set level. The carriage will then continue to traverse towards the centre of the roll, the wheelhead being retracted progressively until the centre of the roll is reached. The roll centre is then ground down in a similar manner to the end-diameter grind sequence, the carriage traversing into the worn end region of the roll and reversing back to grind the high centre down in the minimum number of passes necessary to achieve the roll shape required.



Having achieved the correct roll shape, it is only then necessary to remove any marks from the centre of the roll and to bring the roll surface back to the desired condition.

Normally five separate stages of grinding are introduced into the sequence to achieve this condition, these being:

Rough grind
Rough semi-finish grind
Semi-finish grind
Finish grind
Feedline elimination

Rough grind

During the rough-grind stage, the wheelhead moves forward automatically to compensate for wheel wear and maintains the maximum cut possible. The number of passes are automatically counted until the number pre-set on the counter or indicated on the tape/punch card has been completed. Alternatively, if under control of a sizing gauge, the rough grind passes will continue until the amount of stock removed agrees with that indicated on the tape/punch card.

Rough semi-finish grind

During the rough semi-finish grind stage, the wheelhead infeed is only applied at the ends of the roll as the carriage is reversing. The infeed is by either a timed amount or to a pre-set value of wheelhead current. Compensation for wheel wear does not take place during the passes from one end of the roll face to the other. The number of passes are automatically counted until the number pre-set on the counter or indicated on the tape/punch card has been completed. Alternatively, if under control of the gauge, the rough semi-finish grind passes will continue until the amount of stock removed agrees with that indicated on the tape/punch card.

Semi-finish grind

During the semi-finish grind stage the wheelhead infeed is again only applied at the ends of the roll as the carriage is reversing. The infeed is by either a timed amount or to a pre-set value of wheelhead current. Wheel wear compensation does not take place during the passes from one end of the roll face to the other. The number of passes is automatically counted until the number pre-set on the counter or indicated on the tape/punch card has been completed.

During the rough semi-finish and semi-finish grind stages, the roll speed, carriage traverse speed and wheelhead infeed rates are all automatically adjusted to the optimum for the particular roll and wheel conditions.

Finish grind

During the finish grind stage the wheelhead infeed is again only applied at the ends of the roll when the carriage is reversing. The infeed is to a pre-set value of wheelhead current. Wheel wear compensation does not take place during the passes from one end of the roll face to the other. The number of passes are automatically counted until the number pre-set on the counter or indicated on the tape/punch card has been completed. During the finish grind stage, the roll speed, carriage traverse speed and wheelhead infeed rates are again automatically adjusted to the optimum for the particular roll and wheel conditions.

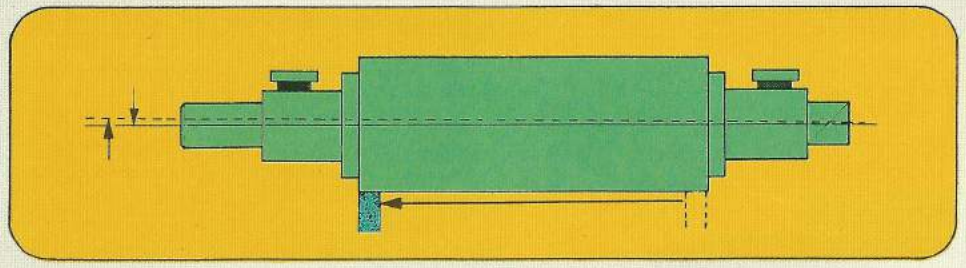
Feedline elimination

Feedline elimination is now introduced to remove any trace of feedline which may remain on the roll face at the completion of the finish-grind stage. During this process the relative disposition of the wheel and roll faces is automatically adjusted so that during the final pass a leading edge of the wheel is always presented to the roll face regardless of whether the roll is being ground parallel or to a concave or convex camber. This process is completed at the roll end if the roll is being ground parallel or concave, or at the roll centre if the roll is being ground convex.

This completes the automatic grinding sequence, and the cycle is completed by the automatic retraction of the wheelhead at maximum rate, followed by automatic switching off of the coolant, automatic stopping of the work rotation, and automatic fast traverse of the wheelhead carriage to a parked position behind the tailstock.

Automatic roll alignment

1 by measurement of wheelhead motor current on the roll body ends



It has been found in many instances that the ends of the roll face beyond the strip width are unaffected by the rolling process, and hence may be used as a datum for aligning the roll prior to grinding.

The workhead-end roll-journal rest has a motorised top block, which is automatically controlled within the cycle sequence. Roll alignment consists of the wheelhead establishing a cut of known value at the tailstock end of the roll barrel with the roll set approximately parallel in the journal rests.

Having established the cut, the carriage then traverses at a rapid rate towards the workhead end of the roll, and at the same time the workhead-end top block automatically retracts approximately 0.3 mm, thus withdrawing the face of the roll from contact with the grinding wheel.

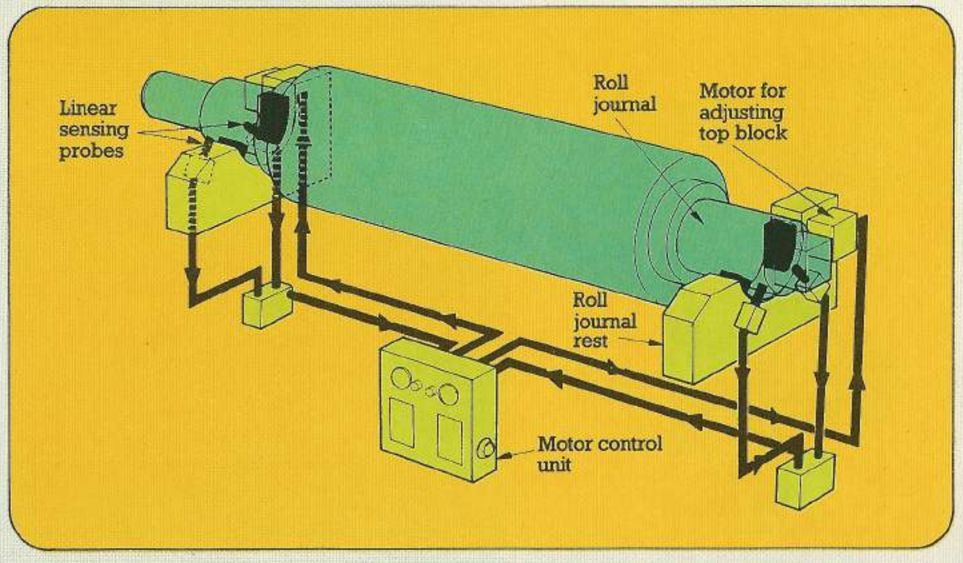
When the wheel has reached the workhead end of the barrel, the carriage stops, and the workhead-end roll-journal rest top block advances the roll towards the wheel until the same motor load current has been established. Thus, the roll face is parallel to the traverse of the wheelhead carriage.

