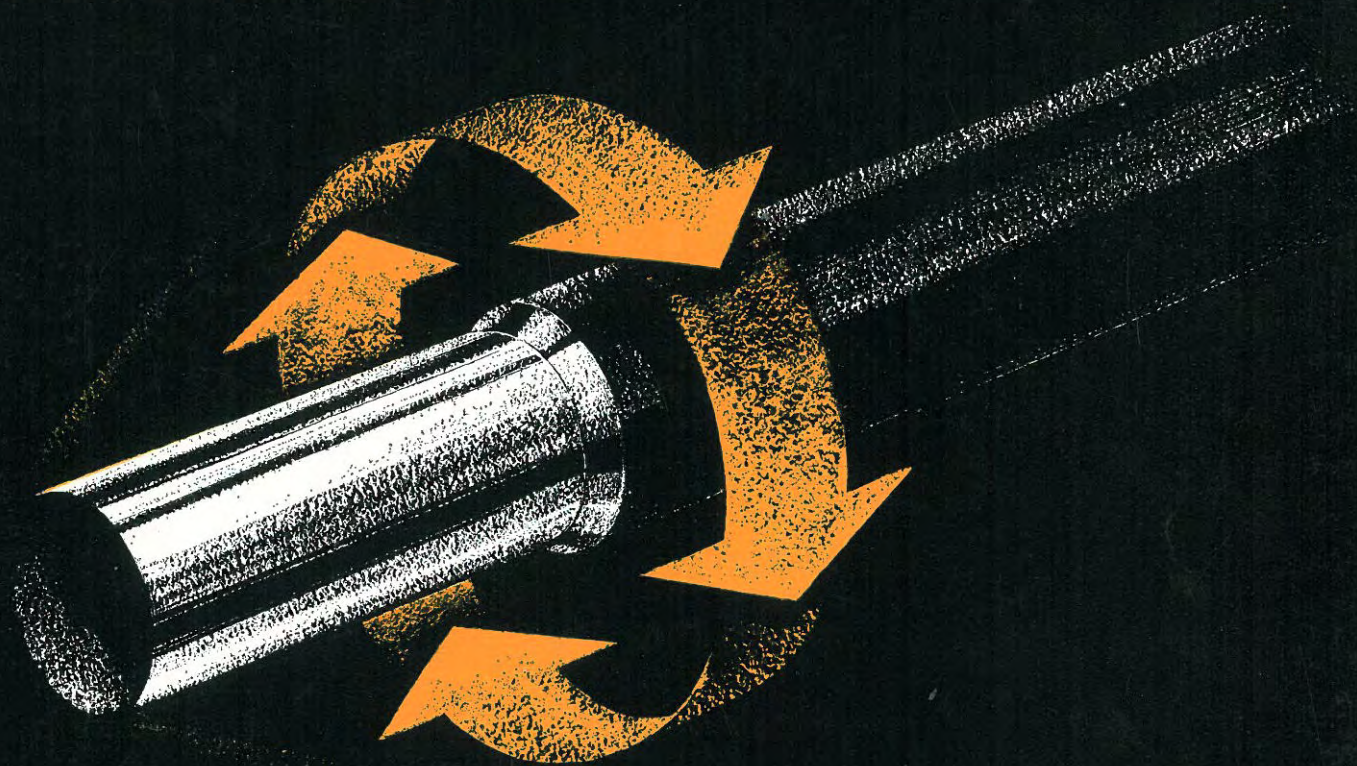


SIR JAMES
**FARMER
NORTON**
& COMPANY LTD.



**centreless
bar turning
machines**

CENTRELESS BAR TURNING MACHINES

The original Farmer Norton Patent Centreless Bar Turning machine was designed many years ago to meet the demands of the Bright Steel Bar Manufacturers, for a machine capable of precision turning carbon and high tensile alloy steel bars of long lengths to diameters within commercial tolerance and having a surface finish comparable with that obtained in a centreless ground bar.

It was never intended, of course, that centreless turning should supersede either bright drawing or centreless grinding, but rather that it was an essential adjunct to such processes.

It has been a long established fact that bright drawn bars are not suitable for arduous duty application such as driving shafts, etc. as any surface defects present after hot rolling will persist, in some degree, throughout the cold drawing process. Again, a perfectly straight bright drawn bar will inevitably distort to an alarming degree when subjected to machining operations, due to the reactions of the internal stresses in the bar, which are released when the outer skin is removed. Such bars have to be straightened by "stretching" in the lathe, which is a laborious and expensive operation and frequently results in the condemnation of the steel supplier. For applications such as hand levers, pins, short lightly loaded shafts, etc., then bright drawn material is highly suitable and owing to its speed of production, comparatively cheap.

In recent years, due to the demand for steel bars to be free from any imperfections, it has been found necessary to remove more metal from the black bars than was hitherto required, and in consequence it has been found to be uneconomical to process such bars by multi-pass centreless grinding—the number of roughing passes required giving a very slow overall throughput and increasing the cost of expenditure on grinding wheels. This particularly applies in the case of removal of the decarburised surface of bars requiring subsequent heat treatment.

INTRODUCTION

Centreless Bar Turning machines were originally designed to use high speed steel tools, but with the recent developments in tungsten carbide tools, Sir James Farmer Norton & Co. Ltd. have re-designed and developed their range of machines to take full advantage of the potential high surface cutting speeds permissible with such tools. The main essential of these machines is their extreme rigidity in all parts, as any suggestion of vibration is fatal to the cutting edges of tungsten carbide tools. As a consequence of the availability of these higher surface cutting speeds it is now acknowledged that it is possible to machine bars through centreless bar turning machines at far higher overall throughput rates than is possible by multi-pass centreless grinding machines.

As a result of the advantages of this process being appreciated by the bright steel bar manufacturers and users, the demand for such machines has rapidly increased until Sir James Farmer Norton & Co. Ltd., are now the world's largest manufacturers of Precision Finished Centreless Bar Turning machines. The machines supplied for precision finish turning are guaranteed to produce bars having a maximum limit of ovality of plus or minus 0.00025 ins. (0.0064 mm.) with a maximum limit of variation in diameter of plus or minus 0.001 ins. (0.025 mm.) in any 20 feet (6 metres) length of bar. The resulting finish is within 8/12 micro-inches (0.2/0.3 microns).

To obtain such results, there is no necessity to perform any prior roughing turning operation, one pass through the machine being sufficient. The usual stock removal from the black bar diameter varies up to about $\frac{3}{8}$ ins. (2.4 mm.) for bars up to 3 ins. (76 mm.) diameter and $\frac{1}{4}$ ins. (3 mm.) for bars up to 4 ins. (100 mm.) diameter, although in some cases it may be necessary to exceed these figures, and it is possible to remove as much as $\frac{1}{4}$ ins. (6 mm.) from the diameter at one pass through the machine.

It is thus apparent that such a process has the virtues of grinding, without the inherent expensive costs of initial rough turning and centreless grinding or multi-pass centreless grinding.

The machines supplied for precision finish turning can also be used for semi-rough finish turning, the only difference being in the types of cutter heads to be used. Most users of these machines carry both types of cutter heads and so are able to change from precision finish to semi-rough finish turning without delay. The machines are fitted with a wide range of feeds to allow for this changeover. When semi-rough finish turning, it is possible to use feeds as high as 0.5 ins. (12 mm.) per revolution of the cutter head, from which it will be realised that extremely high rates of production are possible.

Semi-rough turned bars are very much in demand for subsequent manufacture into high quality seamless steel tubes and for use in bar automatics, where, owing to wide variations in diameter of black rolled bars, it is impossible to use standard collets for each batch of sizes. Semi-rough turned bars ensure freedom from surface defects and diameters within specified tolerances. Machines designed specifically for high speed semi-rough turning of bar or turning of rod from coil to coil or from coil to cut straight length are the subject of separate brochures which will be forwarded upon application to Sir James Farmer Norton & Co. Ltd.

Centreless Bar Turning has now become a necessary process in the production of bars free from surface imperfections and these machines offer practically unlimited scope within their own particular sphere. Besides the actual steel bar manufacturers, steel bar users, such as manufacturers of automobiles, aero engines, ball and roller bearings, textile machinery, springs, nuts and bolts, etc., will find that installation of these machines will considerably reduce costs in the production of high class quality steel bars.

In addition to carbon steel bars, these machines are extensively used for the production of bars of high tensile alloy steels, stainless steels, Nimonic, uranium, bronze, aluminium alloys, cast iron, etc., etc.

N U M B E R

2

CENTRELESS BAR TURNING MACHINE

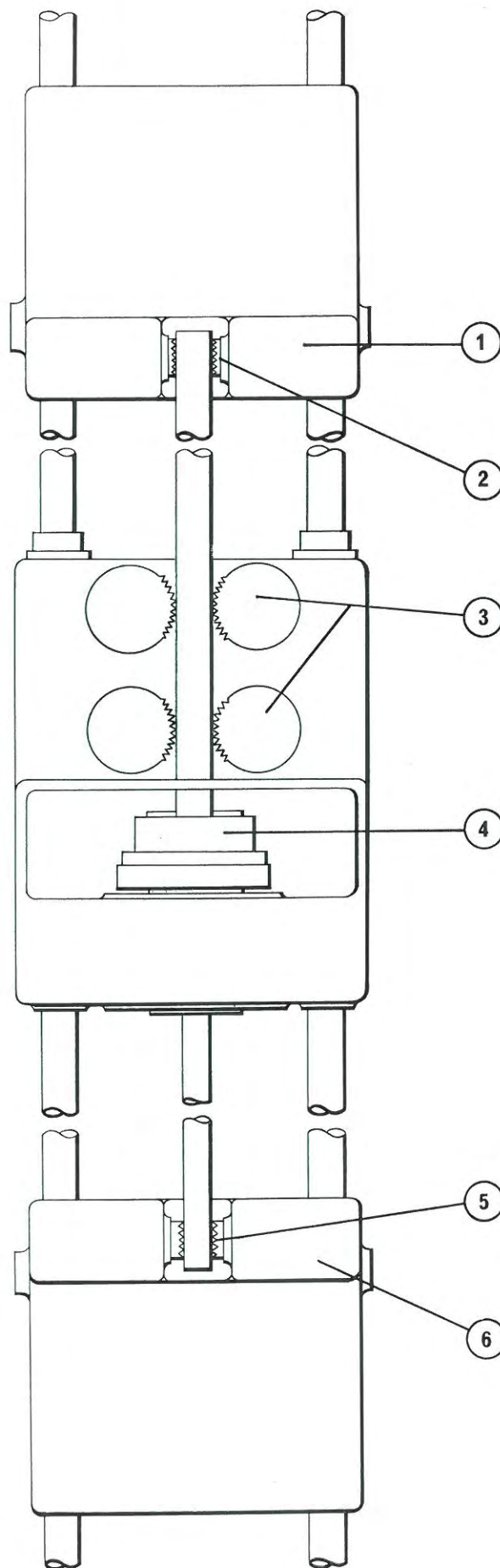
DESCRIPTION

The general principle is that the bar to be machined is passed through pre-set rotating cutter heads whilst the bar itself is prevented from being rotated by the gripping carriage. A bar is selected from the input stillage and deposited into the ingoing gripping carriage (1) where it is gripped in jaws (2). The carriage (1) is then traversed forward until the leading end of the bar is engaged and nipped between the first pair of opposed rotating serrated feed rolls (3). These serrated feed rolls are rotating at a pre-set speed, and this speed of rotation determines the throughput feed rate of the bar. When once the bar is under the control of the serrated feed rolls, it continues to traverse forward into and through the rotating cutter head (4) which turns the bar to the pre-determined diameter. Upon emerging through the cutter head and clear of the headstock the leading end of the bar is gripped in the gripping jaws (5) of the outgoing gripping carriage (6). The gripping jaws (2) of the ingoing gripping carriage (1) are then released and the carriage returned to its original starting position for the reception of the next bar. In the meantime, the serrated feed rolls (3) continue to feed the first bar through the cutter head (4) and to push the outgoing gripping carriage (6) along the traverse bars at the outgoing side. A second bar is now loaded into the ingoing carriage (1), gripped and then traversed forward until the leading end butts up against the trailing end of the first bar. This relationship is maintained until the trailing end of the first bar is passing through the serrated feed rolls (3) when the leading end of the second bar is, in its turn, nipped between the feed rolls (3). From then on the forward feed motion of the second bar pushes the first bar right through the cutter head (4) when it can then be released from the outgoing gripping carriage (6) and removed from the machine. As, during this process, the outgoing gripping carriage (6) has been pushed along to the far end of the traverse bars, it is then necessary to traverse this carriage back to be in position to grip the leading end of the second bar by the time this emerges from the machine. The cycle of operations is then repeated for the second and subsequent bars i.e. grip in outgoing carriage (6) release from ingoing carriage (1), return ingoing carriage (1) to its original starting position, insert and grip fresh bar in ingoing carriage (1), traverse fresh bar forward until leading end butts up against trailing end of previous bar and fresh bar is nipped in feed rolls (3), release and remove finished turned bar on completion of machining; and soon until the last bar in that particular batch is going through the machine. As a following bar, a short undersize stock bar is kept by the side of the machine, to be used for pushing the last bar of a batch right through the machine. The stock bar is then withdrawn by the reverse feed motion and reserved for further use.

