# Machinery

and production engineering

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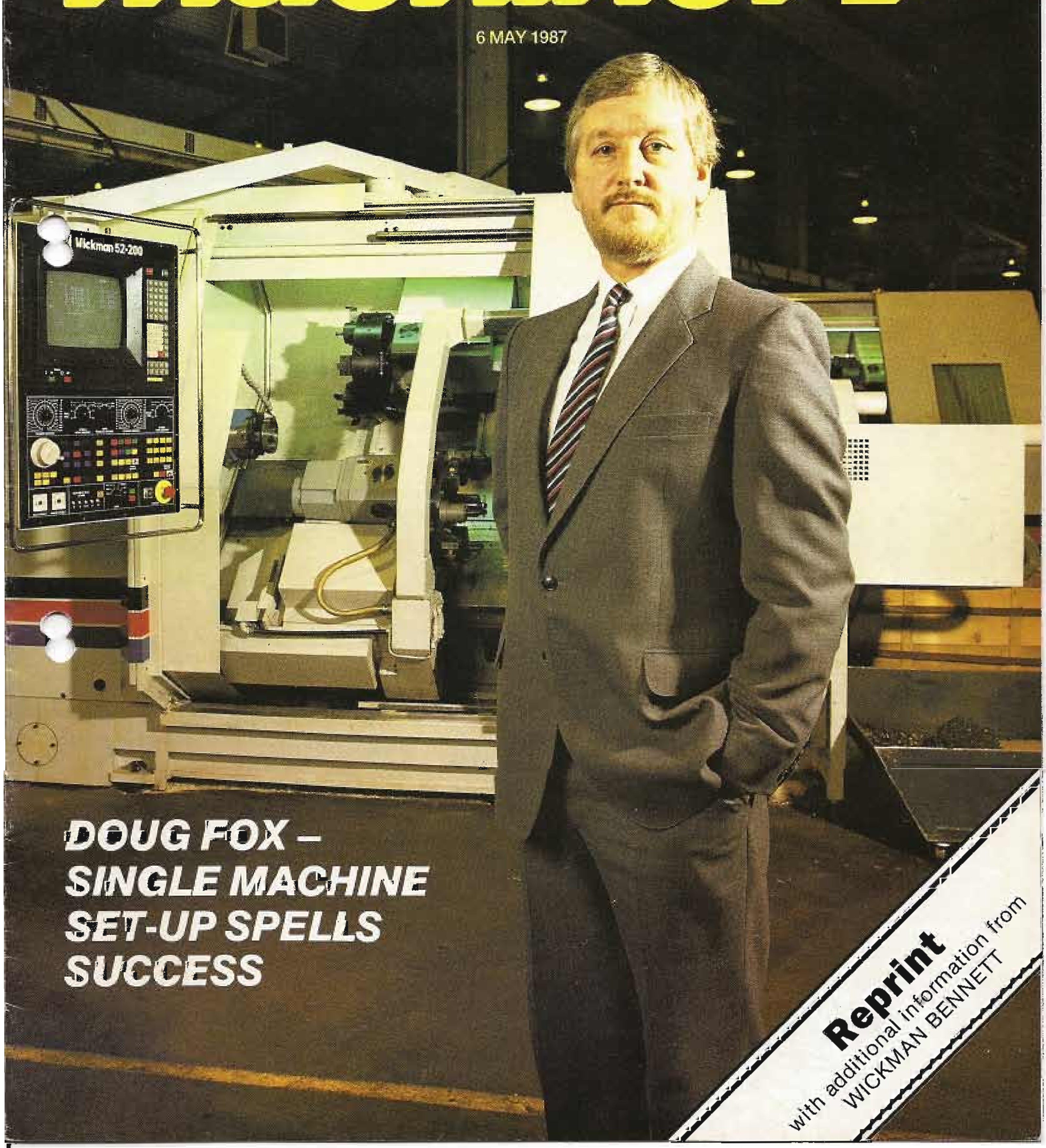



**DOUG FOX – SINGLE MACHINE SET-UP SPELLS SUCCESS**

**Reprint** with additional information from WICKMAN BENNETT

# WICKMAN BENNETT

This is the amalgamation of two internationally established names from the British Machine Tool Industry — Wickman and Webster Bennett.