2 by probing the roll necks

It may, in some instances, be preferable to align the roll from the necks, and in this method, a system of differential balance between two probes on each neck is employed which datums the axis of the roll irrespective of the diameters of the two necks.

The outputs of two measuring heads are connected in such a way that the balance between them indicates that the roll is on the required centre.

Motorised adjustment is fitted to the top block of both roll-journal rests in this case, which during the roll alignment stage operate independently and simultaneously to bring both ends of the roll on to the correct axis. As each rest achieves a balance between the measuring heads, a signal stops the feed motor operating the top block and the roll is correctly aligned at this point.



Roll matching

Automatic roll alignment from the necks as described in Alignment 2 is necessary when roll matching is required, since the use of a single-point gauge on the centre of the roll body demands that the axis of the roll has been previously aligned in relation to the wheelhead carriage slideways.

Assuming, therefore, that the rolls are ground in pairs to be matched for size, the gauge performs the following functions:

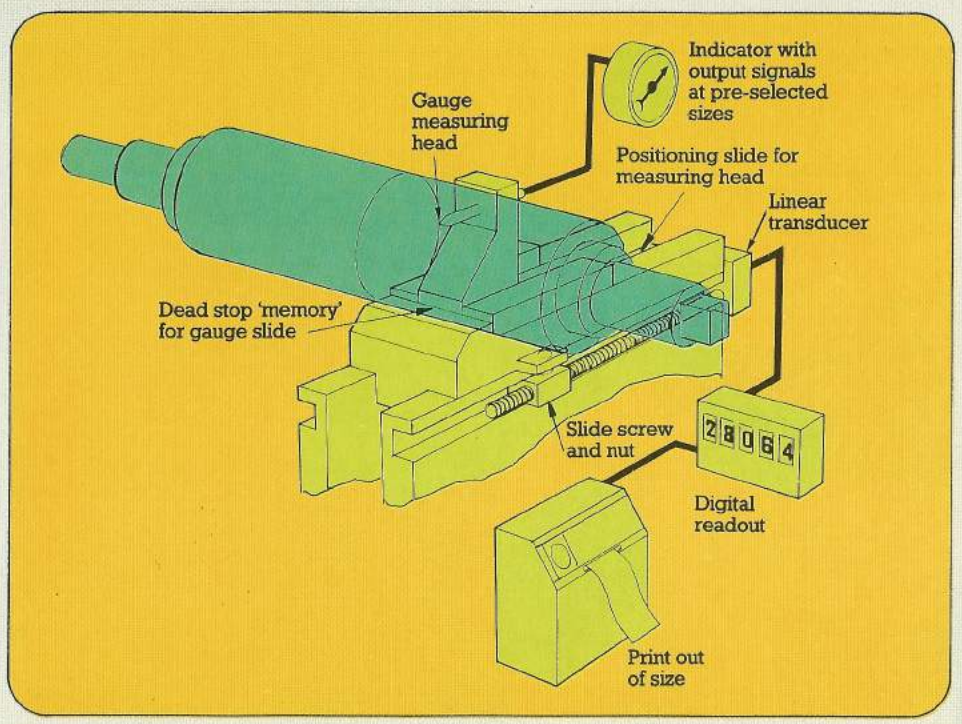
Controls the amount of metal to be ground from the first roll.

Controls the sizing of the second roll to match that of the first irrespective of the amount of metal to be removed from the second roll (it will be seen from this that it is always necessary to grind the smaller of a pair of rolls first).

Controls the stages of grinding operation of both rolls from the point at which it is applied, i.e. at the commencement of the rough-grind stage, to the end of rough semi-finish grind. If required, a printed read-out of the roll size can be given for each roll, and the signal for this is given from the gauge.

Output signals from the gauge control the grinding operation, and determine the point at which the rough-grind stage ceases and the rough semi-finish grind stage commences, and ceases.

At the end of the rough semi-finish grind stage, the gauge is withdrawn from the roll face in order to minimise wear on the probe. At this point in the cycle, the majority of stock has already been removed, and there will probably be little more than 0.05 mm stock removal left on the roll. Thus, we will have consistent conditions of finish and stock removal to final diameter, which, by using the same number of semi-finish and finish passes on both rolls, will ensure the same diameter is reached.



Standard duty specification

Model	TWA		TWB		TWR		TWR	
	mm	in	mm	in	mm	in	mm	in
Maximum swing	965	38	1120	44	1600	63	1905	75
Maximum diameter ground with full size wheel	815	32	1065	42	1525	60	1830	72
Size of standard grinding wheel (diameter × width × hole)	762 × 50 × 305 (30 × 2 × 12) on each machine							
Minimum diameter of grinding wheel	430 (17) on each machine							
Maximum distance between grinding wheel and works centre	735	31	865	36	1090	45	1245	51
Minimum distance between grinding wheel and work	405 (16) on each machine							
Minimum diameter ground with full size wheel*	159 (6) on each machine							
Wheel speeds (variable speed motor) rpm	600 to 1200 on each machine							
Grinding wheel feed (advance of wheel)								
One revolution of handwheel	0.25 (0.01) on each machine							
One division of handwheel	0.0025 (0.0001) on each machine							
Work speeds	Can be varied according to requirements							
Wheelhead carriage traverse speed	50-3050 mm per min (2-120 in per min) on each machine							
Capacity of roll journal rests (2-point type)	150-510	6-20	150-455	6-18	150-635	6-25	150-635	6-25
or	305-660	12-26	255-660	10-26	455-815	18-32	455-815	18-32
or			405-760	16-30	635-915	25-36	635-915	25-36
Capacity of roll journal steadies (3-point type)	See page 5							
Capacity of roll body steadies	Variable on each machine							
HP of motor for grinding wheel spindle drives	40 or 60		40 or 60		40 or 60		40 or 60	
HP of motor for wheelhead carriage traverse drive	5		5		5		5	
HP of motor for workhead drive*	10		15		15/20		15/20	
Approximate net weight of machines with 6095 mm. (240 ins.) length between centres	30480 kg	34 ton	32510 kg	32 ton	39625 kg	39 ton	39870 kg	39.25 ton
Approximate gross weight of machines with 6093 mm. (240 ins.) length between centres	34545 kg	34 ton	37085 kg	36.5 ton	447705 kg	44 ton	45201 kg	44.5 ton

The machines can be supplied in a wide range of length capacities. *This capacity may be modified according to work requirements.