The whole of the above process is entirely continuous while the machine is running, only for infrequent adjustments to the cutter heads, etc. is the machine stopped.

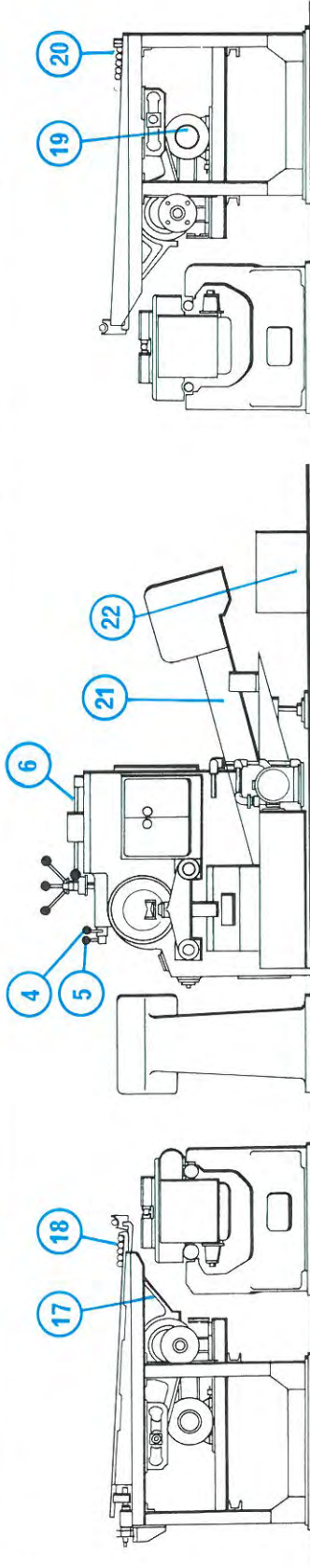
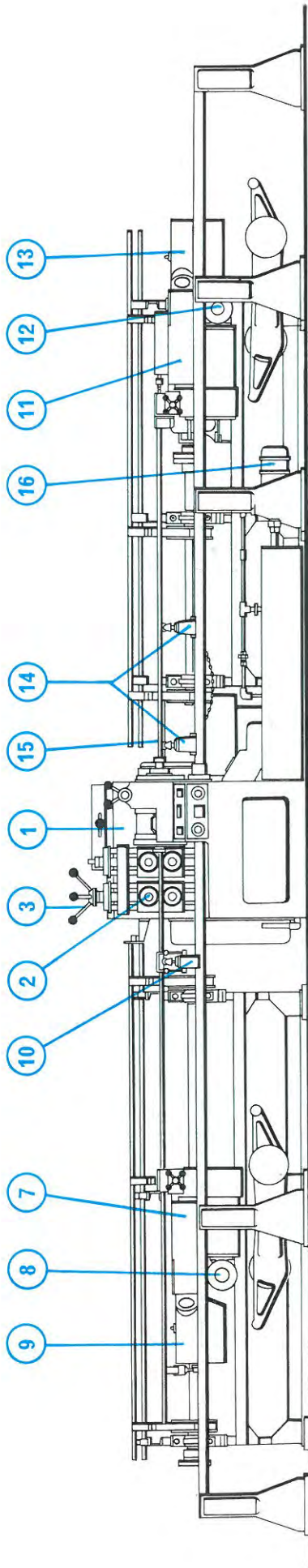
Machines can be supplied for manual operation i.e. bar selection, gripping and carriage traverse, bar release and discharge, or for fully automatic operation from a central control panel affixed to the headstock, where the operator is entirely free, apart from supervisory inspection. It is thus possible for one operator to control two or more machines.

1	INGOING GRIPPING CARRIAGE
2	INGOING GRIPPING JAWS
3	SERRATED FEED ROLLS
4	CUTTER HEAD
5	OUTGOING GRIPPING JAWS
6	OUTGOING GRIPPING CARRIAGE

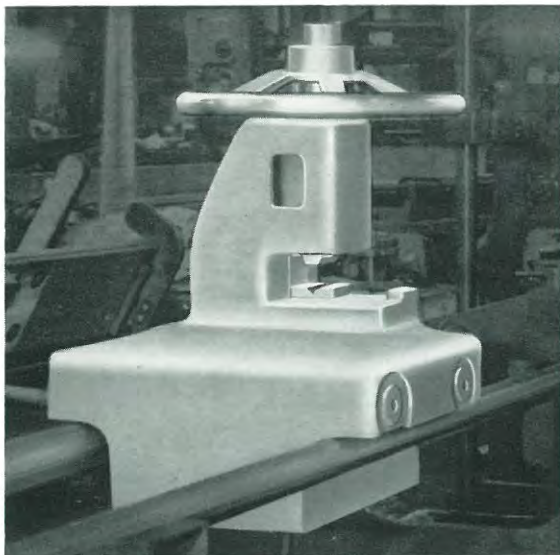




No. 2 CENTRELESS BAR TURNING MACHINE
FULLY AUTOMATIC OPERATION

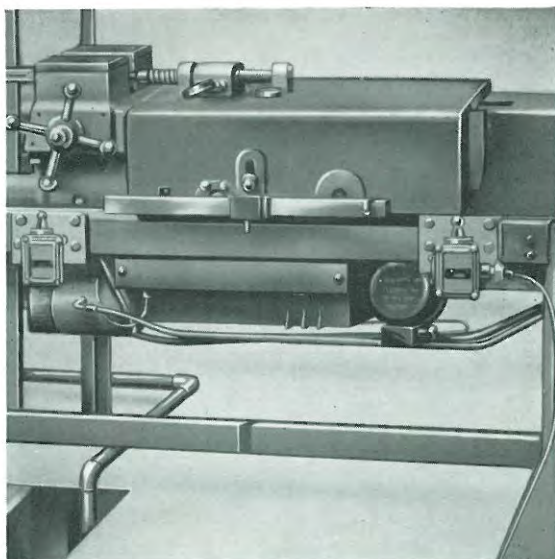


1	HEADSTOCK	12	HYDRAULIC PUMP AND MOTOR UNIT.
2	FEED ROLLERS	13	HYDRAULIC UNIT
3	STARWHEEL FOR FEED ROLLER ADJUSTMENT	14	MOVEABLE ROLLER SUPPORT
4	CHANGE GEAR HANDLE	15	FINISHED BAR
5	CHANGE GEAR HANDLE	16	COOLANT PUMP UNIT
6	CLUTCH LEVER	17	LOADING ARM
7	INGOING GRIPPING CARRIAGE	18	BLACK BARS
8	HYDRAULIC PUMP AND MOTOR UNIT	19	MOTOR FOR UNLOADING ARM
9	HYDRAULIC UNIT	20	FINISHED BARS
10	FIXED ROLLER SUPPORT	21	SWARF CONVEYOR
11	OUTGOING GRIPPING		



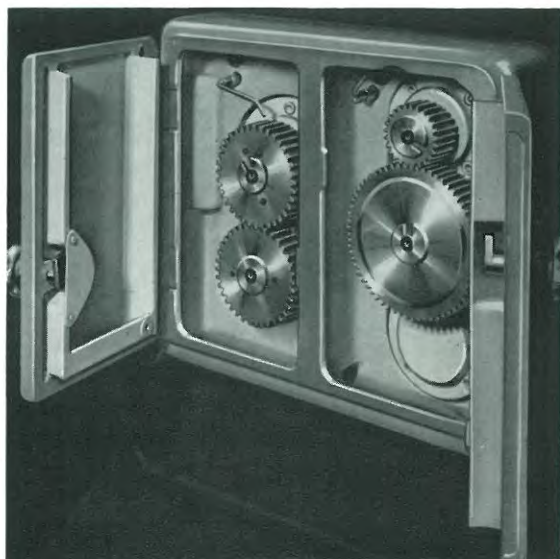
HAND GRIPPING CARRIAGE

Interchangeable hardened alloy steel gripping jaws for black and rough turned bars and hard phosphor bronze jaws for finished turned bars are supplied to cover the full range of bar diameters. The bottom jaw is set to suit the bar size, whilst the top jaw clamps onto the bar by means of the large diameter handwheel. The carriage is mounted on free running rollers and is traversed along the traverse bars by hand.



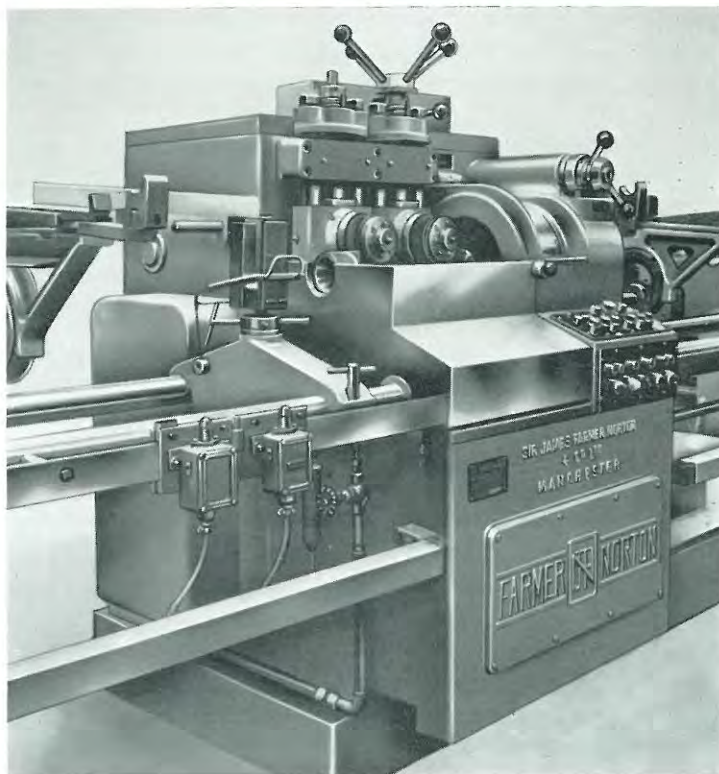
HYDRAULIC GRIPPING CARRIAGE

Interchangeable hardened alloy steel and hard phosphor bronze gripping jaws are supplied to cover the full range of bar diameters. The gripping jaws are actuated by hydraulic cylinder and toggle lever mechanism whilst the carriage traverse along the traverse bars is motivated by hydraulic motor driven from a self contained motor driven pump and tank unit mounted within the carriage itself. Control of the carriage is from the headstock.



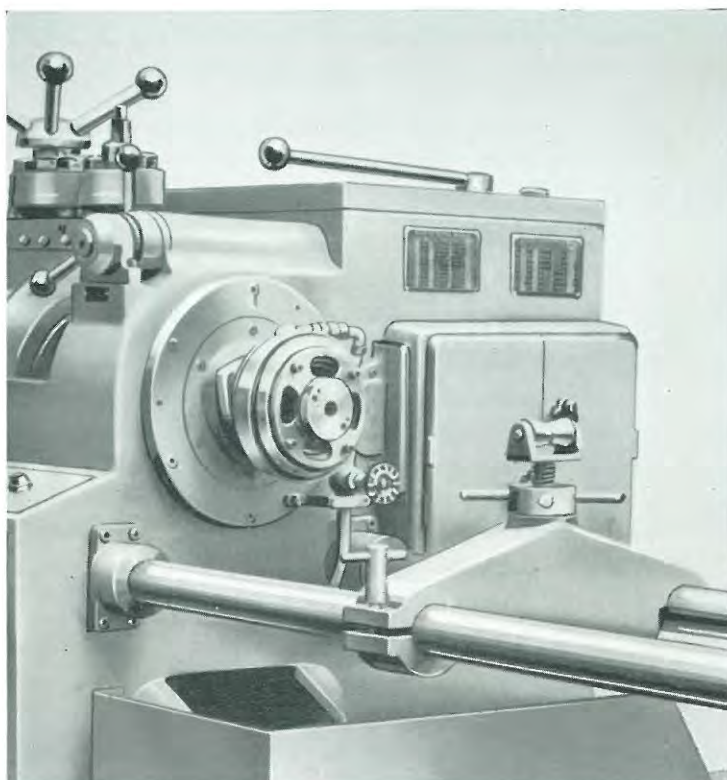
SPINDLE SPEED AND FEED RATE CHANGES

Eleven changes of spindle speeds are provided by means of a 3-speed lever change in combination with pick-off gears. Likewise nine changes of feed rate by means of a 2-speed lever change together with pick-off gears. All internal gears and the pick-off gears are continuously lubricated by means of a pump mounted inside the headstock. A hand lever mounted on top of the headstock provides for feed reverse through multi-plate clutches. On fully automatic machines, this lever can be arranged to move automatically to the neutral position if the ingoing bar stillage is empty or if the outgoing bar stillage is full.