The common denominator between these companies is that they both won their reputation for turning machines.

Wickman sold over 15,000 multi-spindle automatics worldwide while Webster Bennett made an equally impressive contribution to the development of vertical turning lathes, with again over 15,000 machines built.

Since the merger the emphasis has been applying the new technologies to develop a comprehensive range of advanced turning machines.

The Wickman 52–200 described in this independently prepared article is just one of the new machines for the 1990's.

A recent development from the Webster & Bennett stable is a new design of CNC vertical turning lathe which features an automatic tool changer rather than the conventional turret.

This overcomes one of the major drawbacks associated with turning — the limited tool capacity.

This machine can hold all the tools for a whole family of components in a magazine. Also, 'sister' tools can be stored and automatically changed. This enhances the unmanned running capability. Each tool carries with it its own off-sets.

Wickman Bennett are determined to remain at the leading edge of innovation for advanced technology turning. If you manufacture turned parts from around 5mm to 6m diameter, why not talk to Wickman Bennett?

# ONE UNIT OUT-PERFORMS MILLION-POUND FMS

**Mike Wildish reports how a sub-contractor's continual search for efficient production techniques has led the company to forsake its million-pound flexible manufacturing system in favour of a single £185 000 machine for a particular component.**

Five-axis machining on a stand-alone twin-spindle lathe is producing 80 per cent more gear blanks than a Kent-based automotive sub-contractor could achieve on a £1·2 million flexible manufacturing system. And the change in methods, which now rely on operator—instead of robot—loading, has also overcome runout problems.

Ketlon of Paddock Wood ships 35 000 components/day and, in 1984, commissioned the four-machine (lathes) FMS for gear blank production. Sales director, Doug Fox, insists that the FMS order was the right decision at the time; part-funded by the Government's FMS grant scheme, the installation represented state-of-the-art technology and showed that Ketlon was willing to keep its shopfloor up to date to stay ahead of the competition. But technology developments and new machine designs, coupled with a continual desire to obtain the most efficient production route, led Ketlon to compare its gear turning section with the latest 52-200 £185 000 five-axis turning centre made by sister company, Wickman Bennett of Coventry.

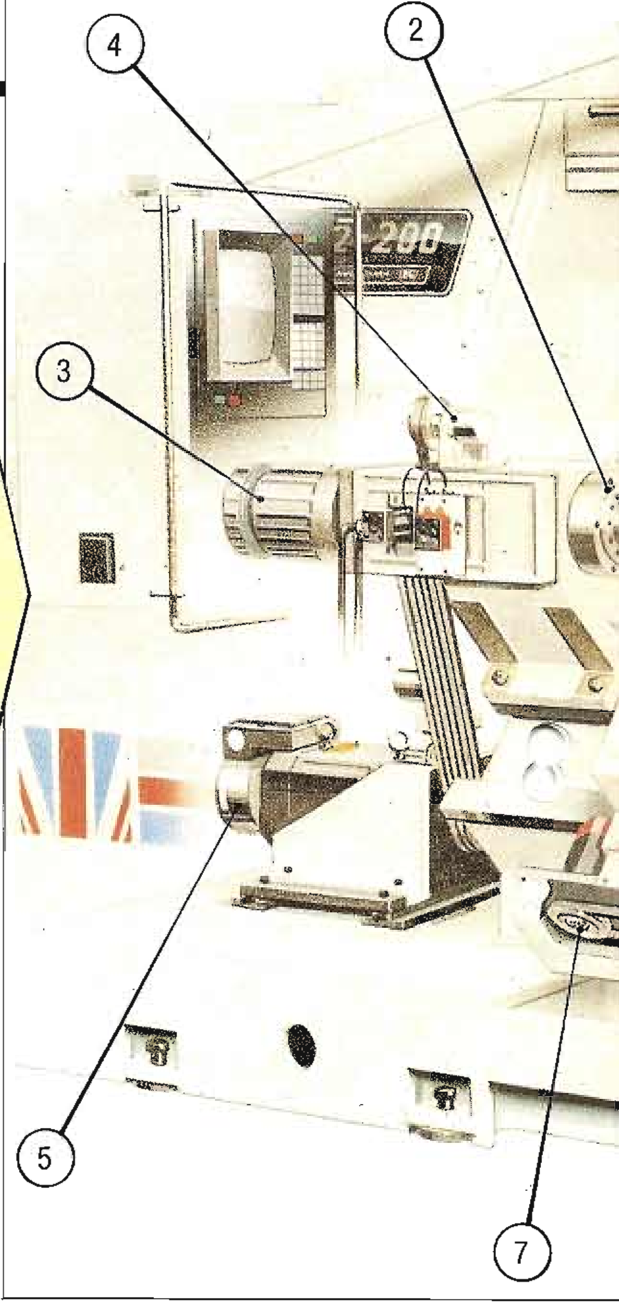
*The operational procedures for both methods complete a blank ready for gearcutting.*