Heavy duty specification

Model	TWA		TWB		TWR	
	mm	**in**	**mm**	**in**	**mm**	**in**
Maximum swing	1220	48	1525	60	1830	72
Maximum diameter ground with full size wheel	815	32	1065	42	1675	66
Size of standard grinding wheel (diameter × width × hole)	915 × 100 × 305 (36 × 4 × 12) on each machine					
Minimum diameter ground with full size wheel	50	2	100	4	100	4
Maximum distance between grinding wheel and work centres	865	34	990	39	1295	51
Minimum distance between grinding wheel and work centres	485	19	510	20	510	20
Wheel speeds (variable speed motors)	500-1000 rpm on each machine					
Grinding wheel feed (advance of wheel) One revolution of handwheel	0.250 (0.010) on each machine					
One division of handwheel	0.0025 (0.0001) on each machine					
Workspeeds	Can be varied according to requirements					
Wheelhead carriage traverse speeds	75-4191 mm per min (3-165 in per min) on each machine					
Capacity of roll journal rests (2 point type)	150-510	6-20	150-455	6-18	150-635	6-25
or	455-710	18-28	255-660	10-26	455-865	18-32
or			510-815	20-32	710-1015	28-40
HP of motor for grinding wheel spindle drive	60 or 100					
HP of motor for wheelhead carriage traverse drive	5 on all machines					
HP of motor for workhead drive	15 to 35 according to size of machine					
HP of motor for workhead traverse	3				5	
HP of motor for workstock traverse	3 on all machines					
Approx net weights of machines with 6095 mm (240 ins) length between centres	78230 kg	172480 lbs	84330 kg	185920 lb	103630 kg	228480 lb

Churchill traversing table roll grinders Models C, D & F

Churchill roll grinding machines are equally suitable for high-speed rough grinding and for the production of precision rolls to ultra-fine finishes (less than one micro-inch CLA).

The automatic electronic feed mechanism ensures maximum use of the power available at the grinding wheel. Considerable time is saved and less operating skill is required to adjust the grinding wheel feed when grinding worn or damaged rolls, with this type of feed.

Electronic feed means that the cut taken by the grinding wheel is constant. Feed can be adjusted for the wheel to just "kiss" the roll, allowing the virtual automatic process of finishing. Automatic infeed reduces the necessity of diamond dressing and increases wheel life.

The design and quality construction of the machines ensures that wear of all moving parts is reduced to the absolute minimum. This attention to detail results in a long life with minimum maintenance, throughout which precision production is obtained. C, D and F machines permit the decisive finishing of concave, parallel or convex rolls.

In addition, they are suitable for many other applications, such as printing press cylinders, hydraulic press rams, drill press columns, and other cylindrical components requiring accuracy and uniformity of surface. Rolls can be of chilled or alloy iron, steel, brass, granite, or any other material used for rolling metals, rubber, plastics, textiles and paper. C, D and F roll grinding machines are available to suit special requirements.

Wheelhead

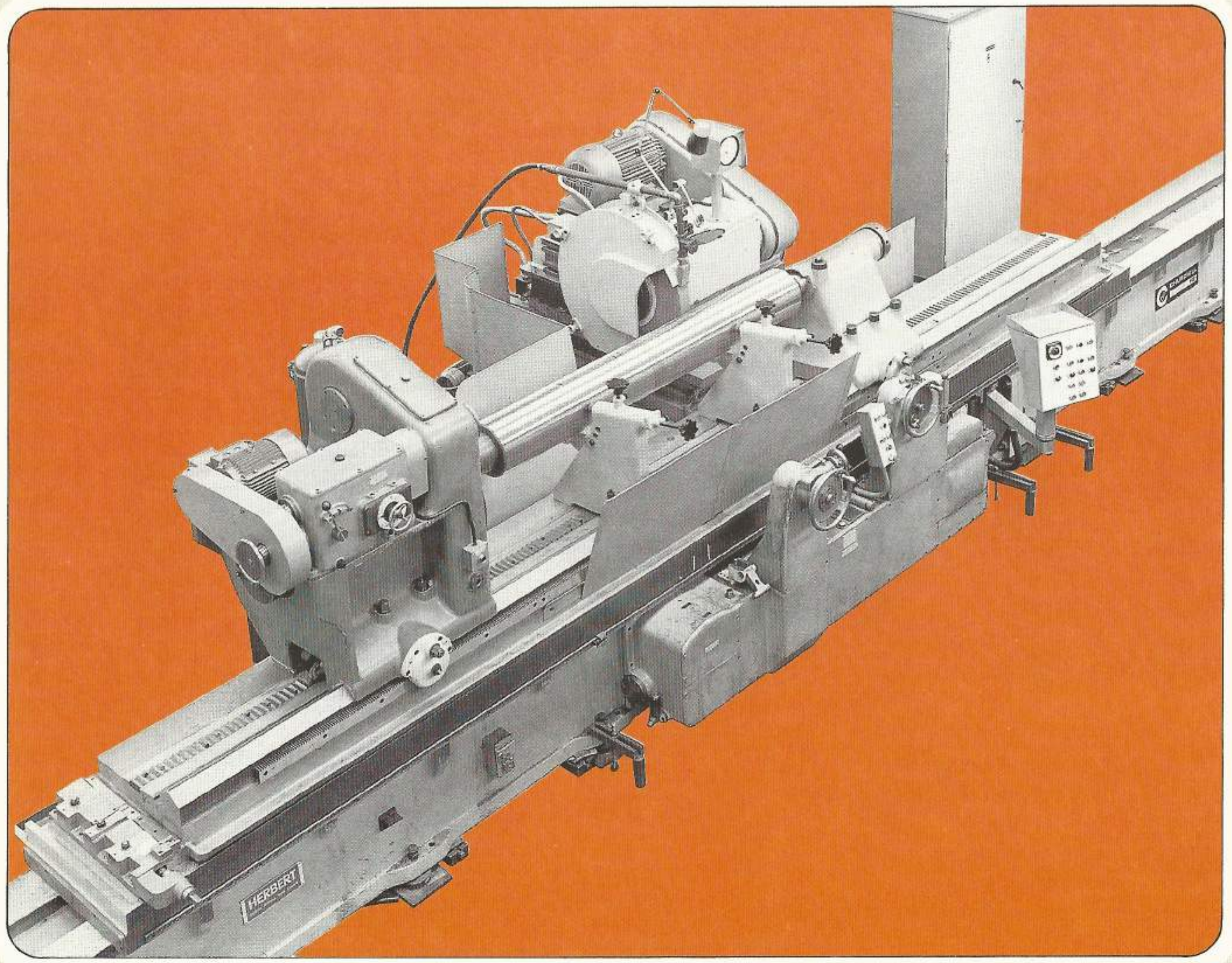
The wheelhead ensures maximum rigidity of support to the bearings of the grinding wheel spindle, which is of nitralloy steel. The grinding wheel spindle is supported hydrostatically in bronze bearings externally fed with oil at a pressure of approximately 400 lbf/in^2, and provides a standard surface speed of up to 45 m/sec. (8,500 sfpm) to be used.