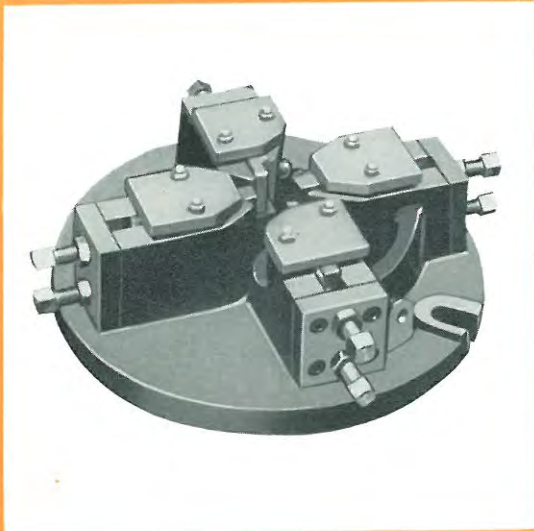
HEADSTOCK FROM FEED END

Each opposing pair of serrated feed rolls are self-centralising and are adjusted by means of the star wheels above the feed unit. The rotating Cutter Head is completely covered during operation, whilst an easily operated roller cover provides ready access for inspection, tool adjustment, etc. A steady bush guides the bar into the Cutter Head. An adjustable steady supports the bar prior to its entry into the guide bush.

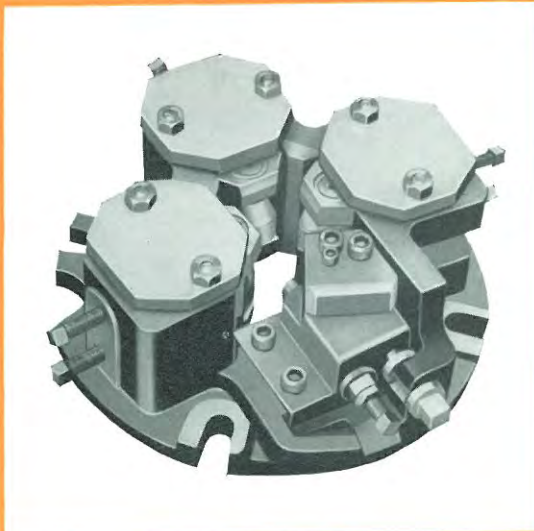


HEADSTOCK FROM EXIT END

An adjustable collet inside the spindle immediately behind the Cutter Head is regulated from the rear end of the headstock. Incorporated in the collet arrangement is the coolant flow to the rear side of the Cutter Head. An adjustable steady supports the bar on its exit from the headstock. Spindle speed, feed change and feed reverse levers are mounted on the headstock as also are the electrical control push buttons, etc.



(a)



(b)



(c)

ROUGH TURNING CUTTER HEADS

R2RS & R2RL—Radial Type Tools

R2TS & R2TL—Tangential Type Tools.

The cutter head bodies are steel castings designed for maximum rigidity and for ease of handling and rapid tool changing. The high grade steel tool blocks are clamped in accurately machined slideways and adjusted by robust high tensile screws. Normally two tools at 180° with plain steadies beneath and at 90° to the tools are provided, but four tools may be used if desired. All heads are balanced to eliminate vibration when rotating.

SINGLE TOOL PRECISION FINISHING CUTTER HEADS

F2R—Radial Type Tools

F2T—Tangential Type Tools.

When a high degree of surface finish is required, the precision Finishing Head is used. This incorporates a single tool block assembly together with three roller block assemblies mounted in an accurately machined body. The special steel pressure rollers have solid shanks carried in needle roller bearings mounted in blocks which are guided and clamped in accurately machined slots. Radial type tools can be used throughout the full range but it is impractical to use tangential type tools for bars below $\frac{3}{4}$ ins. (19 mm.) diameter.

TOOL SETTING

For pre-setting of cutter heads on the bench a tool setting stand is provided which consists of a spigot location plate fitted with a hardened steel bush insert to suit the mandrels which are made for individual bar sizes. The same setting stand is used for all cutter heads for this size of machine. To minimise cutter head changing time, a spare cutter head is usually set up while the machine is running.

SPECIFICATION

No. 2 SIZE PATENT CENTRELESS BAR TURNING MACHINE

The machine is generally as the accompanying illustrations and comprising :—

MAIN HEADSTOCK

The main headstock is a rigid box section casting containing the spindle driving mechanism. A large opening protected by an easily operated roller cover, is provided for access to the cutter head. An internal chute and large side opening rapidly clears the swarf and coolant on to a swarf tray or on to a swarf conveyor.

MAIN SPINDLE DRIVE

The main spindle drive is from a constant speed motor, mounted inside the main headstock, by multiple "Vee" belts through a 3-speed gearchange in conjunction with pick-off gears and through single helical gears on to the main spindle.

MAIN SPINDLE

The main spindle is of forged carbon steel and carries the large single helical driving gear. It is mounted on large specially selected roller and "paired" double purpose bearings.

On the front end of the spindle is an accurately machined spigot location faceplate for mounting of the cutter heads. The whole of the spindle assembly is accurately dynamically balanced.

BAR GUIDES

Interchangeable bar guides are provided both immediately in front of and behind the cutter head. The bar guides behind are adjustable externally and their housing protrudes into the main spindle and provides the necessary ductings for leading coolant to the rear side of the cutter head.

FEED ROLL DRIVE

The drive to the feed is taken from the main drive by means of a worm and worm wheel and reversing spiral bevels. A 2-speed gear change in conjunction with pick-off gears gives a wide range of bar feed rates. The final drive to the four serrated feed rollers is transmitted through heavy duty universal joints.

FEED SADDLES

The feed saddles are extremely rigid units sliding on large diameter guide bars. The vertical adjustment of the feed saddles is by star handwheel and large diameter high tensile steel screws suitably resiliently loaded to compensate for slight diameter variations in the black bar. Simultaneous centralisation of the saddles, irrespective of bar diameter, truly centres the bar at all times. The drive ends of the feed spindles form large tapered noses to rigidly drive the special heat-treated steel feed rolls which are serrated in the form of a "Vee" shaped groove.

ROLLER SUPPORTS

Fixed and travelling roller bar supports are supplied both at the ingoing and outgoing ends of the machine. They are mounted on the large diameter traverse bars and are adjustable to suit the full range of bar diameters.

Pedestal supports carried on the foundation support the traverse bars.

HAND OPERATED GRIPPING CARRIAGES

Hand operated gripping carriages are free running on the traverse bars and are provided with bar clamping arrangements operated through large diameter heavy handwheels and high tensile steel screws of special design for rapid and rigid gripping of the bar. The clamps are fitted with renewable hardened alloy steel grips for black and rough turned bars and hard phosphor bronze grips for finish turned bars.

Or, alternatively—

HYDRAULICALLY OPERATED TRAVERSING AND GRIPPING CARRIAGES

Hydraulically operated carriages embodying their own self-contained motorised pump and tank hydraulic systems provide “push-button” bar gripping and traversing, operated from the operator’s stand. Such carriages are necessary for semi or fully automatic machines.

Gripping is of the 4-point type and the clamps are fitted with renewable hardened steel grips for black and rough turned bars and hard phosphor bronze grips for finished turned bars.

LIMIT SWITCHES

Stop and limit switches are fitted to prevent damage due to over-run of carriages. Additional limit switches are also provided for automatic machines to ensure correct sequencing of operations.

BAR STILLAGES FOR HAND OPERATED GRIPPING CARRIAGES

Bar Stillages for hand operated machines are not included. They can be supplied with the machine, but as they are comparatively simple, clients usually provide their own.

MECHANICAL BAR HANDLING EQUIPMENT FOR SEMI AND FULLY AUTOMATIC MACHINES

Mechanical bar handling equipment is essential for semi and fully automatic machines and this comprises fabricated steel stillages for black and turned bars with loading and unloading arms driven by electric motors through worm reduction gears. Electrical interlocks are provided between the arms and the hydraulic carriages to give fully automatic working. Each finished turned bar is in turn held clear of the stillage for checking by the operator whilst the machine is in motion.

CUTTER HEADS

Cutter heads of the precision finishing type shown on page 8 are usually supplied with the machine as standard equipment but rough turning cutter heads can be supplied if so desired. With all types of heads the swarf is removed in continuous ribbons which are rapidly broken up into small pieces without fouling the steadies. An accurate finish is thus obtained without frequent tool adjustments.

SWARF DISPOSAL

The swarf produced from the machine is side discharged either into swarf trays with which is incorporated the coolant tank, or on to a motorised swarf conveyor embodied with a coolant tank. The conveyor elevates the swarf and deposits it into bins on floor level.

MAIN DRIVE MOTOR

The main drive motor is 20 H.P. 1440 R.P.M. squirrel cage, screen protected suitable for standard alternating current supply, complete with driving pulleys, belts, etc.

Push buttons on the machine headstock provide “start”, “stop” and “inch” controls.

MOTOR DRIVEN PUMP UNIT

A motor driven pump unit with all necessary piping, valves, etc., is provided to give a copious flow of coolant to both the front and rear of the cutter head.

STANDARD EQUIPMENT

The machine is generally as the foregoing specification complete with runways and two *hand gripping* carriages and arranged for motor drive through "Vee" belts and pulleys and the following:—

Two Cutter Heads (type F2R) range $\frac{1}{2}$ in. to 2 ins. diameter (12 mm. to 50 mm.).
One Cutter Head Setting Plate and One Sample Mandrel.
One Motor Driven Coolant Pump Unit with necessary pipes, valves, etc.
Necessary Electrical Control Gear for Main Motor and Coolant Pump.
One Set of Four Serrated Feed Rolls to cover full bar range.
One Set of Steel Carriage Gripper Jaws for Ingoing and Outgoing Carriages.
One Set of Phosphor Bronze Carriage Gripper Jaws for Outgoing Carriage only.
One Sample Ingoing Steady Bush.
One Sample Outgoing Steady Bush.
One Adjustable Ingoing Bar Steady Assembly.
One Adjustable Outgoing Bar Steady Assembly.
All necessary Spanners, Screwkeys, etc.
One Grease Gun.
One Complete Set of Foundation Bolts and Plates.
Two copies of Maintenance and Instruction Manual.

EXTRA EQUIPMENT

- Item 1. Hydraulic Gripping and Traversing Carriages instead of Hand Gripping Carriages.
- Item 2. Mechanical Bar Handling Equipment with Ingoing and Outgoing Bar Stillages to suit maximum length of bar.
- Item 3. One Swarf Tray combined with Coolant Tank.
- Item 4. One Motorised Swarf Conveyor and Coolant Tank to raise the swarf and deposit it into bins on floor level (exclusive of bins).
- Item 5. One complete output Bar Steady assembly.
- Item 6. Spare Cutter Head (type F2R) range $\frac{1}{2}$ in. to 2 in. diameter (12 mm. to 50 mm.).
- Item 7. Spare Cutter Head (type F2T) range $\frac{3}{4}$ in. to 2 ins. diameter (19 mm. to 50 mm.).
- Item 8. Spare Cutter Head (type R2RS) range $\frac{1}{2}$ in. to $1\frac{1}{4}$ ins. diameter (12 mm. to 32 mm.).
- Item 9. Spare Cutter Head (type R2RL) range $1\frac{1}{8}$ ins. to 2 ins. diameter (28 mm. to 50 mm.).
- Item 10. Spare Cutter Head (type R2TS) range $\frac{1}{2}$ in. to $1\frac{1}{4}$ ins. diameter (12 mm. to 32 mm.).
- Item 11. Spare Cutter Head (type R2TL) range $1\frac{1}{8}$ ins. to 2 ins. diameter (28 mm. to 50 mm.).
- Item 12. Extra Cutter Setting Mandrels (to client's specified sizes).
- Item 13. Spare Tungsten Carbide Tools for type F2R Head.
- Item 14. Spare Tungsten Carbide Tools for type F2T Head.
- Item 15. Spare Tungsten Carbide Tools for type R2RS Head.
- Item 16. Spare Tungsten Carbide Tools for type R2RL Head.
- Item 17. Spare Tungsten Carbide Tools for type R2TS Head.
- Item 18. Spare Tungsten Carbide Tools for type R2TL Head.
- Item 19. Spare Set of Hardened Steel Grippers for Ingoing and Outgoing Carriages.
- Item 20. Spare Set of Phosphor Bronze Grippers for Outgoing Carriage only.
- Item 21. Spare Set of Four Serrated Hardened Steel Feed Rollers.