Each lathe in the FMS has robot loading, probing and automatic conveyoring, and can run unmanned for an hour, limited by the length of the conveyor. The machines can run independently or, in Ketlon's case, in pairs —the system produced two different parts at the same time, so each pair performed first and second operations. Part scheduling and programming was performed in an adjacent purpose-built control room, with instructions automatically downloaded as required.

Gear blank forgings were fed by operator to the conveyor from a stillage. The operator oversaw the system and was responsible for output, quality and for maintaining statistical process control charts. The blanks were then robot-loaded to the chuck of the first lathe and, after turning, the robot unloaded the part, placed it on the conveyor for feeding to the second machine, where the second robot loaded it for final turning. Once machined, the robot unloaded the part to the outfeed conveyor ready for gearcutting.

Ketlon had experienced sporadic runout problems on the bores— which have a 0·037 mm TIR

| Key | |
|---|---|
| 1 Main turret integral motor drive to each driven position | 7 Drive for lower turret. Electro-mechanical brake on ballscrew if belt fails |
| 2 Chuck or collet feed | 8 Z axis ball screw and motor |
| 3 Chuck cylinder | 9 Pick up spindle 5½ kW AC drive |
| 4 Encoder | 10 Spline shaft drive |
| 5 11 KWAC main motor 2 stage gearbox 3·2:1 belt drive to spindle | 11 Encoder |
| 6 Lower turret | 12 Pick up drive |
| | 13 Drive X axis |




## Top of the range

The 52-200 is at the top of the Wickman Bennett CNC turning range, and is available with up to seven axes. The line up includes two-, three-, four- and five-axis models.

Built in Coventry (the factory is geared for 100 machines/year) the machines feature a meehanite-constructed 45° slant bed in two configurations. The two-axis version has three slideways, one carries the tailstock; four slideways are built into the three- and four-axis versions to carry twin turret slides. The five-axis machine also has four slideways and a bed extension that supports the extra travel of the secondary operation spindle. All beds are cast from a common pattern. The 6000 revs/min spindle assembly with 200 mm chuck or 52 mm bar capacity options, two-axis top slideway and 10 m/min rapid travels, are common for the range.

The two-axis machine has Fanuc OT control, a single 12-station turret, with options of four driven tools and a fitted tailstock. The three-axis machine has Fanuc OT control, a 12-station turret with optional four driven positions, and a six-station with all tools driven in the single-axis lower turret. The four-axis machine comes with Fanuc 11TT, twin two-axis, eight-position non-driven turrets with four driven tool options on each. And the five-axis, again with Fanuc 11TT, has twin turrets either having eight or 12 non-driven tool options on each, with optionally four- or eight-driven stations respectively.

Five-axis machine version also has the secondary operation 5·5 kW spindle capable of synchronous running with the main 11 kW spindle. This eliminates: runout when transferring parts to the second machining position; marking of gripping diameters on the second operation; and part-off pips when working with bar, because both stock material and component are fully supported throughout the cut. Both spindles are available with c axis positioning to give a true seven-axis machine.

The secondary spindle is claimed to be able to support full cuts from the lower turret, and it is possible to drill on centre with both turrets to their respective spindles at the same time. Load monitoring is included for tool breakage detection.