Wheelhead infeed

As well as the normal hand operated infeed, two separate automatic infeed systems are included.

1. AUTOMATIC "PICKFEED" operates at each reversal of the table traverse when a predetermined increment of wheelhead infeed is applied. This increment can be increased or decreased at will by the operator.

2. AUTOMATIC ELECTRONIC FEED ensures that maximum use is made of the power available at the grinding wheel and consequently guarantees the optimum production of rolls from the machine. This time-saving feature can be easily engaged or disengaged according to work being ground. Less operating skill is required.



Work table

The standard work table is of one piece construction and is traversed by means of a precision rack and pinion gear drive, ensuring completely smooth movement in either direction.

On the Models C and D the table traverse speed is infinitely variable and is controlled by electro magnetic clutches which also provide an adjustable dwell at each table reversal. On the Model F, a wide range of table traverse speeds is provided by means of a 3-speed motor and 5-speed gear box. A simple and easy means of adjusting the dwell at each table reversal is incorporated.

All models are equipped with quickly adjustable trip dogs by which the table traverse stroke can be accurately set for grinding up to shoulders.

Correction for slight errors in parallelism can easily be made by using the "set over" adjustment incorporated in the tailstock. Whenever the machine is required for grinding taper journals an easily adjustable swivel table can be supplied.

Workhead

The workhead, which is of the dead centre type, has a belt drive to ensure the best possible finish on the workpiece. Experience has proved conclusively that a much better finish is obtained in a shorter time using Vee belt drives, than is possible with any other type of drive.

A self-aligning work driver automatically compensates for minor errors in setting and provides a balanced driving tongue to the roll.

A wide range of workspeeds are available by means of a variable speed motor and a precision built change speed gearbox. This provides infinitely variable speeds over the range.

All shafts run in anti-friction bearings, and the electric motor is precision dynamically balanced to guarantee smooth and vibration-free rotation.

Roll journal rests

The roll journal rests supplied with this range of machines are adjustable and cater for a wide range of workpiece diameters. The special design of these rests reduces setting up time to a minimum. Positioning of journal rests is carried out in a similar manner to the workhead and tailstock.

Cambering mechanism

The cambering mechanism automatically shapes the roll in a concave or convex curve, usually of parabolic form.

The mechanism has been carefully designed so that there are no gears and no keyways. Backlash, with the consequent malformation of the form, is therefore eliminated.

Bed

The machine bed, which is made from good quality cast iron, has been specifically designed to ensure maximum rigidity and stability.

The hand-scraped slideways, generously proportioned to give low unit loading and lifelong accuracy, are chilled to a hardness of approximately 200 brinel. Lubrication is fully automatic, and complete protection against the ingress of swarf etc. is ensured by closely-fitting flexible covers.

Tailstock

The tailstock is of heavy construction and accurately mounted on the table ways. On machines with swivelling tables the tailstock is made in one piece, but when the machine has a solid table the tailstock is of two-piece construction to provide "set over" adjustment for alignment correction. The hardened spindle is of the dead centre type and is screw adjusted by means of a handwheel.

Both Workhead and Tailstock are easily adjustable along the tableways by means of a rack and pinion drive.

Specification

	Model C		Model D		Model F	
	Metric	Imperial	Metric	Imperial	Metric	Imperial
Maximum swing over workbed	405 mm	16 in	610 mm	24 in	760 mm	30 in
Maximum diameter ground with full size wheel	355 mm	14 in	510 mm	20 in	710 mm	28 in
Minimum diameter ground with full size wheel	0					
Size of standard grinding wheel (diameter x width x hole)	660 × 50 × 305mm (26 × 2 × 12 in)					
Grinding wheel speeds — variable	500-750 rpm					
Motor for grinding wheel drive	30 hp		40 hp		40 hp	
Metal removal capacity per minute	16.4 cc	1 cu. in	32.7 cc	2 cu. in	41.0 cc	2½ cu. in
Drive to standard workhead	Belt		Belt		Chain	
Motor for workhead drive	2 hp		5 hp		7½ hp	
Size of workcentres	No. 4 Morse		No. 6 Morse		No. 6 Morse	
Motor for table drive	3 hp		5 hp		3 hp	
Table traverse speeds per minute	102-5334 mm	4-210 in	100-3010 mm	4-123 in	75-1650 mm	3-65 in
Maximum camber with standard cams — convex or concave	3.05mm (0.120 in)					
Capacity of standard journal rests	50-254 mm	2-10 in	115-305 mm	4½-12 in	250-520 mm	10-201½ mm
Maximum weight of roll accommodated supported on roll rests	680 kg	1500 lb	3310 kg	7300 lb	9072 kg	20 000 lb
Weight carried between live centres when journal grinding	680 kg	1500 lb	3310 kg	7300 lb	7720 kg	17000 lb