MACHINE DATA

Maximum Diameter of Black Bar		2 $\frac{1}{8}$ ins. (54 mm.)
Minimum Diameter of Turned Bar		$\frac{1}{2}$ ins. (12 mm.)
Minimum Length of Bar—Hand Gripping	..	5 ft. 0 ins. (1520 mm.)
Hydraulic Gripping	..	5 ft. 0 ins. (1520 mm.)
Maximum Length of Bar—Standard (can be increased)	..	20 ft. (6 metres)
Range of Spindle Speeds (11 changes)	..	154 to 1066 R.P.M.
Range of Feeds (9 changes)		0.015 ins. to 0.125 ins.) (0.38 mm. to 3.17 mm.)
(optional ranges)	.. or	0.03 ins. to 0.25 ins. (0.76 mm. to 6.35 mm.) per revolution of spindle
Main Motor—Horse Power		20
Speed		1440 R.P.M.
Overall Length of Machine (for 20 ft. bars)	..	49 ft. (15 metres)
Overall Width of Machine (with swarf conveyor)		9 ft. 6 ins. (3 metres)
Overall Height of Machine		4 ft. 6 ins. (1.37 metres)

SHIPPING SPECIFICATION

Standard Machine

(with hand gripping carriages)

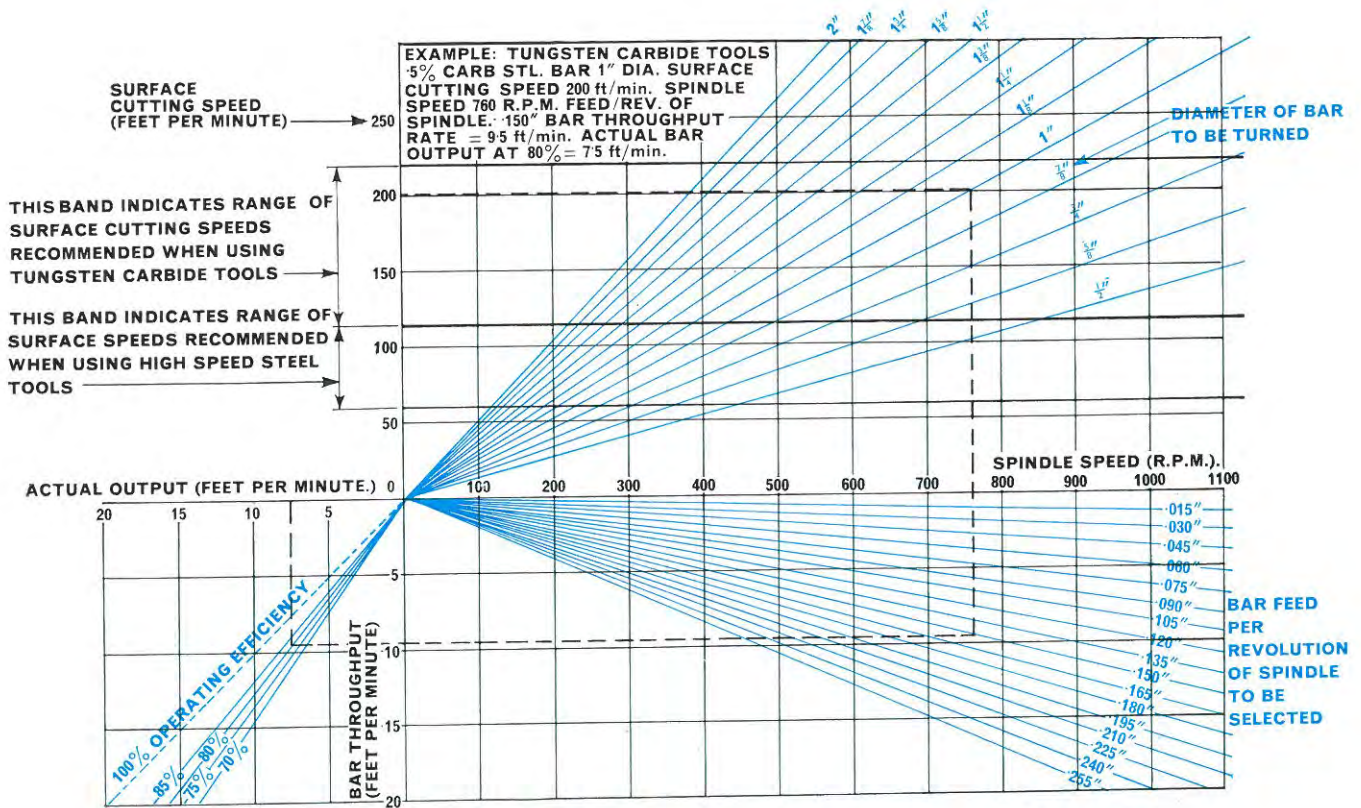
Net Weight		110 cwts. (5,600 kgs.)
Gross Weight		140 cwts. (7,120 kgs.)
Volume of Packing Cases		410 cu.ft. (11.6 cu.metres)

Extra for Hydraulic Carriages

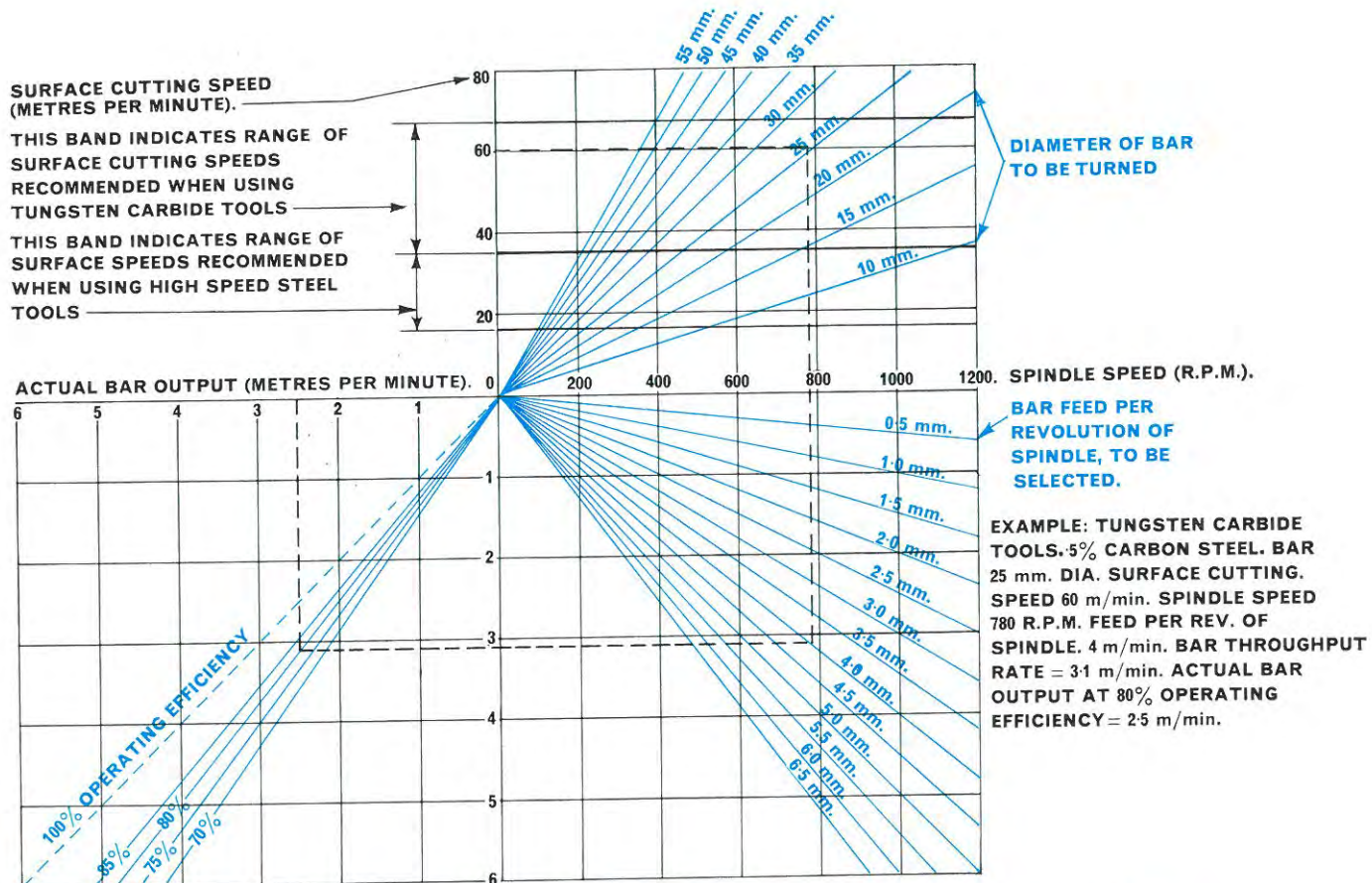
Net Weight		8 cwts. (406 kgs.)
Gross Weight		9 cwts. (457 kgs.)
Volume of Packing Cases		70 cu.ft. (1.98 cu.metres)

Extra for Mechanical Handling Gear and Stillages

Net Weight		65 cwts. (3,300 kgs.)
Gross Weight		85 cwts. (4,320 kgs.)
Volume of Packing Cases		350 cu.ft. (9.9 cu.metres)



GRAPHICAL DETERMINATION OF BAR OUTPUT RATES - No 2 MACHINE (IN INCHES)



GRAPHICAL DETERMINATION OF BAR OUTPUT RATES - No 2 MACHINE (METRIC)

N U M B E R

3&4

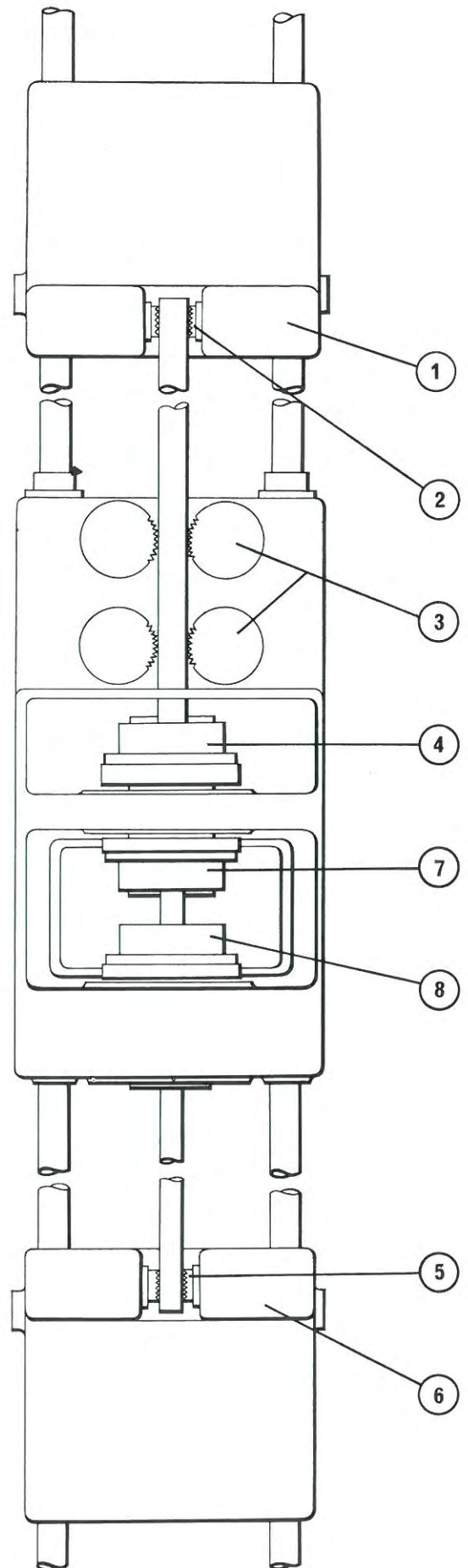
CENTRELESS
BAR TURNING
MACHINES

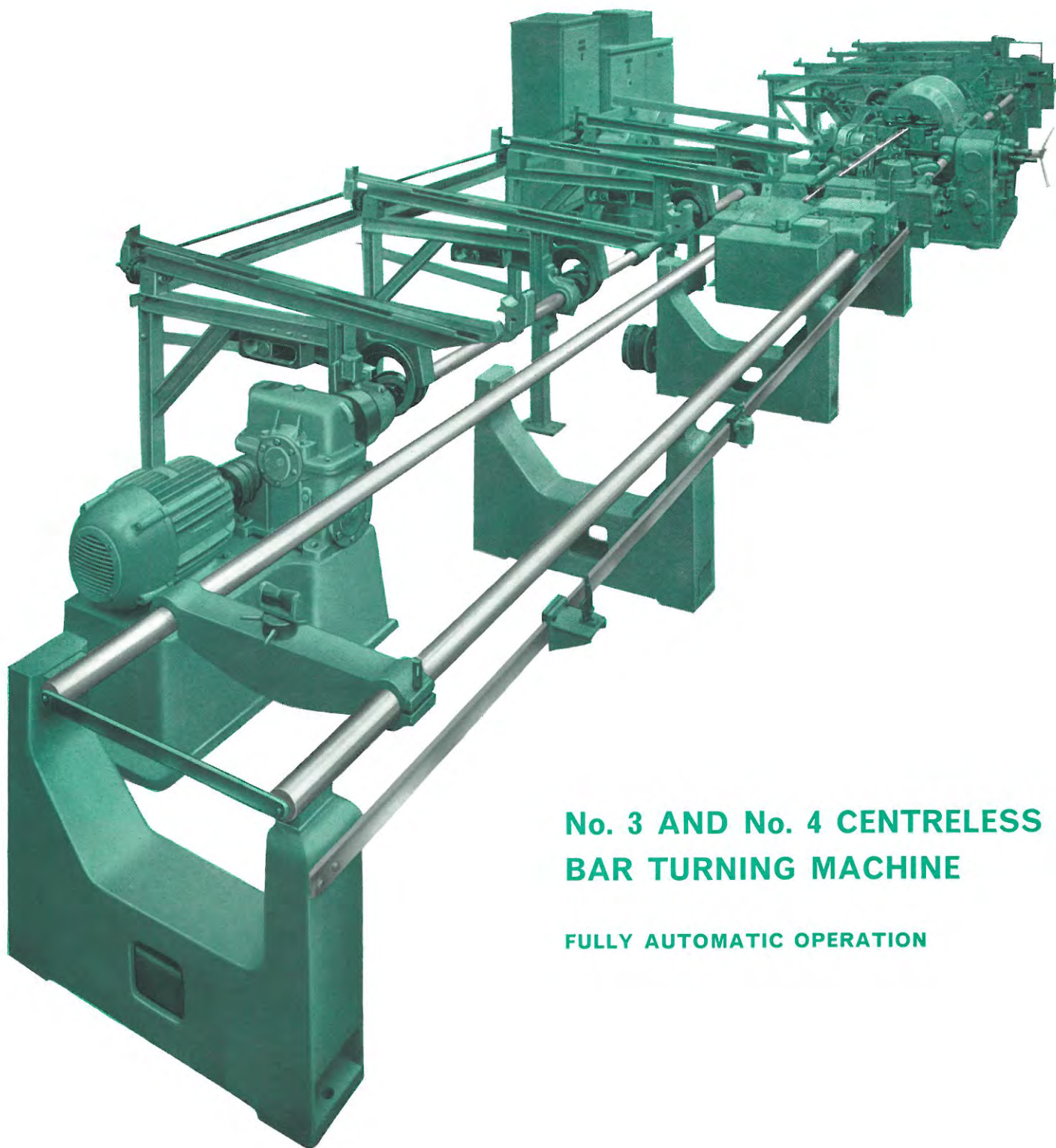
DESCRIPTION

The general principal of operation of the No. 3 and 4 size machines is basically the same as that of the No. 2 size machine, as described on page 2 in that the selected black bar is gripped in jaws (2) of the ingoing carriage (1) and traversed forward into the serrated feed rolls (3) which then take control and feed the bar forward through the rotating cutter head (4) until when it emerges from the headstock. It is then gripped in jaws (5) of the outgoing carriage (6) whereupon the jaws (2) release the bar and the ingoing carriage (1) returns to its starting position to receive the second black bar, etc.