Software was one major area that demanded a lot of time and energy. Compiled in-house, the package uses canned cycles and the generation of its own diagnostics in plain English to simplify matters. For instance, one M code requires the addition of only a programmed distance for the complete spindle stop and synchronise routine. This single function combines spindle stop, collet open, part catcher forward, electronically synchronised spindles, move forward secondary spindle, and close collet.

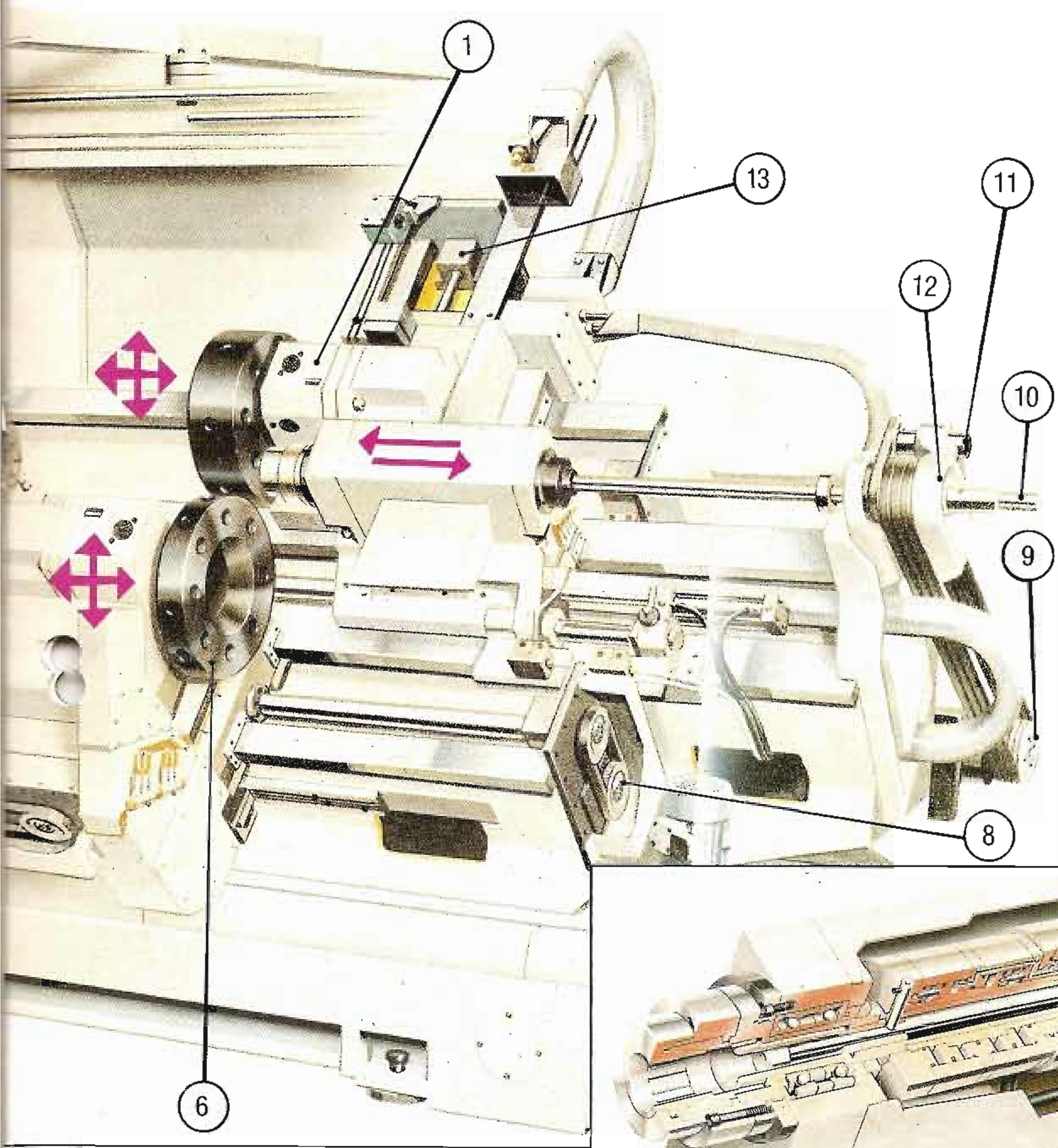
The 52-200 can be interfaced with probing, gantry loaders or a Cucchi automatic bar loader, which allows unmanned running as determined by magazine capacity.