Model C						
Model Code No	Length between centres		Floorspace on full traverse		Floorspace width	
	mm	in	mm	in	mm	in
13220	1270	50	4625	182	2210	87
13221	1525	60	5130	202	2210	87
13222	1830	72	5740	226	2210	87
13224	2440	96	6960	274	2210	87
18131	3050	120	8180	322	2210	87

Model D						
Model Code No	Length between centres		Floorspace on full traverse		Floorspace width	
	mm	in	mm	in	mm	in
18015	1830	72	6705	264	3430	135
18016	2440	96	7925	312	3430	135
18135	3050	120	9145	360	3430	135
18135	3660	144	10365	408	3430	135
18136	4270	168	11580	456	3430	135
	4880	192	13410	528	3430	135

Model F						
Model Code No	Length between centres		Floorspace on full traverse		Floorspace width	
	mm	in	mm	in	mm	in
18018	2440	96	8535	336	3505	138
18019	3050	120	9755	384	3505	138
18137	3660	144	10975	432	3505	138
18138	4270	168	12190	480	3505	138
18139	4880	192	13410	528	3505	138
18140	5490	216	14630	576	3505	138
18141	6100	240	15850	624	3505	138

Churchill planetary grinders Models UA, UB, UC & UD

The Churchill planetary type grinding machine has been designed specially for grinding bores and outside diameters in machine parts which cannot be conveniently rotated. The machines operate on the planetary principle; the grinding wheel whilst rotating at high speed also moves in a circular orbit within the bore or around the diameter being ground. The grinding spindle is secured to the faceplate of the main spindle and is quickly interchangeable with other sizes.

The various adjustments on Churchill machines enable diameters to be ground in accurate relationship with previously finished surfaces.

This type of machine is manufactured in four sizes, the smallest being:

The Model UA which is capable of grinding bores up to 355mm diameter by a max. length of 760mm – to the largest:

The Model 'UD' which could grind up to a 1015mm dia. bore and 3050mm length.

Grinding spindles

These are of the detachable tube type and are obtainable in a variety of sizes governed by the capacity of the machine and the particular work required enabling bores as small as 25mm to be ground. The manufacture of grinding spindles is subject to tests throughout so that the high-class work obtained by them fully meets the exacting needs of present day machinery workshops. Only precision type bearings are used and these are carefully inspected and matched so as to give maximum efficiency and accuracy.

Grinding spindles are available for the grinding of external diameters where the standard amount of planetary stroke is insufficient to cater for the diameter to be ground.

Work table

The worktable is extremely rigid as it is stationary during grinding operations and is mounted on the main body of the machine. Cross movement of the table is either hand or power operated and a micrometer dial ensures that accurate cross adjustment is made.

Grinding wheel traverse

Traverse of the grinding wheel through the bore is by movement of the wheelhead carriage. Piston type hydraulic mechanism provides a continuous range of speeds up to 3.66 metres per minute. Sensitive hand traverse is also provided. The stroke length is accurately set by trip dogs.

Grinding wheel feed

Grinding feed is applied by increasing the eccentricity of the grinding wheel spindle. This adjustment is very sensitive and can be applied gradually as required throughout the grinding operation. It is obtained by double eccentric sleeves on the model UA and by an adjustable slide on the larger models.

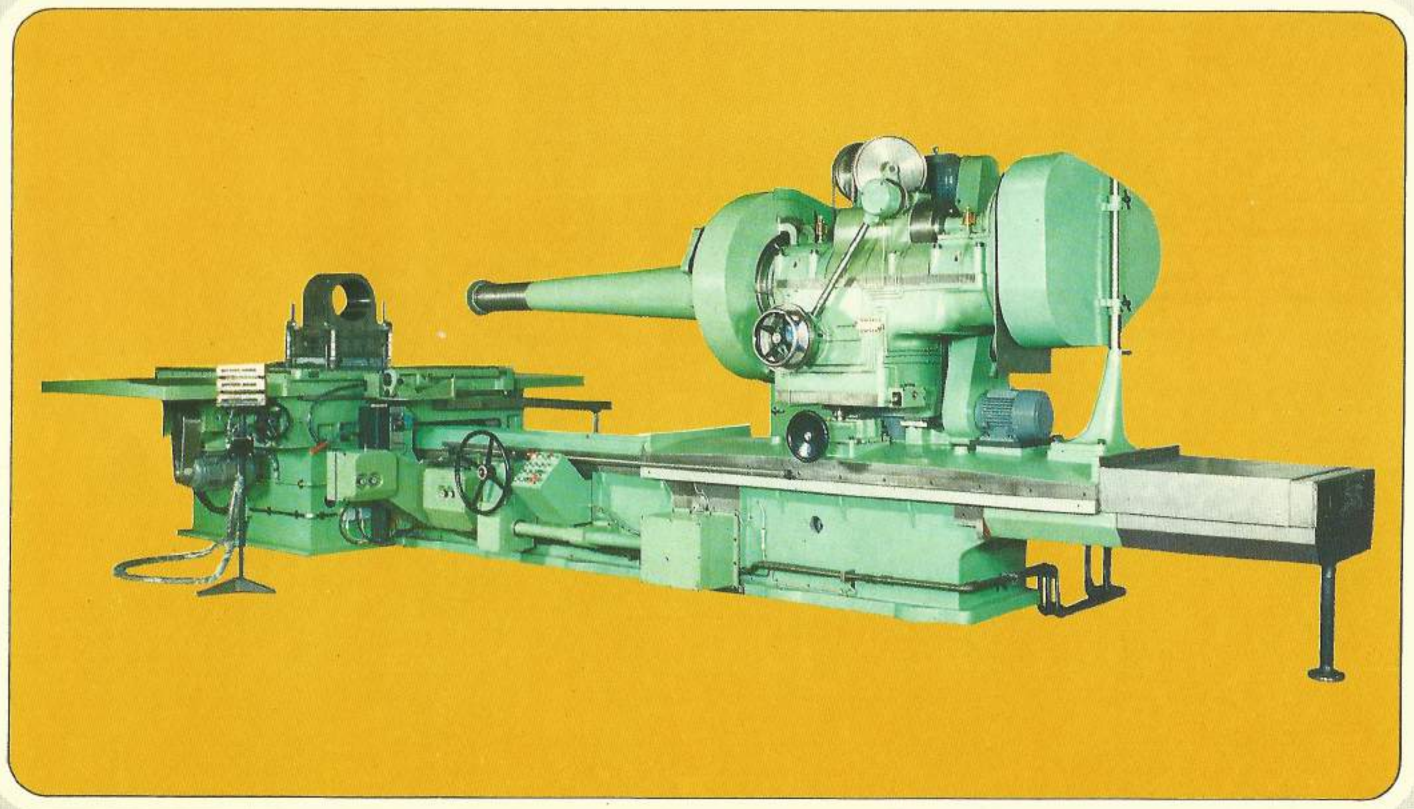
Power elevation to the wheelhead is standard on all machines.