In the No. 3 and 4 size machines however, provision is made for mounting a second cutter head known as the output or finishing head (8) with a roller steady (7) between the two cutter heads. It will be appreciated that the larger bars catered for in these machines usually require more metal removal than the bars processed in the smaller machines and in consequence it is adviseable to use the two cutter heads. The input or roughing cutter head (4) is responsible for approximately 60% of the metal removal and the output or finishing cutter head (8) removes the remainder. As with the smaller machines, the No. 3 and 4 sizes can be supplied for manual, semi-automatic or fully automatic operation.

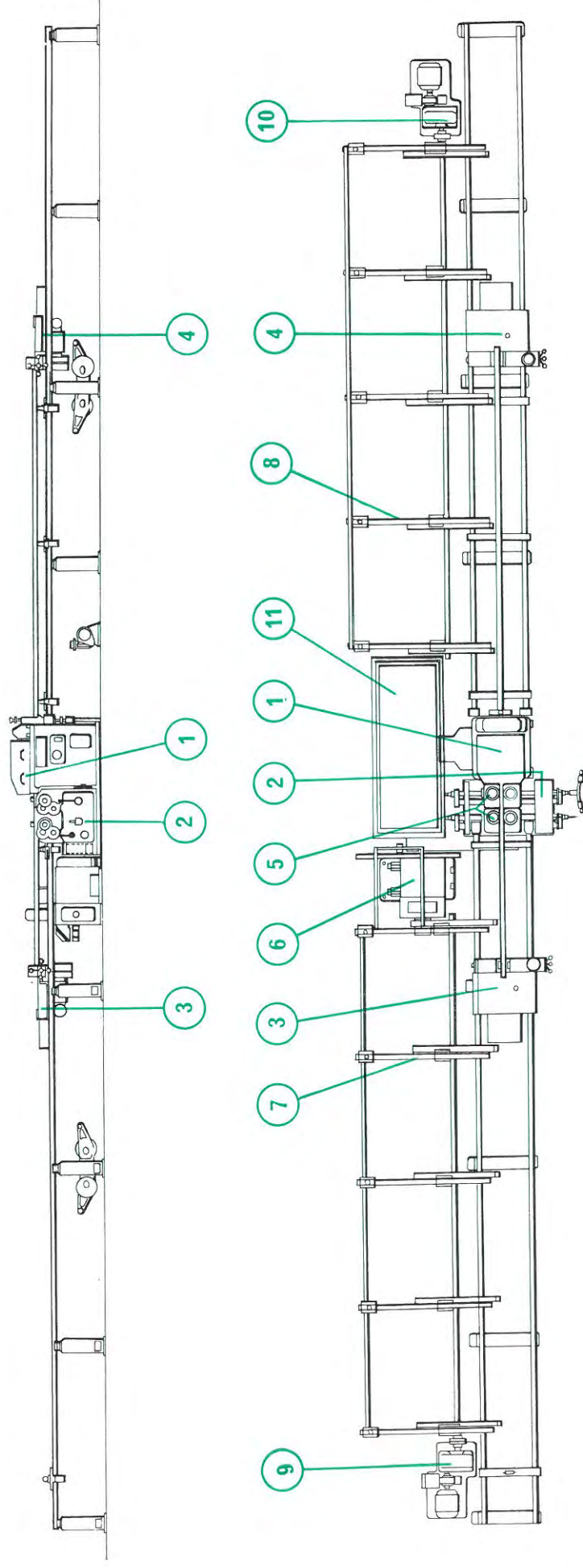
1	INGOING GRIPPING CARRIAGE
2	INGOING GRIPPING JAWS
3	SERRATED FEED ROLLS
4	CUTTER HEAD
5	OUTGOING GRIPPING JAWS
6	OUTGOING GRIPPING CARRIAGE
7	ROLLER STEADY
8	OUTPUT FINISHING HEAD



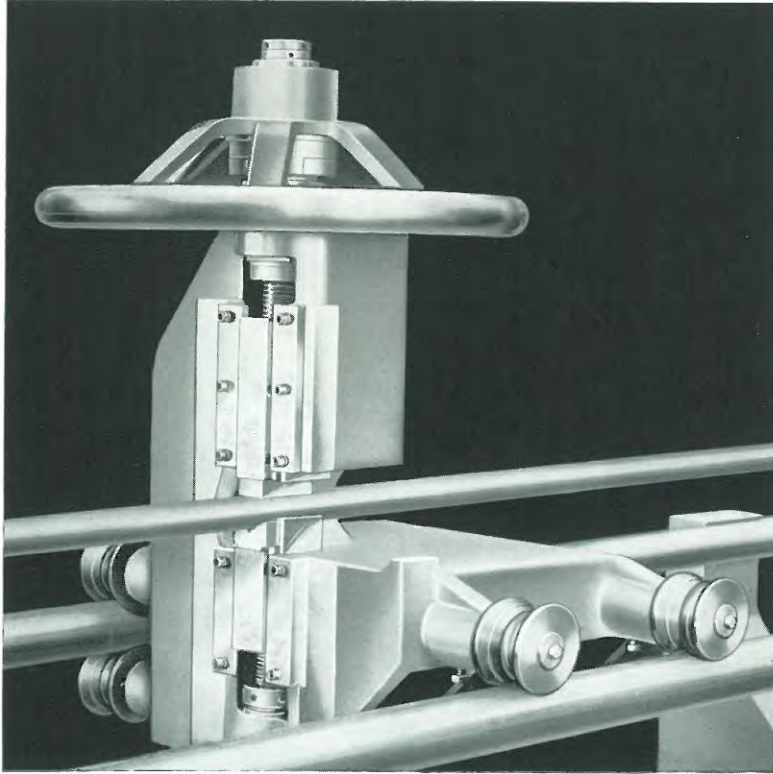


No. 3 AND No. 4 CENTRELESS BAR TURNING MACHINE

FULLY AUTOMATIC OPERATION

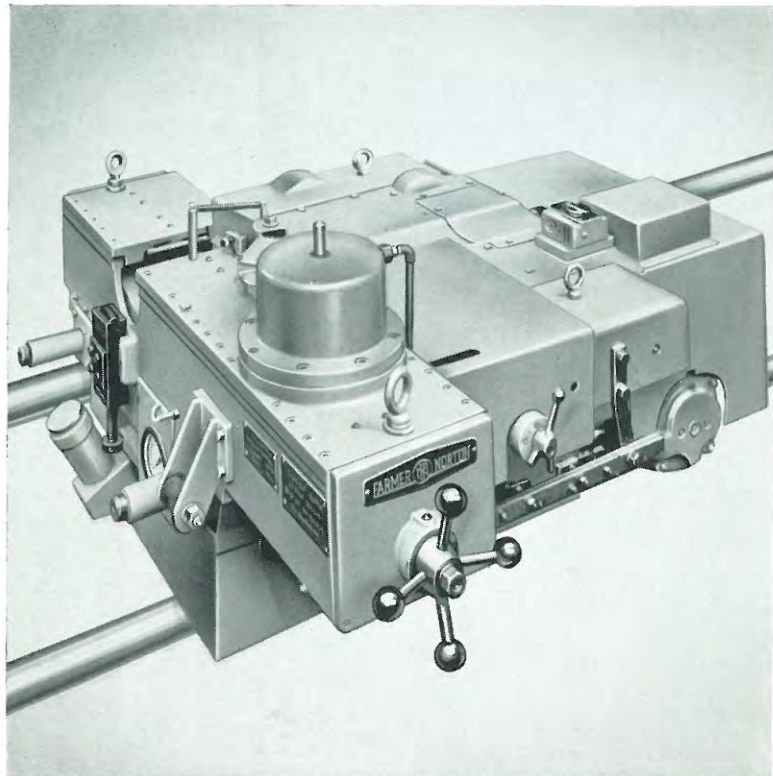


1	HEADSTOCK
2	FEED UNIT
3	INGOING GRIPPING CARRIAGE
4	OUTGOING GRIPPING CARRIAGE
5	SERRATED FEED ROLLS
6	MAIN DRIVE MOTOR
7	INGOING BLACK BAR STILLAGE
8	OUTGOING BRIGHT BAR STILLAGE
9	BLACK BAR LOADING DRIVE
10	BRIGHT BAR UNLOADING DRIVE



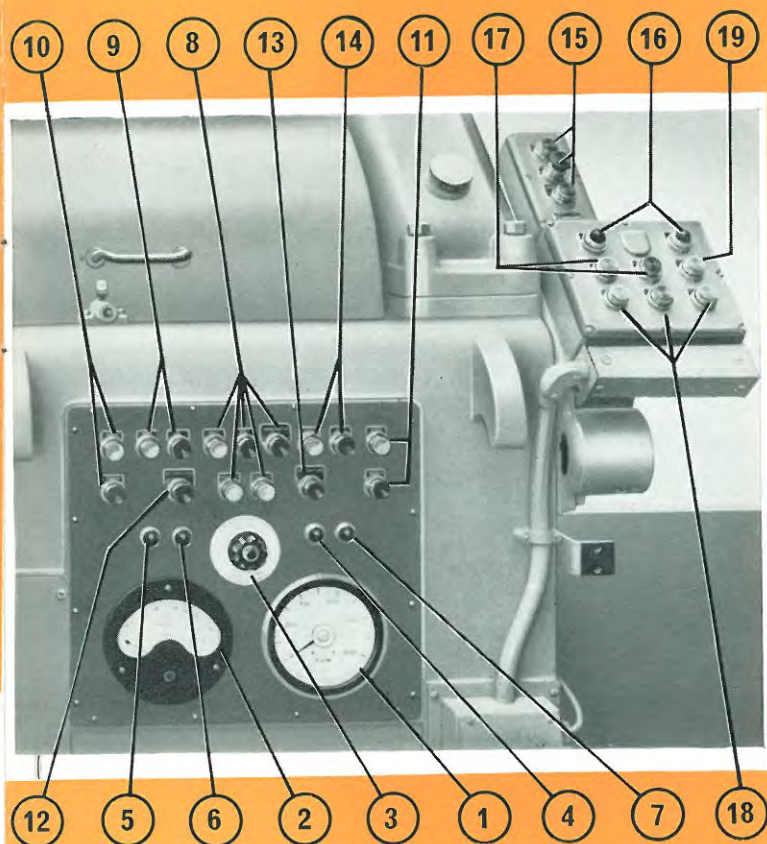
HAND GRIPPING CARRIAGE

The carriages are arranged for side loading and discharge. Interchangeable hardened alloy steel gripping jaws for black and rough turned bars and hard phosphor bronze jaws for finished turned bars are supplied to cover the full range of bar diameters. The bottom jaw is adjustable to suit the bar size, whilst the top jaw clamps onto the bar by means of the large diameter hand-wheel. The carriages are free running along the traverse bars.