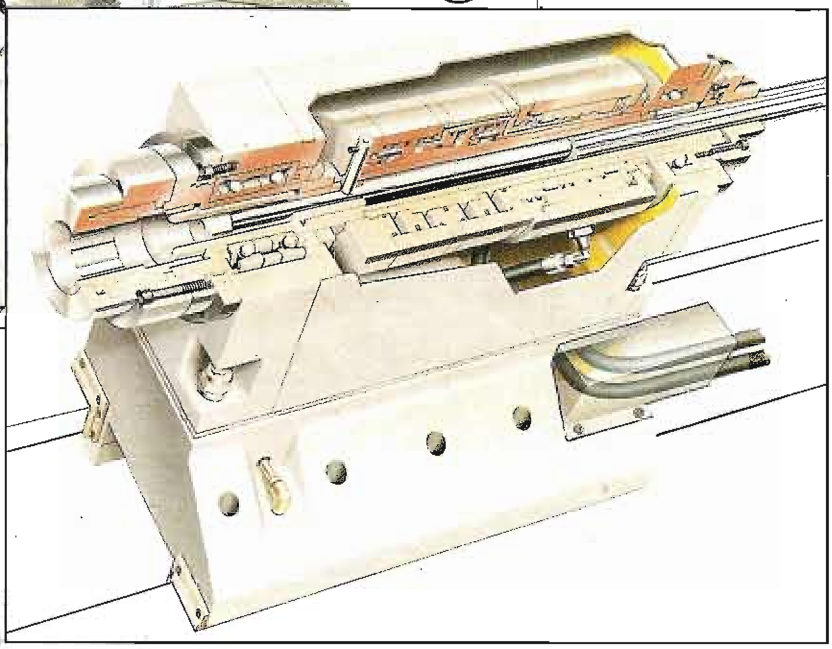
Currently in build is an addition to the range. The 76-250 uses the same frame but has a 76 mm bar capacity and the capability to carry a 10 in chuck. It has an 18·5 kW AC motor with a maximum 4000 revs/min spindle.

process tolerance—blamed on swarf pick-up and the positional drift of the loading robot. This often meant that the robots were switched off and the workpieces loaded manually—which, of course, negates the FMS concept. Runout also caused blend marks on outside diameters, which have a 0·025 mm tolerance, and the face-to-bore errors gave problems when gear teeth hobbing. And if not detected, tolerance build up occurred, because the parts were stacked four at a time on the hobbing mandrel.

Ketlon maintains a tight statistical process control (SPC) scheme, so any blip on the chart caused considerable concern and meant time-consuming 100 per cent routines to detect the offenders. Reclaimable parts were put through a rectification grinding operation.

Another problem was maintaining the 0·025 mm tolerance in the bore. Not a machine fault, adds Fox, but the probing would not guarantee anything tighter so the machine control was always trying to nudge the finish boring tool into tolerance. Fox agrees that probing would