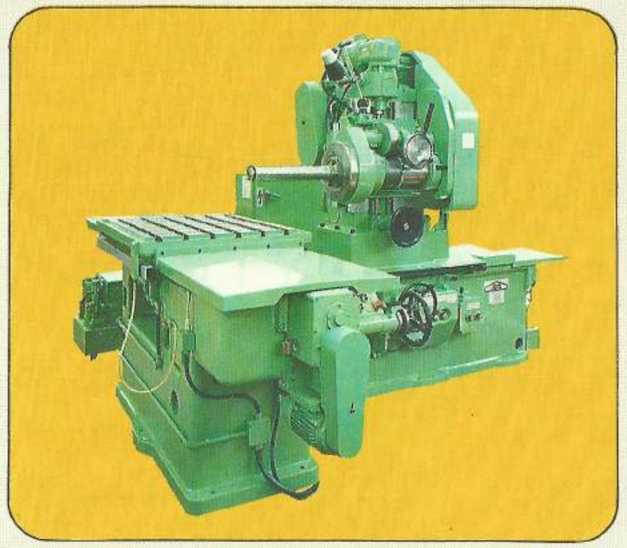
Ease of operation

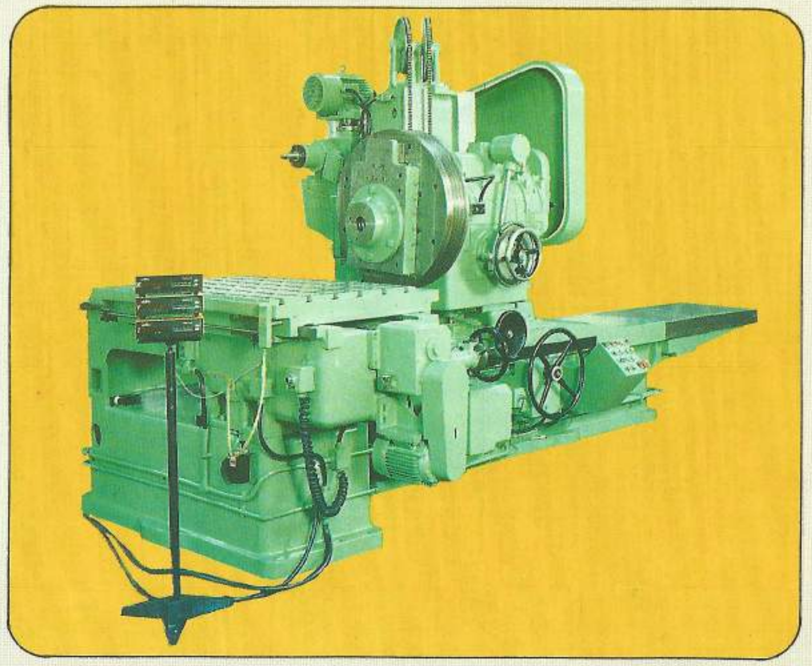
By ergonomically grouped controls which reduce operator fatigue.

Electrical equipment

The whole of the electrical equipment is specially designed for precision grinding duty and ensures unbroken operation over a very long life.





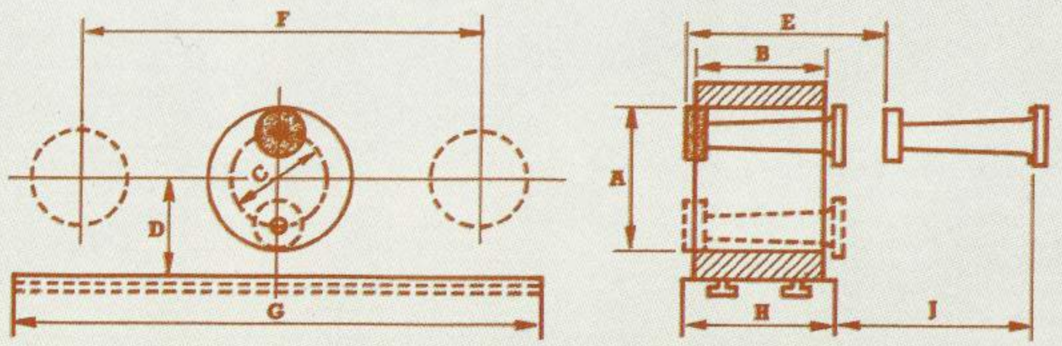


The wheelhead and traverse motors are of the totally enclosed type and are built to British Standards Specification. They have to pass the Churchill test for smooth running, a very stringent specification having been established to ensure that no vibration is transmitted to the machine which might adversely affect the finish of the ground work.

The control equipment is either fitted to the body or supplied as a separate cubicle, and all wiring is carried out in oil and coolant resisting cable. The control push buttons are of the suds proof type and are fitted in a position convenient to the operator.