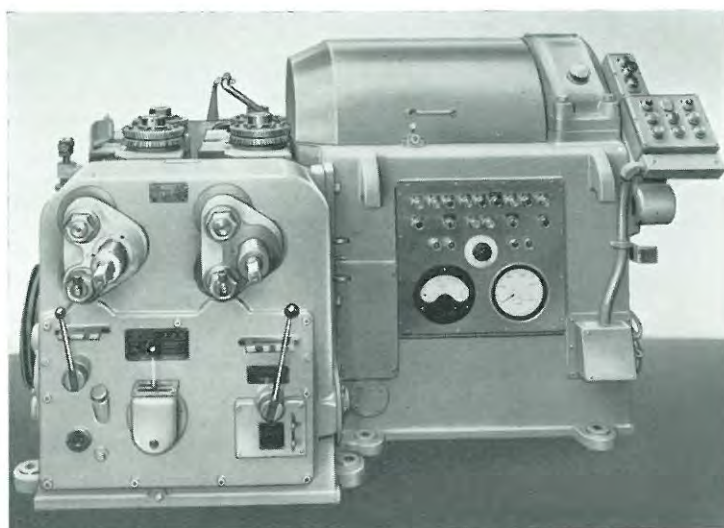


HYDRAULIC GRIPPING CARRIAGE

These carriages are arranged for top loading and discharge and, again, interchangeable hardened alloy steel gripping jaws are supplied to cover the full range of bar diameters. Gripping jaw actuation is by hydraulic cylinder and toggle lever mechanism and motivation of the carriage traverse is by hydraulic motor. A self-contained motor driven pump and tank unit is mounted within each carriage and control of the carriage is from the headstock.

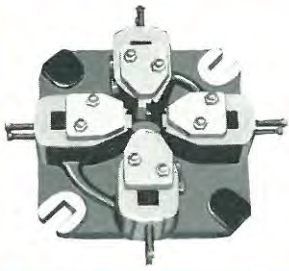


1	SPINDLE SPEED TACHOMETER
2	AMMETER
3	PRE-SET VARIABLE SPINDLE SPEED CONTROL
4	INDICATOR LAMP - MAINS POWER "ON"
5	INDICATOR LAMP - HYDRAULIC PUMP "ON"
6	INDICATOR LAMP - COOLANT PUMP "ON"
7	INDICATOR LAMP - UNIT READY
8	MAIN DRIVE CONTROLS - START, STOP, INCH, ACCELERATE, RETARD
9	HYDRAULIC PUMPS - START, STOP
10	INGOING CARRIAGE GRIPPING - OPEN, CLOSE
11	OUTGOING CARRIAGE GRIPPING - OPEN, CLOSE
12	INGOING CARRIAGE TRAVERSE - REVERSE, OFF, FORWARD
13	OUTGOING CARRIAGE TRAVERSE - REVERSE, OFF, FORWARD
14	COOLANT PUMP - START, STOP
15	MAIN DRIVE - MASTER STOP, RE-SET, INCH (INTERLOCK)
16	INDICATOR LAMPS - SEMI & FULLY AUTOMATIC CYCLE
17	SEMI-AUTOMATIC CONTROLS - "ON", "OFF"
18	SEMI-AUTOMATIC CONTROLS - LOAD, TRANSFER (GRIP) UNLOAD
19	FULLY AUTOMATIC CYCLE CONTROL - "ON"

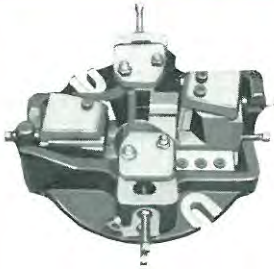


HEADSTOCK

Access to the cutter heads and roller steady is by easily operated hinged covers on the headstock. Spindle speed variation and "start", "stop" and "inch" are included in the control panel on the headstock and the actual spindle speed registers on a large diameter tachometer dial. Levers on the front of the feed unit provide an 8-speed feed change and feed reverse, whilst star handwheels give simultaneous adjustment to the serrated feed roll saddles.



(a)



(b)



(c)



(d)



(e)



(f)

ROUGH TURNING CUTTER HEADS

RADIAL TYPE TOOLS

R3RS and R3RL—For No. 3 Size Machine

R4RS and R4RL—For No. 4 Size Machine

The cutter head bodies are steel castings designed for maximum rigidity and for ease of handling and rapid tool changing. The high grade steel tool blocks are clamped in accurately machined slideways and adjusted by robust high tensile steel screws. Normally two tools at 180° with plain steadies beneath and at 90° to the tools are provided but four tools may be used if so desired. All heads are dynamically balanced to eliminate rotational vibration.

ROUGH TURNING CUTTER HEADS

TANGENTIAL TYPE TOOLS

R3TS and R3TL—For No. 3 Size Machine

R4TS and R4TL—For No. 4 Size Machine

Again these cutter heads are of all-steel construction and accurately machined in the slideways, etc. As with the radial type cutter heads they are normally provided with two tools at 180° with plain steadies beneath and at 90° to the tools, but again four tools may be used if so desired. Tangential type cutter heads are to be recommended when using tungsten carbide tools and they can be adapted for using "throw-away" tips. All heads are dynamically balanced.

PRECISION FINISHING CUTTER HEADS

RADIAL TYPE TOOLS

F3RS and F3RL—For No. 3 Size Machine

F4RS and F4RL—For No. 4 Size Machine

When a high degree of surface finish is required, the all-steel precision finishing head is used. This incorporates a single tool block assembly, together with three roller block assemblies, mounted in an accurately machined body. The special hardened steel pressure rollers have solid shanks carried in needle roller bearings mounted in blocks which are guided and clamped in accurately machined slots in the head. Radial type heads are usually used in conjunction with high speed steel or "Stellite" tipped tools. All heads are dynamically balanced.

PRECISION FINISHING CUTTER HEADS

TANGENTIAL TYPE TOOL

F3TS and F3TL—For No. 3 Size Machine

F4TS and F4TL—For No. 4 Size Machine

The heads are basically the same as the radial type tool heads, each incorporating a single tool block assembly together with 3 pressure roller block assemblies. In these heads however the adjustable tool block mounts the tool tangentially to the surface of the bar and such tools are to be recommended when using tungsten carbide tools and, as with the tangential type rough turning heads, they can be adapted for using "throw-away" tips. As with all the other heads the cuttings are removed in a continuous ribbon which is rapidly broken up into small pieces of swarf for ease of disposal. All heads are dynamically balanced.

ROLLER STEADY

S3S and S3L—For No. 3 Size Machine

S4S and S4L—For No. 4 Size Machine

The roller steadies again, are of all steel construction and accurately dynamically balanced. They are mounted on the left hand face of the spindle "spider" after the input head but immediately preceding the output head. They each incorporate three roller block assemblies at 120° in accurately machined slots in the body. The special hardened steel pressure rollers have solid shanks carried in needle roller bearings which are mounted in the blocks. The blocks themselves are fully adjustable throughout the range of the steady and are rigidly clamped at the correct setting.

TOOL SETTING

For pre-setting of cutter heads and roller steadies on the bench, a setting stand is provided which consists of a spigot location plate fitted with a hardened steel bush insert to suit the mandrels which are made for individual bar sizes. The same setting stand is used for all cutter heads and roller steadies for both the No. 3 and No. 4 size machines. To minimise cutter head and steady changing time, a spare set of heads and steady is usually set up while the machine is running.

No. 3 & 4 Size PATENT CENTRELESS BAR TURNING MACHINES

Both machines are generally as the accompanying illustrations and comprise:—

MAIN HEADSTOCK

The main headstock is a rigid box section casting containing the spindle driving mechanism. Large openings are provided for access to the cutter heads and steadies, and easily operated hinged covers protect the operator and prevent any swarf or coolant from being ejected from the front of the machine. A large opening at the rear provides for the discharge of swarf and coolant down an inclined chute, either into swarf trucks in the foundation, or on to a swarf conveyor at the rear of the machine.

MAIN SPINDLE DRIVE

The main drive is by a variable-speed motor, mounted on slide rails at the rear of the machine, which by means of multiple "Vee" belts drives on to the machine pulley and through high tensile steel single helical gears on to the spindle driving gear. All driving shafts run on ball and roller bearings and the gears in a continuous oil bath.

MAIN SPINDLE

The main spindle is a large diameter steel casting carrying the large single helical final driving gear and it is mounted on specially selected roller journal bearings, the end thrust being taken by large diameter "paired" double purpose bearings. The centre portion of the spindle is in the form of a "spider", the left hand face of which mounts the roller steady and the right hand face carrying the finishing cutter head. Provision is made for mounting an input roughing cutter head on the extreme left hand face of the spindle. The whole of the spindle assembly is accurately dynamically balanced. The headstock is provided with caps for ready access to the main spindle and its bearings.

COOLANT BARREL AND BAR STEADY

A coolant barrel protrudes up the hollow spindle from the rear end and provides the necessary ductings for leading the pressurised coolant to the rear side of the output cutter head. Incorporated in the barrel assembly of the No. 3 Machine is an externally adjustable bar steady for guiding and steadying the smaller sizes of bars as they leave the output cutter head. In the No. 4 Machine, this is achieved by means of guide bushes.

FEED GEAR BOX

The feed gear box is built into a complete rigid feed unit bolted on to the ingoing end of the main headstock and is driven from the spindle drive pulley shaft by spiral bevel and worm reduction gears. It carries a feed reverse through multi-plate clutches and provides eight changes of feed by sliding gears on spline shafts. The gears are of special heat-treated steel running in oil and all shafts are mounted on ball and roller bearings throughout. The control levers are conveniently placed in front of the feed gear unit within easy reach of the operator. The final feed drive is transmitted through worm reduction gears to the feed saddles carrying the serrated feed rolls.

FEED SADDLES

The feed saddles are extremely rigid units sliding on large diameter guide bars. Simultaneous cross adjustment of the front and rear saddles is by star hand-wheels from the front of the machine through large diameter high tensile steel screws suitably resiliently loaded to allow for any slight variations in the diameter of the black bars. Sufficient adjustment is provided to cover the full range of bar sizes within the capacity of the machine. The feed spindles carrying the large diameter final feed drive worm wheels are machined from high tensile steel forgings and are mounted on heavy ball and roller bearings. The upper ends of the feed spindles form large tapered spindle noses to provide rigid drives to the serrated feed rollers. These feed rollers, which are of special heat-treated steel, have special serrations machined in the "Vee" shaped grooves.

SPECIFICATION

ROLLER SUPPORTS

Fixed and travelling roller bar supports are supplied both at the ingoing and outgoing ends of the machine. They are mounted on the large diameter traverse bars and are adjustable to suit the full range of bar diameters. Pedestal supports carried on the foundation support the traverse bars.

HAND OPERATED GRIPPING CARRIAGES

Hand operated gripping carriages are free running on the traverse bars and are provided with 3-point bar clamping arrangements operated through large diameter heavy handwheels and high tensile steel screws of special design for rapid and rigid gripping of the bar. The clamps are fitted with renewable hardened alloy steel grips for black and rough turned bars and hard phosphor bronze grips for finished turned bars.

Or, alternatively—

HYDRAULICALLY OPERATED TRAVERSING AND GRIPPING CARRIAGES

Hydraulically operated carriages embodying their own self-contained motorised pump and tank hydraulic systems provide "push button" bar gripping and traversing operated from the operator's stand.

Such carriages are necessary for semi or fully automatic machines.

Gripping is of the 4-point type and the clamps are fitted with renewable hardened steel grips for black and rough turned bars and hard phosphor bronze grips for finished turned bars.

LIMIT SWITCHES

Stop and limit switches are fitted to prevent damage due to over-run of carriages. Additional limit switches are also provided for automatic machines to ensure correct sequencing of operations.

BAR STILLAGES FOR HAND OPERATED GRIPPING CARRIAGES

Bar stillages for hand operated machines are not included. They can be supplied with the machine, but, as they are comparatively simple, clients usually provide their own.

MECHANICAL BAR HANDLING EQUIPMENT FOR SEMI AND FULLY AUTOMATIC MACHINES

Mechanical bar handling equipment is essential for semi and fully automatic machines and this comprises fabricated steel stillages for black and turned bar, with loading and unloading arms driven by electric motors through worm reduction gears. Electrical interlocks are provided between the arms and the hydraulic carriages to give fully automatic working. Each finished turned bar is, in turn, held clear of the stillage for checking by the operator whilst the machine is in motion.

CUTTER HEADS AND STEADIES

A complete set of cutter heads and steadies to cover the full range of bar diameters within the capacities of the machines is supplied. A set comprises rough turning type cutter heads R3RS and R3RL (R4RS and R4RL for No. 4 machine), precision finishing cutter heads F3RS and F3RL (F4RS and F4RL for No. 4 machine), and roller steadies S3S and S3L (S4S and S4L for No. 4 machine) as shown on page 20. These standard cutter heads are of the radial tool type. For high production machines, then the tangential tool type also shown on page 20 can be supplied instead of the radial tool type at a slightly extra cost. The cutter heads and roller steady are of easy access and quickly change when re-setting is necessary.

MOTOR DRIVEN PUMP UNIT

A motor driven pump unit with all necessary piping, valves, etc., is provided to give a copious flow of coolant to both the front and rear cutter heads.

SWarf DISPOSAL

The swarf produced from these machines is rear discharged either into swarf trucks sunk into a pit in the foundation in which is incorporated the coolant tank, or, on to a motorised swarf conveyor embodied with a coolant tank. The conveyor elevates the swarf and deposits it in bins on floor level.

STANDARD ELECTRICAL SPECIFICATION FOR VARIABLE SPEED D.C. DRIVE

MOTOR

One 40/40 H.P. 500/1500 R.P.M. screen protected, shunt wound D.C. motor, suitably rated for the drive of the machine, in accordance with BS.2613. Speed variation by shunt rheostat control, giving constant H.P. throughout the range.