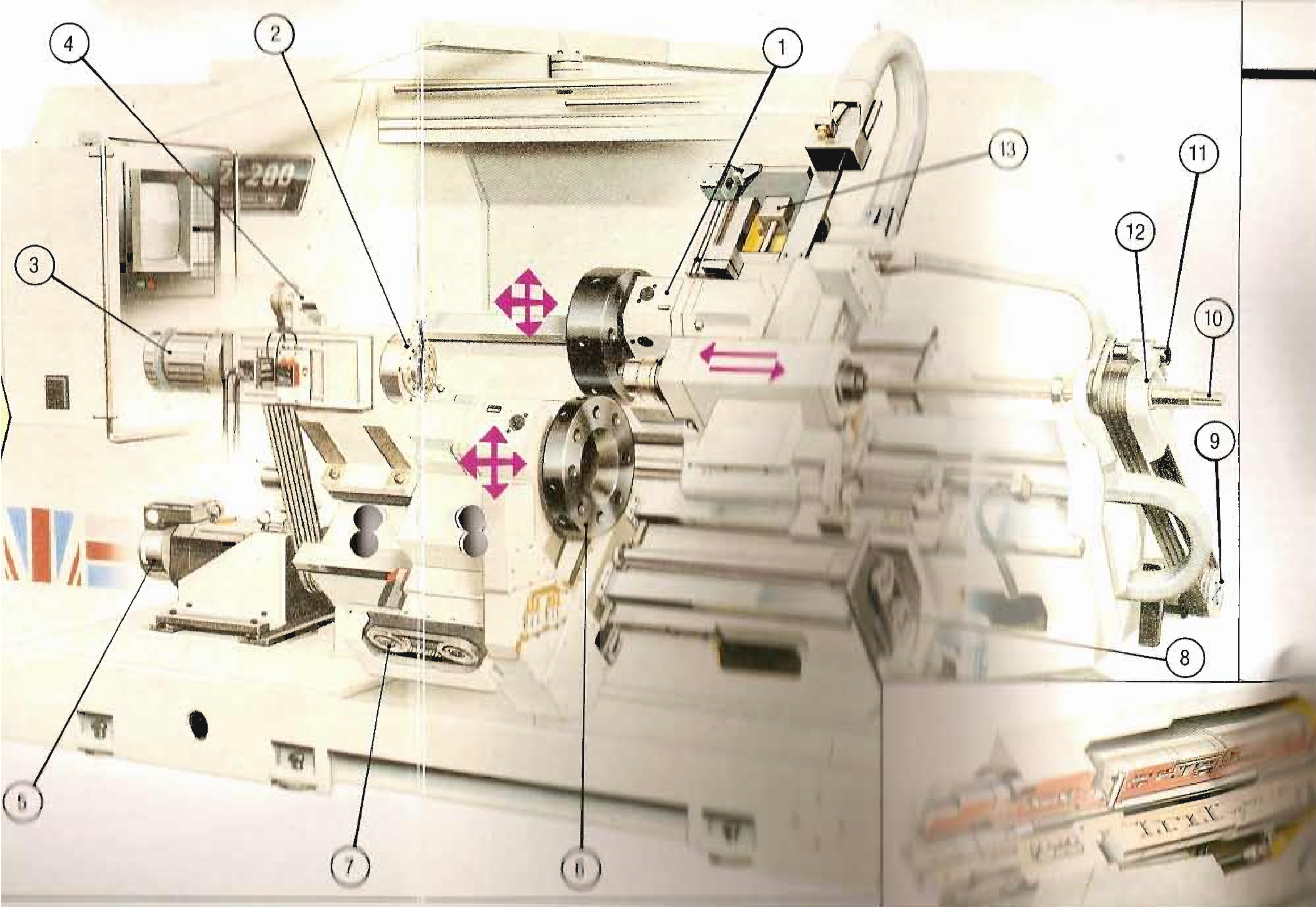



have been better linked to an £11 000 optional statistical package in the control software, so that every fifth part or a sequence of five parts every hour were monitored alternatively using off-line post-process gauging. However, the result was that the probing cycle had been programmed out on close tolerance work, reverting to traditional operator gauging which saved about two minutes on the machining cycle.

The five-axis lathe was set up with parts loaded manually and unloaded automatically, with the finished components being ejected into a controlled parts catcher. Probing was not fitted. The 52-200 has upper and lower twin turrets and a secondary operation sliding spindle mounted in the position occupied by a tailstock on a normal machine. This facility permits second operations on the reverse side of a component using tooling mounted in the lower turret while the main spindle is reloaded and the first operation performed. The secondary spindle is powered forward and can be synchronised with the main spindle to take the part from the main chuck and move it back into position for second operation machining.

This is where the five-axis machine scores against a two machine set-up. By balancing operations on the two spindles, two separate tasks can be performed in the time it takes one on a normal CNC lathe. And as the secondary spindle is mechanically clamped on the same slideways as the headstock, concentricity is assured—as the initial quality run traces confirmed.