Specification

All dimensions in millimetres		Model UA	UB	UC	UD
Capacity with largest internal spindle that can be fitted	A x B	355 x 760	560 x 1220	815 x 2135	1015 x 3050
Maximum diameter of planetary stroke	C	75	150	150	150
Maximum centre height over table	D	455	965	785	785
Minimum centre height over table	D	205	305	455	455
Maximum length of traverse of grinding wheelhead	E	865	1525	2440	3355
Total cross adjustment of table	F	815	840	840	840
Length of table	G	965	1220	1220	1525
Width of table	H	760	815	815	1830
Minimum distance between table edge and spindle mounting	J	840	1600	2970	3760
Number of planetary motion speeds		4	4	4	4
Traverse speeds (infinitely variable)		Up to 3.658 metres per minute			
HP of wheel spindle motor		3	5	7.5	10
HP of traverse drive motor		2	3	3	3
HP of planetary drive motor		2	3	3	3
HP of wheelhead elevating motor		2	3	3	3
Floor space required at full traverse stroke (overall length x overall width)		3505 x 2135	4570 x 2590	7770 x 2590	8685 x 2895
Approximate net weight		4215kg	12850kg	15695kg	18540kg



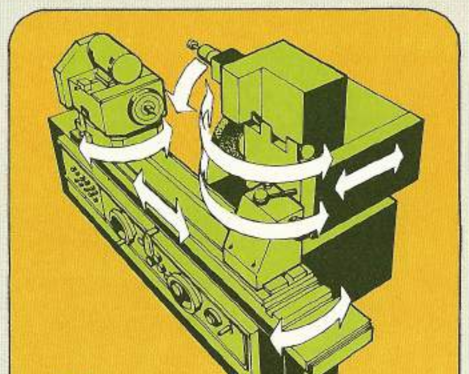
Churchill plain & universal grinders Model BX Series 2

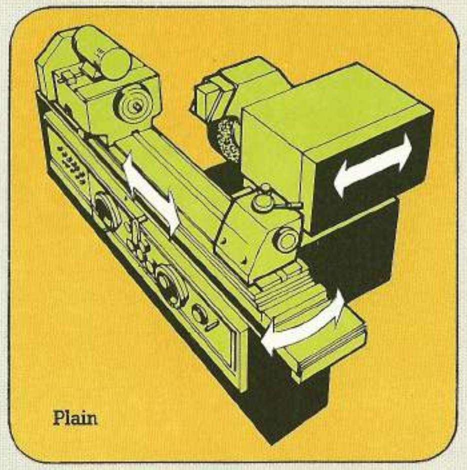
Operational mode

Manual
The grinding operation is under the control of the operator. Aids to production such as rapid advance and return of the wheelhead, and automatic pick feed, are fitted.

Semi-automatic
The grinding cycle is fully automatic but other functions such as wheel truing and compensation for reduction in wheel diameter, are controlled by the operator. Increased production results from the hydraulic plunge feed facility. Gauging equipment can be fitted to increase output and improve accuracy.

Fully automatic
The complete machining cycle, including wheel truing and compensation, is fully automatic. The combination of plunge grinding, automatic gauging and profile wheel truing gives maximum output and accuracy for mass production. The operator merely loads and unloads the component.


Fully universal


Plain

Wheelhead

The large diameter spindle is supported by air bearings. Increased production and accuracy result from the following advantages when compared with conventional bearings:

- Warm-up period is unnecessary.
- The wheel can be balanced on the machine.
- A greater number of workpieces can be ground between dressings.
- No spindle end float.
- Longer wheel life is possible.
- No lubrication.
- Thermal distortion is eliminated.
- Lower maintenance cost.
- Faster stock removal possible with standard 45 m/sec (8800 sfpm) wheel speed.

The wheelhead is mounted on widely-spaced vee and flat anti-friction slides to give extremely accurate and sensitive feed response. A hydraulic backlash eliminator ensures consistency of infeed.

Power-operated quick approach and return to the wheelhead is fitted to facilitate rapid positioning. The wheelhead is either heavy-duty (11kW) or standard-duty (5.5kW). Four different wheelhead configurations are available

Hydraulic plunge feed

Hydraulic feed of the grinding wheel is fitted on machines with automatic grinding cycles. The rate and amount of infeed are infinitely variable, allowing the operator easily to pre-set the optimum constant feed rate and travel to suit specific grinding conditions. Forward feed is either to a dead stop or controlled by a sizing gauge.

Workhead

Infinitely-variable work speeds are provided by a thyristor-controlled motor. This well-proven design provides a silent, vibrationless drive, which eliminates work speed fluctuation even at the slowest speeds, and irrespective of work load. Fitted with ultra-precision taper roller bearings. Heat generation is minimised. Inching (jogging) control facilitates workpiece inspection on the machine.

Three types of standard and heavy-duty workhead:

- Dead centre—for workpieces held between centres.
- Combined live spindle and dead centre —both for workpieces held between centres and for those which require a chuck or fixture.
- Combined live spindle and dead centre on a swivel base—to provide a fully universal facility.

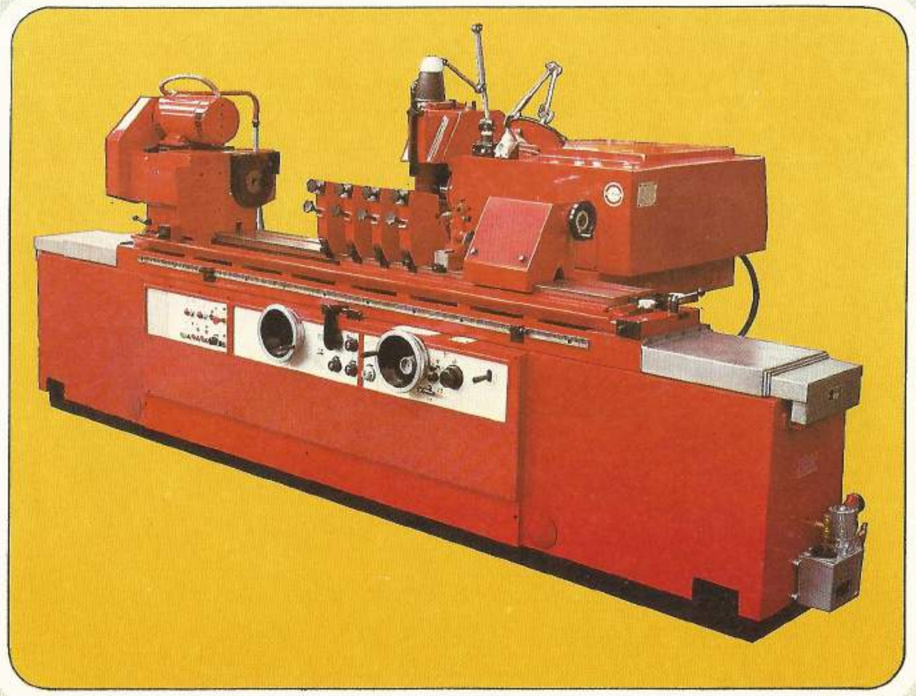
Internal grinding

Internal grinding on a universal machine can be carried out without disturbing the alignment or removing the external grinding wheel. The internal grinding spindle on a universal machine is carried on a swing-down bracket, which is secured to the front face of the wheelhead. Bores up to 455 mm (18 in) long can be ground. A wide variety of proprietary internal spindles are available.