RECTIFIER

Rectifier where D.C. supply is not available.

The above motor would be supplied from a natural air cooled semi-conductor rectifier, suitably rated, output 440 volts, D.C., 2-wire.

Input to suit customer's supply.

The rectifier unit would be rated in accordance with BS.1698 Class II suitable for an ambient temperature not exceeding 35 degrees centigrade.

The unit would be enclosed in a sheet steel, floor fixing cubicle, with access door and removable covers.

CONTROL GEAR

Control gear comprising automatic starting panel for the motors, consisting of a sheet steel enclosure to BS.587 type 1A, dust and damp protecting. All necessary internal connections for remote control would be included.

OPERATOR'S CONTROLS

Push buttons would be fitted on the control station on the headstock for "Start" "Stop" "Increase Speed" and "Decrease Speed" as well as all other auxiliary controls.

A remote ammeter would also be mounted on the control station.

CABLES

No cables for interconnection between Motor, rectifier and control gear are included. Cable sealing boxes can be supplied, provided we are given a full specification of the cables to be provided by the user.

STANDARD EQUIPMENT No. 3 SIZE MACHINE

The machine is generally as the foregoing specification, complete with runways and two *hand gripping* carriages and arranged for motor drive through the "Vee" belts and pulleys and the following:—

One Cutter Head (type R3RS) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).

One Cutter Head (type R3RL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).

One Cutter Head (type F3RS) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).

One Cutter Head (type F3RL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).

One Roller Steady (type S3S) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).

One Roller Steady (type S3L) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).

One Cutter Head Setting Plate and One Sample Mandrel.

One Motor Driven Coolant Pump Unit with necessary Pipes, Valves, etc.

One set of Four Serrated Feed Rolls to cover full bar range.

One Set of Hardened Alloy Steel Carriage Gripper Jaws for Ingoing and Outgoing Carriages.

One Set of Hard Phosphor Bronze Carriage Gripper Jaws for Outgoing Carriage only.

All necessary Spanners, Screwkeys, etc.

One Grease Gun.

One Complete Set of Foundation Bolts and Plates.

Two Copies of Maintenance and Instruction Manual.

STANDARD EQUIPMENT No. 4 SIZE MACHINE

The machine is generally as the foregoing specification, complete with runways and two *hand gripping* carriages and arranged for motor drive through the "Vee" belts and pulleys and the following:—

- One Cutter Head (type R4RS) range 1 in. to 2½ ins. (25 mm. to 65 mm.).
- One Cutter Head (type R4RL) range 2¼ ins. to 4 ins. (57 mm. to 102 mm.).
- One Cutter Head (type F4RS) range 1 in. to 2½ ins. (25 mm. to 65 mm.).
- One Cutter Head (type F4RL) range 2¼ ins. to 4 ins. (57 mm. to 102 mm.).
- One Roller Steady (type S4S) range 1 in. to 2½ ins. (25 mm. to 65 mm.).
- One Roller Steady (type S4L) range 2¼ ins. to 4 ins. (57 mm. to 102 mm.).
- One Cutter Head Setting Plate and One Sample Mandrel.
- One Motor Driven Coolant Pump Unit with necessary Pipes, Valves, etc.
- One set of Four Serrated Feed Rolls to cover full bar range.
- One Set of Hardened Alloy Steel Carriage Gripper Jaws for Ingoing and Outgoing Carriages.
- One Set of Hard Phosphor Bronze Carriage Gripper Jaws for Outgoing Carriage only.
- All necessary Spanners, Screwkeys, etc.
- One Grease Gun.
- One Complete Set of Foundation Bolts and Plates.
- Two Copies of Maintenance and Instruction Manual.

MACHINE DATA No. 3 SIZE MACHINE

Maximum Diameter of Black Bar		3½ ins. (80 mm.)
Minimum Diameter of Turned Bar		½ ins. (12 mm.)
Minimum Length of Bar—Hand Gripping	..	7 ft. 6 ins. (2286 mm.)
—Hydraulic Gripping		9 ft. 6 ins. (2895 mm.)
—Fully Automatic	..	11 ft. 6 ins. (3505 mm.)
Maximum Length of Bar—Standard	..	20 ft. (6 metres)
		(can be increased)
Range of Spindle Speeds—R.P.M.	..	120 to 360 and/or 300 to 900
Range of Feeds per revolution of Spindle	..	⅓ in. to ¼ in. (0.8 mm. to 6.4 mm.)
(8 changes) optional ranges	.. or	⅛ in. to ½ in. (1.6 mm. to 12.7 mm.)
	or	⅛ in. to ⅜ in. 1.6 mm. to 4.8 mm.)
Main Motor—Horse Power		40/40 H.P.
Speed		500/1500 R.P.M. (infinitely variable)

SHIPPING SPECIFICATION

Standard Machine

(with hand gripping carriages)

Nett Weight	230 cwts. (11,700 kgs.)
Gross Weight	265 cwts. (13,460 kgs.)
Volume of Packing Cases	690 cu.ft. (19.5 cu.metres)

Extra for Hydraulic Carriages

Net Weight	32 cwts. (1,625 kgs.)
Gross Weight	38 cwts. (1,930 kgs.)
Volume of Packing Cases	110 cu.ft. (3.11 cu.metres)

Extra for Mechanical Handling Gear and Stillages

Net Weight	105 cwts. (5,320 kgs.)
Gross Weight	125 cwts. (6,350 kgs.)
Volume of Packing Cases	440 cu.ft. (12.45 cu.metres)

MACHINE DATA No. 4 SIZE MACHINE

Maximum Diameter of Black Bar	$4\frac{1}{8}$ ins. (105 mm.)
Minimum Diameter of Turned Bar	1 ins. (25 mm.)
Minimum Length of Bar—Hand Gripping ..	7 ft. 6 ins. (2286 mm.)
—Hydraulic Gripping ..	9 ft. 6 ins. (2895 mm.)
—Fully Automatic ..	11 ft. 6 ins. (3505 mm.)
Maximum Length of Bar—Standard ..	20 ft. (6 metres)
(can be increased)	
Range of Spindle Speeds—R.P.M. ..	90 to 270 and/or 267 to 800
Range of Feeds per revolution of Spindle ..	$\frac{1}{32}$ in. to $\frac{1}{4}$ in. (0.8 mm. to 6.4 mm.)
(8 changes) optional ranges ..	or $\frac{1}{16}$ in. to $\frac{1}{2}$ in. (1.6 mm. to 12.7 mm.)
	or $\frac{1}{8}$ in. to $\frac{3}{8}$ in. (3.2 mm. to 9.5 mm.)
Main Motor—Horse Power	40/40 H.P.
Speed	500/1500 R.P.M. (infinitely variable)

SHIPPING SPECIFICATION

Standard Machine

(with hand gripping carriages)

Nett Weight	230 cwts. (11,700 kgs.)
Gross Weight	265 cwts. (13,460 kgs.)
Volume of Packing Cases	690 cu.ft. (19.5 cu.metres)

Extra for Hydraulic Carriages

Net Weight	32 cwts. (1,625 kgs.)
Gross Weight	38 cwts. (1,930 kgs.)
Volume of Packing Cases	110 cu.ft. (3.11 cu.metres)

Extra for Mechanical Handling Gear and Stillages

Net Weight	105 cwts. (5,320 kgs.)
Gross Weight	125 cwts. (6,350 kgs.)
Volume of Packing Cases	440 cu.ft. (12.45 cu.metres)

EXTRA EQUIPMENT No. 3 SIZE MACHINE

- Item 1. Hydraulic Gripping and Traversing Carriages instead of hand gripping carriages.
- Item 2. Mechanical Bar Handling Equipment with Ingoing and Outgoing Bar Stillages for 20 ft. (6 metres) maximum length of bar.
- Item 3. Equipment as Item 2 for each extra 5 ft. (1.5 metres) length over the standard 20 ft. (6 metres).
- Item 4. Two Swarf Trucks with rails (for pit type coolant tank).
- Item 5. One Motorised Swarf Conveyor Combined with Coolant Tank to raise the swarf and deposit it into bins on floor level (exclusive of bins).
- Item 6. One Spare Cutter Head (type R3RS) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).
- Item 7. One Spare Cutter Head (type R3RL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).
- Item 8. One Spare Cutter Head (type F3RS) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).
- Item 9. One Spare Cutter head (type F3RL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).
- Item 10. One Cutter Head (type R3TS) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).
- Item 11. One Cutter Head (type R3TL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).
- Item 12. One Cutter Head (type F3TS) range $\frac{3}{4}$ in. to $1\frac{1}{2}$ ins. (19 mm. to 38 mm.).
- Item 13. One Cutter Head (type F3TL) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).
- Item 14. One Spare Roller Steady (type S3S) range $\frac{1}{2}$ in. to $1\frac{1}{2}$ ins. (12 mm. to 38 mm.).
- Item 15. One Spare Roller Steady (type S3L) range $1\frac{3}{8}$ ins. to 3 ins. (35 mm. to 77 mm.).
- Item 16. Spare Tungsten Carbide Tools for types R3RS, F3RS Heads (state type).
- Item 17. Spare Tungsten Carbide Tools for types R3RL, F3RL Heads (state type).
- Item 18. Spare Tungsten Carbide Tools for types R3TS, F3TS Heads (state type).
- Item 19. Spare Tungsten Carbide Tools for types R3TL, F3TL Heads (state type).
- Item 20. Spare Special Iron Steady Pads for types R3RS, R3TS Heads (state type).
- Item 21. Spare Special Iron Steady Pads for types R3RL, R3TL Heads (state type).
- Item 22. Spare Special Iron Steady Pads for types F3RS, F3TS Heads (state type).
- Item 23. Spare Special Iron Steady Pads for types F3RL, F3TL Heads (state type).
- Item 24. Spare Special Hardened Steel Pressure Rollers for types F3RS, F3TS, S3S Heads (state type).
- Item 25. Spare Special Hardened Steel Pressure Rollers for types F3RL, F3TL, S3L Heads (state type).
- Item 26. Spare Needle Roller Bearings for Pressure Rollers for types F3RS, F3TS, S3S Heads (state type).
- Item 27. Spare Needle Roller Bearings for Pressure Rollers for types F3RL, F3TL, S3L Heads (state type).
- Item 28. Extra Cutter Setting Mandrels (to client's specified sizes).
- Item 29. Spare Set of Hardened Steel Grippers for Ingoing and Outgoing carriages.
- Item 30. Spare Set of Phosphor Bronze Grippers for Outgoing Carriage only.
- Item 31. Spare Set of Four serrated Hardened Steel Feed Rollers.