**Continued overleaf**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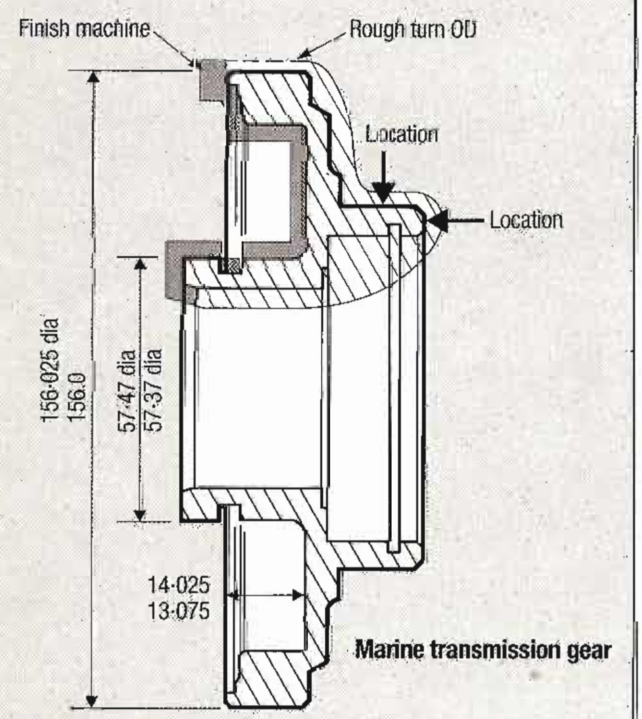
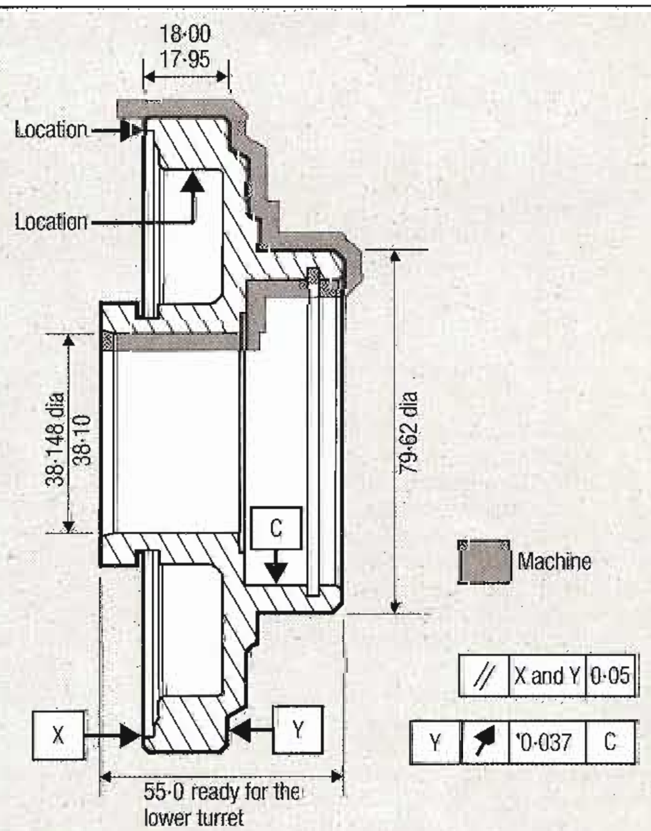
Ketlon soon decided to transfer from the FMS full production of a complex marine transmission component. And it found that the usual daily 20-hour production run using similar speeds and feeds and at 100 per cent efficiency, produced 277 gear blanks —80 per cent more than that with the FMS, with its operating efficiency of 95 per cent (with robots in use). The Wickman Bennett machine cannot better 85 per cent over the day, due to operator fatigue and relaxation allowances. Regarding floor-to-floor times, counting robot loading but not conveyoring, the FMS lathes took eight minutes 40 secs to produce a part. And one operator was in attendance. With basically the same speeds and feeds, but using the simultaneous machining facility and including operator loading, the 52-200 can produce a part in half the time.