Tailstock

A dead-centre tailstock with adjustable pressure regulator to prevent distortion of slender workpieces, is provided in one of the following forms:

- Lever operated — quick action suitable for light workpieces.
- Handwheel operated—for heavy workpieces.
- Hydraulically operated — to reduce operational fatigue in mass-production of heavy workpieces. Hydraulic tailstocks are interlocked with the automatic cycle of the machine to prevent accidental release of the workpiece during grinding.



All tailstock barrels are spring loaded to compensate for axial expansion of the workpiece during grinding.

Work table

The work table is in two sections so that the top table can be swivelled for taper grinding. A graduated scale is fitted to enable quick settings to be made by fine screw adjustment. A dial indicator gauge can be fitted to simplify setting.

For grinding up to a shoulder, a dial indicator and dead stops can be supplied. Stainless-steel telescopic covers protect the slideways. The table traverse is hydraulically actuated and provides an infinitely-variable speed range.

In-process sizing

On manually-operated machines gauging can be supplied to give visual indication to the operator when size is reached — it does not control the grinding cycle.

On machines having an automatic grinding cycle, mechanical dead stop sizing is fitted. The wheelhead infeed is arrested by the dead stop and, after a pre-determined spark-out period during which size is reached, the wheelhead retracts.

To give increased accuracy and avoid subsequent inspection an electro-sizing gauge can be fitted. When the wheelhead reaches a pre-set oversize position, a signal is transmitted from the gauge to arrest the infeed. After a pre-determined spark-out period, during which size is reached, the gauge signals the wheelhead to retract. Gauges can be arranged for manual or automatic application to the workpiece.

Controls

The controls are instinctive and within easy reach of the operator without bending.

The electrical controls are isolated from the hydraulics. The left-hand handwheel is for manual operation of the table traverse and is interlocked with the hydraulic table drive. As the hydraulic drive is selected, the hand-wheel mechanism is automatically disengaged and does not rotate as the table traverses under power.

The right-hand handwheel sets the grinding wheel in-feed. The automatic wheelhead feed, operating at each table reversal, can be varied between 0.005 and 0.025 mm. Other features include: variable table traverse speeds with instant reversal; variable dwell at each end of the table travel stroke; quick-power traverse to the wheelhead crossfeed; all machine functions can be interlocked to provide single-button start automatic cycle.

Automatic wheel dressing

Profiling on grinding wheels up to 200 mm (8in) wide by the power operated forming device mounted on the wheelhead is available on plain, semi and fully automatic machines only.

Other table mounted, manually-operated truing devices are available including radius, angle, side and face and Diaform attachments.

Digital readout

Digital display provides an aid to grinding multi-diameter workpieces when it is not practical or economical to plunge grind in one operation with a formed wheel. Its use eliminates the need to stop the cycle and measure each diameter manually.

The digital display indicates the approach to pre-set size or allows the required size to be pre-set when using automatic plunge feed. Size displayed is in either Metric or Imperial units; changeover from one to the other is by a simple switch.

Specification

Plain and semi-automatic			**mm**					**in**		
Nominal size of machine (swing)	300		400		500	12		16		20
Maximum swing (diameter)	330		430		530	13		17		21
Maximum diameter ground with automatic infeed	300		300		300	12		12		12
Work speeds (rev/min)			15 to 300					15 to 300		
Table traverse speeds (per min)			75 to 3048					3 to 120		
Range of automatic feed (reduction in diameter)			0.005 to 0.025					0.0002 to 0.001		
Workhead motor			1.5kW					2hp		
Length between centres	1015	1520	2030	2540	3045	40	60	80	100	120
Table swivel – included angle	14°	11°	9°	8°	7°	14°	11°	9°	8°	7°
Number of two-point steadies	3	4	5	6	7	3	4	5	6	7
Floor space – full traverse	4521	5740	6960	8179	9398	178	226	274	322	370
– width	2845	2845	2845	2845	2845	112	112	112	112	112
Universal machines only			**mm**					**in**		
Diameter of standard faceplate	300		400		400	12		16		16
Grinding wheel speeds (rev/min)			1795 and 2151					1795 and 2151		
Standard grinding wheel (diameter x width x hole)			450 x 50 x 203.2 standard					18 x 2 x 8 standard		
Maximum diameter ground with new wheel	300		400		500	12		16		20
Wheelhead motor			5.5kW					7.5hp		
Wheelhead swivel			90°					90°		
Workhead swivel to wheel			90°					90°		
Workhead swivel from wheel			90°					90°		
Capacity of standard 4-jaw chuck	150		250		250	6		10		10
Internal spindle motor			1.1kW					1.5hp		
Cross adjustment of internal grinding spindle (forward from work centre line)			230					9		
Cross adjustment of internal grinding spindle (back from work centre line)			300					12		
Maximum distance between workhead faceplate and end of internal spindle barrel	915	1425	1930	2440	2950	36	56	76	96	116
Except Universal machines										
Grinding wheel speeds (rev/min)			1350 and 1540					1350 and 1540		
Standard grinding wheel (diameter x width x hole)			60 x 80 x 304.8 standard					24 x 3 x 12 standard		
Maximum diameter ground with new wheel	300		300		300	12		12		12
Wheelhead motor			11kW					15hp		
Weights and dimensions — all machines			**kg**					**lb**		
Net weight (except Universal)	6450	7110	7920	8630	9380	14220	15670	17460	19030	20700
Net weight (Universal only)	5790	6600	7360	8130	8960	12770	14560	16230	17900	19740
Approximate shipping specification (1 case) Gross weight (except Universal)	7110	8420	9340	10360	11420	15680	18560	20590	22840	25180
Gross weight (Universal only)	6600	7710	8550	9450	10380	14560	17000	18830	20830	22880
			mm					**in**		
Length	4060	4270	5180	6230	7370	162	168	204	245	290
Width	2411	2411	2411	2411	2411	97	97	97	97	97
Height	2000	2000	2000	2000	2000	80	80	80	80	80