EXTRA EQUIPMENT No. 4 SIZE MACHINE

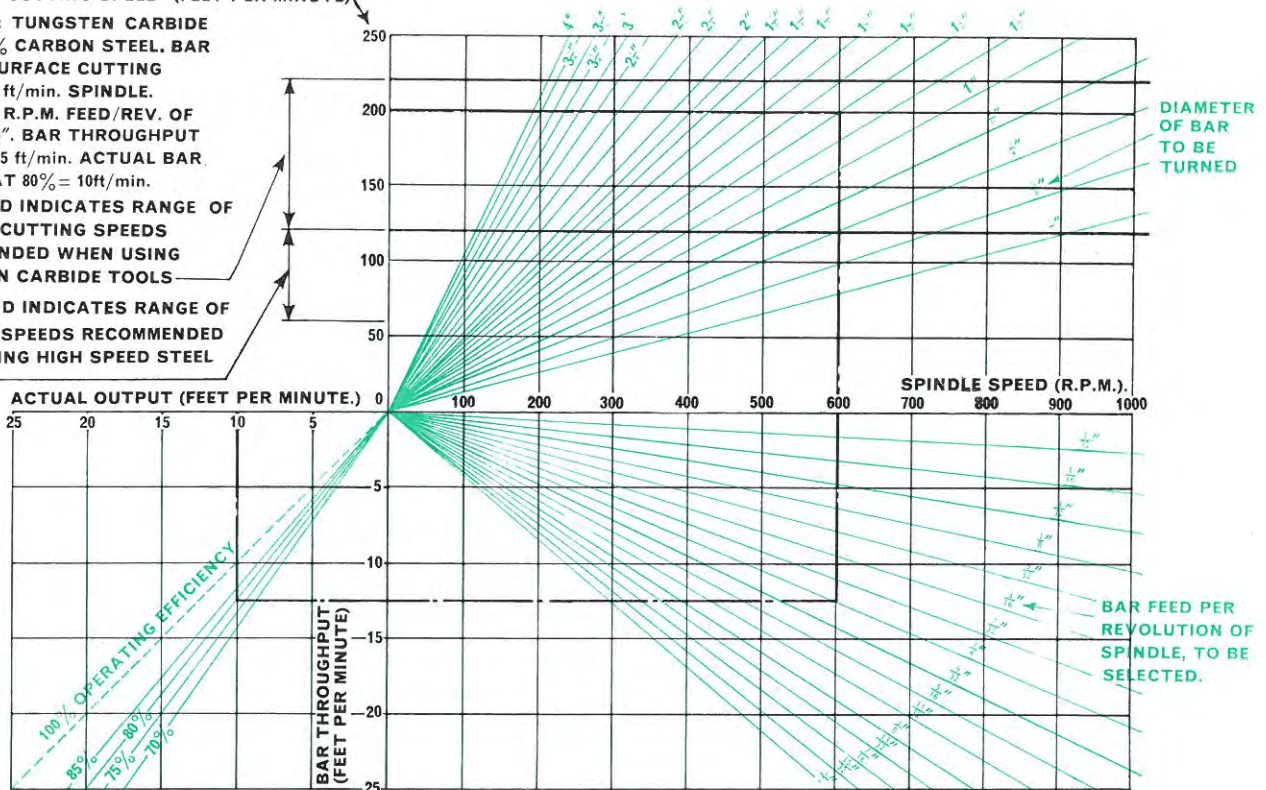
- Item 1. Hydraulic Gripping and Traversing Carriages instead of Hand Gripping Carriages.
- Item 2. Mechanical Bar Handling Equipment with Ingoing and Outgoing Bar Stillages for 20 ft. (6 metres) maximum length of bar.
- Item 3. Equipment as Item 2 for each extra 5 ft. (1.5 metres) length over the standard 20 ft. (6 metres).
- Item 4. Two Swarf Trucks with rails (for pit type coolant tank).
- Item 5. One Motorised Swarf Conveyor Combined with Coolant Tank to raise the swarf and deposit it into bins on floor level (exclusive of bins).
- Item 6. One Spare Cutter Head (type R4RS) range 1 in. to $2\frac{1}{2}$ ins. (25 mm. to 65 mm.).
- Item 7. One Spare Cutter Head (type R4RL) range $2\frac{1}{4}$ ins. to 4 ins. (57 mm. to 102 mm.).
- Item 8. One Spare Cutter Head (type F4RS) range 1 in. to $2\frac{1}{2}$ ins. (25 mm. to 65 mm.).
- Item 9. One Spare Cutter Head (type F4RL) range $2\frac{1}{4}$ ins. to 4 ins. (57 mm. to 102 mm.).
- Item 10. One Cutter Head (type R4TS) range 1 in. to $2\frac{1}{2}$ ins. (25 mm. to 65 mm.).
- Item 11. One Cutter Head (type R4TL) range $2\frac{1}{4}$ ins. to 4 ins. (57 mm. to 102 mm.).
- Item 12. One Cutter Head (type F4TS) range 1 in. to $2\frac{1}{2}$ ins. (25 mm. to 65 mm.).
- Item 13. One Cutter Head (type F4TL) range $2\frac{1}{4}$ ins. to 4 ins. (57 mm. to 102 mm.).
- Item 14. One Spare Roller Steady (type S4S) range 1 in. to $2\frac{1}{2}$ ins. (25 mm. to 65 mm.).
- Item 15. One Spare Roller Steady (type S4L) range $2\frac{1}{4}$ ins. to 4 ins. (57 mm. to 102 mm.).
- Item 16. Spare Tungsten Carbide Tools for types R4RS, F4RS Heads (state type).
- Item 17. Spare Tungsten Carbide Tools for types R4RL, F4RL Heads (state type).
- Item 18. Spare Tungsten Carbide Tools for types R4TS, F4TS Heads (state type).
- Item 19. Spare Tungsten Carbide Tools for types R4TL, F4TL Heads (state type).
- Item 20. Spare Special Iron Steady Pads for types R4RS, R4TS Heads (state type).
- Item 21. Spare Special Iron Steady Pads for types R4RL, R4TL Heads (state type).
- Item 22. Spare Special Iron Steady Pads for types F4RS, F4TS Heads (state type).
- Item 23. Spare Special Iron Steady Pads for types F4RL, F4TL Heads (state type).
- Item 24. Spare Special Hardened Steel Pressure Rollers for types F4RS, F4TS, S4S Heads (state type).
- Item 25. Spare Special Hardened Steel Pressure Rollers for types F4RL, F4TL, S4L Heads (state type).
- Item 26. Spare Needle Roller Bearings for Pressure Rollers for types F4RS, F4TS, S4S Heads (state type).
- Item 27. Spare Needle Roller Bearings for Pressure Rollers for types F4RL, F4TL, S4L Heads (state type).
- Item 28. Extra Cutter Setting Mandrels (to client's specified sizes).
- Item 29. Spare Set of Hardened Steel Grippers for Ingoing and Outgoing Carriages.
- Item 30. Spare Set of Phosphor Bronze Grippers for Outgoing Carriage only.
- Item 31. Spare Set of Four serrated Hardened Steel Feed Rollers.

SURFACE CUTTING SPEED (FEET PER MINUTE)

EXAMPLE: TUNGSTEN CARBIDE TOOLS .5% CARBON STEEL. BAR 1½" DIA. SURFACE CUTTING SPEED 200 ft/min. SPINDLE SPEED 600 R.P.M. FEED/REV. OF SPINDLE ¼". BAR THROUGHPUT RATE = 12.5 ft/min. ACTUAL BAR OUTPUT AT 80% = 10ft/min.

THIS BAND INDICATES RANGE OF SURFACE CUTTING SPEEDS RECOMMENDED WHEN USING TUNGSTEN CARBIDE TOOLS

THIS BAND INDICATES RANGE OF SURFACE SPEEDS RECOMMENDED WHEN USING HIGH SPEED STEEL TOOLS



GRAPHICAL DETERMINATION OF BAR OUTPUT RATES - Nos. 3 & 4 MACHINES (IN INCHES)

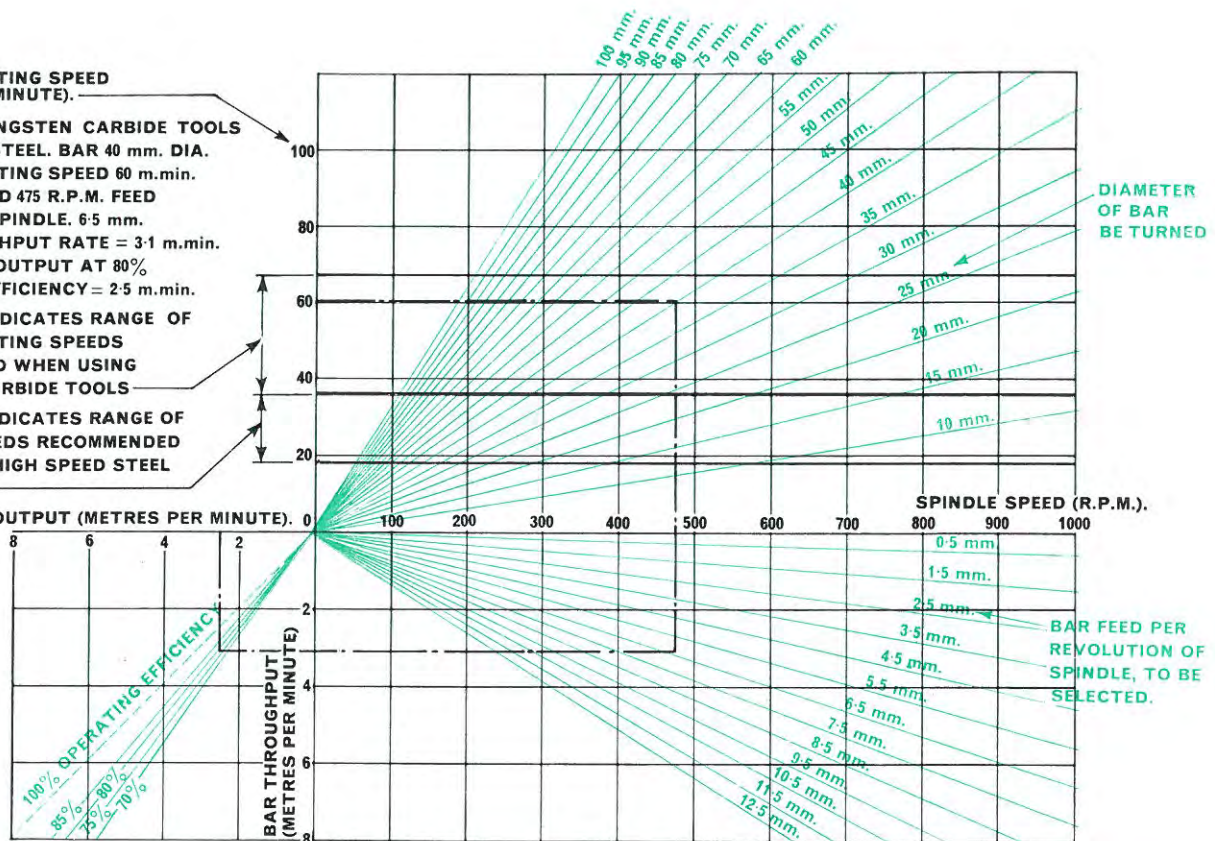
SURFACE CUTTING SPEED (METRES PER MINUTE).

EXAMPLE: TUNGSTEN CARBIDE TOOLS .5% CARBON STEEL. BAR 40 mm. DIA. SURFACE CUTTING SPEED 60 m.min. SPINDLE SPEED 475 R.P.M. FEED PER REV. OF SPINDLE. 6.5 mm. BAR THROUGHPUT RATE = 3.1 m.min. ACTUAL BAR OUTPUT AT 80% OPERATING EFFICIENCY = 2.5 m.min.

THIS BAND INDICATES RANGE OF SURFACE CUTTING SPEEDS RECOMMENDED WHEN USING TUNGSTEN CARBIDE TOOLS

THIS BAND INDICATES RANGE OF SURFACE SPEEDS RECOMMENDED WHEN USING HIGH SPEED STEEL TOOLS

ACTUAL BAR OUTPUT (METRES PER MINUTE).



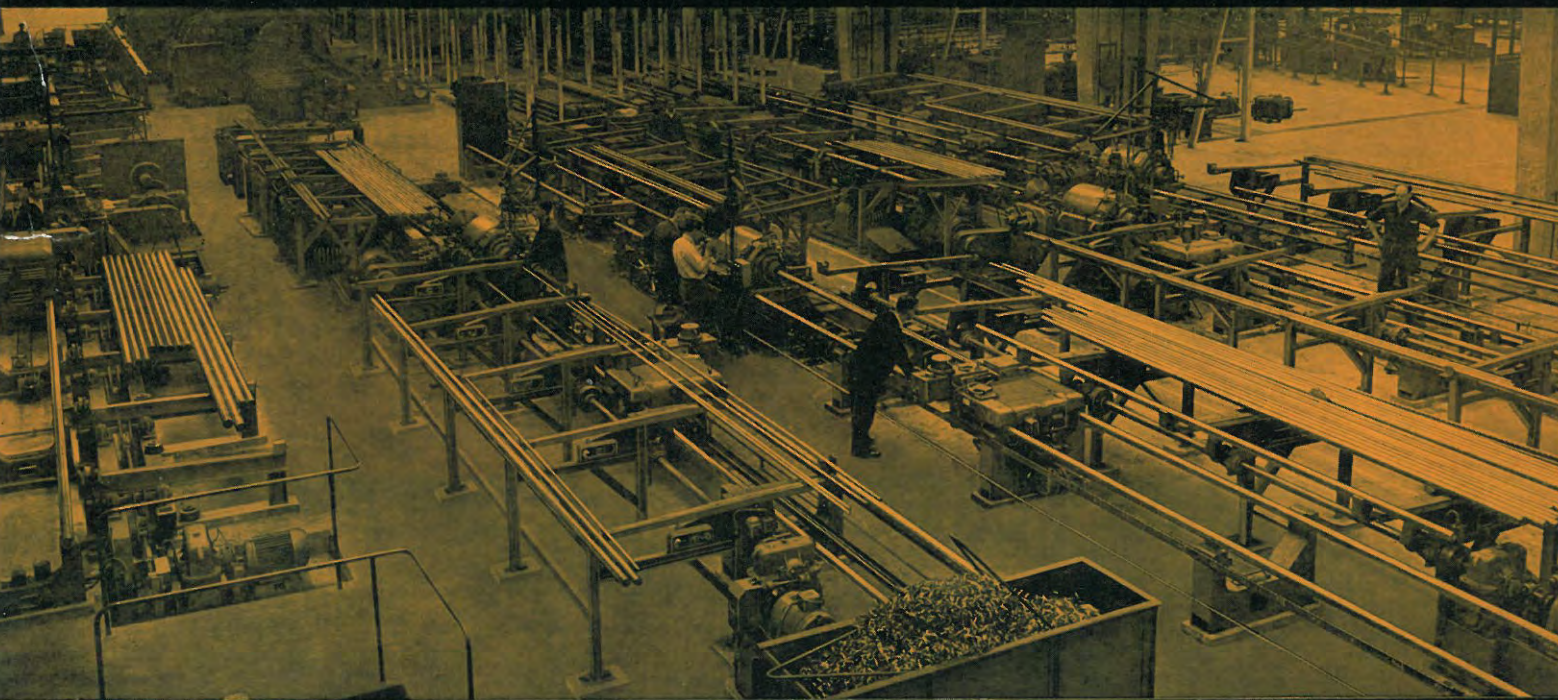
GRAPHICAL DETERMINATION OF BAR OUTPUT RATES - Nos. 3 & 4 MACHINES (METRIC)

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