Change-over and tool resetting is also improved—again thanks to technology developments: the 52-200 uses Sandvik Block Tooling. Programming is carried out using an Epson Prowriter, but program downloading will soon be installed. And the single machine takes much less floorspace and power consumption is 33 kVA against 74·5 kVA with the FMS. ■




**Operation 10**
The marine transmission gear is loaded to enveloping jaws around the boss diameter at the main 11.5 kW spindle by the operator. The inside diameters and faces are rough and finished turned with the top turret leaving a final skim in the main bore. The outside diameter (OD) is only rough machined.

The secondary spindle then comes forward to take the component from the first chuck gripping the part in the finished machined recess before it moves back to the rear position ready for the lower turret to complete the part.




**Operation 20**
The machine stops while the operator loads the next component to the main spindle. Then a pusher in the lower turret ensures the component is located in the secondary spindle before the OD is finished turned, all critical bores machined and the circlip grooves formed. Then it is automatically ejected into a parts catcher by an ejector mounted inside the secondary spindle.

# MACHINE SPECIFICATIONS

| **Machine type** | | **52–200 CNC Series** | | | | **76–250 CNC Series** | | |
|---|---|---|---|---|---|---|---|---|
| Model | 2-axis | 3-axis | 4-axis | 5-axis | 2-axis | 3-axis | 4-axis | 5-axis |
| **Working capacity** | | | | | | | | |
| Bar capacity | | 52 | | | | 76 | | |
| Chuck capacity | | 200 | | | | 250 | | |
| Turning diameter | | 270 | | | | 270 | | |
| Turning length | 555 | 345 | 555 | 325 | 555 | 345 | 555 | 325 |
| Swing diameter over bed | | | 596 | | | | 596 | |
| Slide travel — longitudinal | 555 | 345 | 555 | 325 | 555 | 345 | 555 | 325 |
| Slide travel — traverse (upper slide) | | 210 | | | | | 210 | |
| (lower slide) | – | – | | 185 | – | – | | 185 |
| Second operation spindle — collet bore | | – | | 52 | | – | | 52 |
| Second operation spindle — pick-up stroke | – | – | – | 1000 | – | – | – | 1000 |
| Second operation spindle — ejection stroke | – | – | – | 125 | – | – | – | 125 |
| **Main drive** | | | | | | | | |
| Rating — continuous/30mins | | 11/16kW | | | | | 18.5/22kW | |
| Maximum speed | | 6000 rev/min | | | | | 4000 rev/min | |
| Direction of rotation | | bi-directional | | | | | bi-directional | |
| Positioning feed back method | | Encoder | | | | | Encoder | |
| **Secondary spindle drive** | | | | | | | | |
| Rating — continuous/30mins | – | – | – | 5.5/8kW | – | – | – | 5.5/8kW |
| **Feed drive** | | | | | | | | |
| Rapid traverse rate | | 10m/min | | | | 10m/min | | |
| **Upper slide (2 axis)** | | | | | | | | |
| Turret type | | Disc | | | | Disc | | |
| Number of tooling stations — total | | 12 | | | | 12 | | |
| Number of tooling stations — driven | | 4 | | | | 4 | | |
| **Lower slide (2 axis)** | | | | | | | | |
| Turret type | – | – | Disc | | – | – | Disc | |
| Number of tooling stations — total | – | – | 8 | 8 or 12 | – | – | 8 | 8 or 12 |
| Number of tooling stations — driven | – | – | 4 | 4 | – | – | 4 | 4 |
| **Lower slide (single axis)** | | | | | | | | |
| Turret type | – | Hex | – | – | – | Hex | – | – |
| Number of tooling stations | – | 6 | – | – | – | 6 | – | – |
| **Tailstock** | | | | | | | | |
| Quill diameter | 70 | – | – | – | 70 | – | – | – |
| Quill stroke | 80 | – | – | – | 80 | – | – | – |
| **DIMENSIONS** | | | | | | | | |
| Length | 3515 | 5415 | 3515 | 5115 | 3515 | 5415 | 3515 | 5115 |
| Depth | | 2000 | | 2040 | | 2000 | | 2040 |
| Height | | 2150 | | 2275 | | 2150 | | 2275 |
| **Weight** | 6400kg | 6510kg | 6660kg | 7280kg | 6500kg | 6610kg | 6760kg | 7380kg |

All dimensions in mm unless otherwise stated.