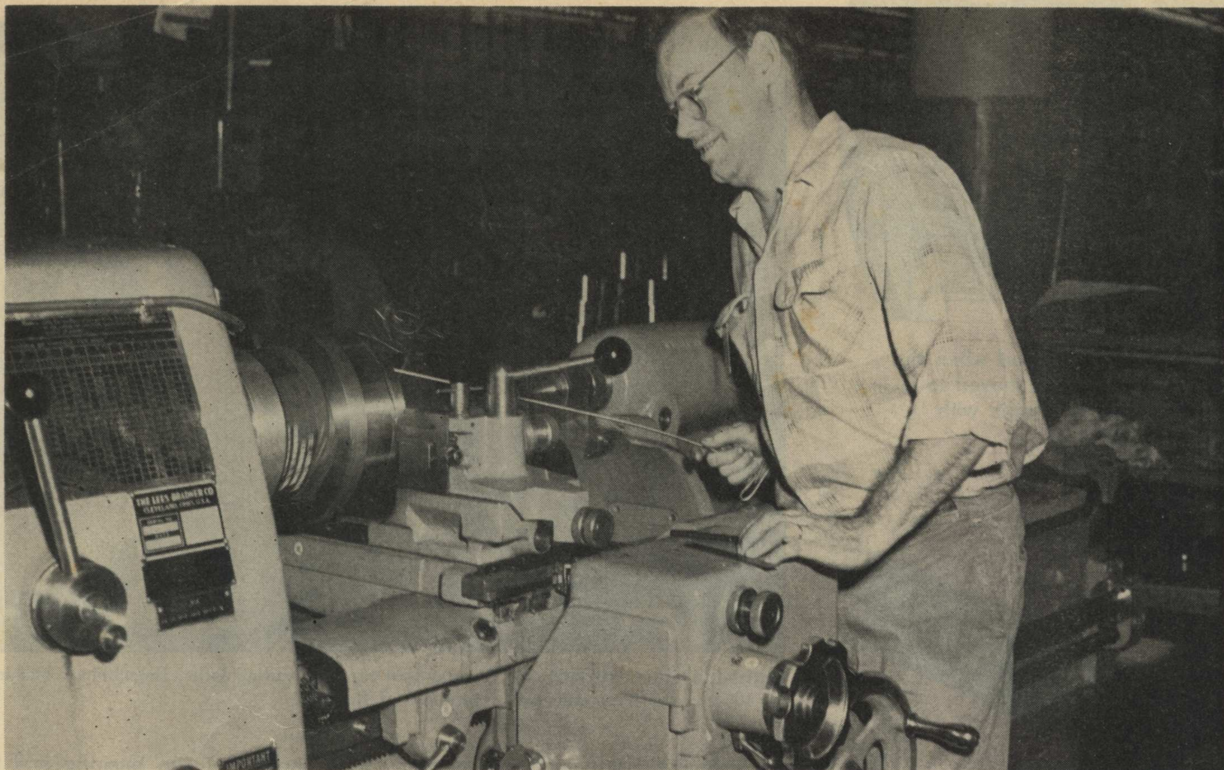


High-speed threading operation lowers tool cost and operating cost

Aim at Watervliet: Cut all threads by "rapid threading"

By Richard T Berg,
assistant editor

All production threading at Watervliet Arsenal will be performed on rapid-threading machines with single-point carbide tools—even when it means developing new equipment to handle workpieces beyond the capacity of present machines. That's the goal of the Rapid Threading Program being pursued here by the Operations Engineering Branch. The only exceptions will be parts harder than R_C 50.

Already, under the guidance of Charles Rose, project leader in the Machine Tool and Process Development Section, the Program has gained a number of cost reductions by switching small and medium parts from thread grinders and thread mills to Cri-Dan rapid threaders.

Larger parts are slated to run on a Bullard Cut Master, adapted to Man-au-trol operation and probably the first vertical machine for rapid threading. It was specially converted for this type of operation but retains all the flexibility of a conventional vertical turret lathe.

In development is an automatic attachment that will convert a standard lathe and still allow it to perform normal lathe operations.

Rapid threading with carbides is not a new idea. However, even though many European concerns have been applying it to good advantage since the end of World War II, US manufacturers have been slow to accept it.

Upon evaluating the process, Watervliet engineers discovered that it possesses a good many advantages over other threading techniques. Speed and cost are the main ones, but quality is important, too.

It operates much faster than either thread grinding or thread hobbing. And it produces a better finish than hobbing does — a smoother finish, without scallops.

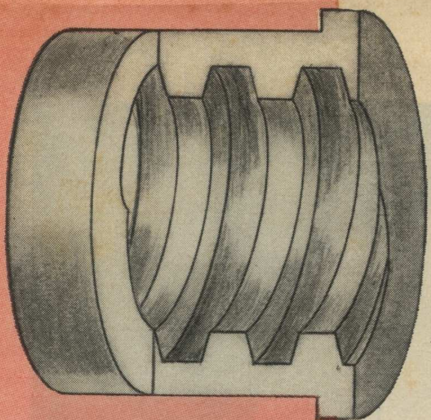
Tool cost is low because the single-point tool is less expensive to originate and maintain than either a multi-point thread hob or a grinding wheel with its dressing diamonds. Lead time required for tooling is also a good deal lower.

Compared with grinding, the machine requires about half as much floor space, and, as it normally operates without coolant, there is no need for elaborate ducting to carry off oil mist and fumes.

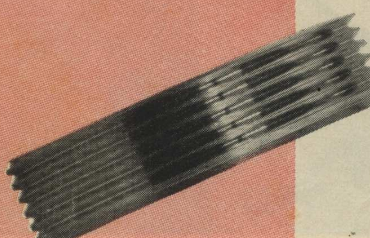
Essentially, the process is a speeded-up version of conventional thread cutting on a lathe. The added speed comes from two main factors: carbide tooling and automatic operation.

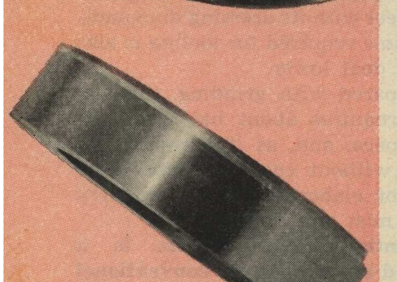
Carbide tools permit higher spindle speeds along with deeper cuts, both tending to increase the rate of metal removal. Automatic operation eliminates much of the time that would otherwise be spent in manipulation —withdrawing the tool from the cut, returning the carriage to the start of the next cut, and setting the tool at the proper depth.

Not only does this remove the human element once the setup is made,



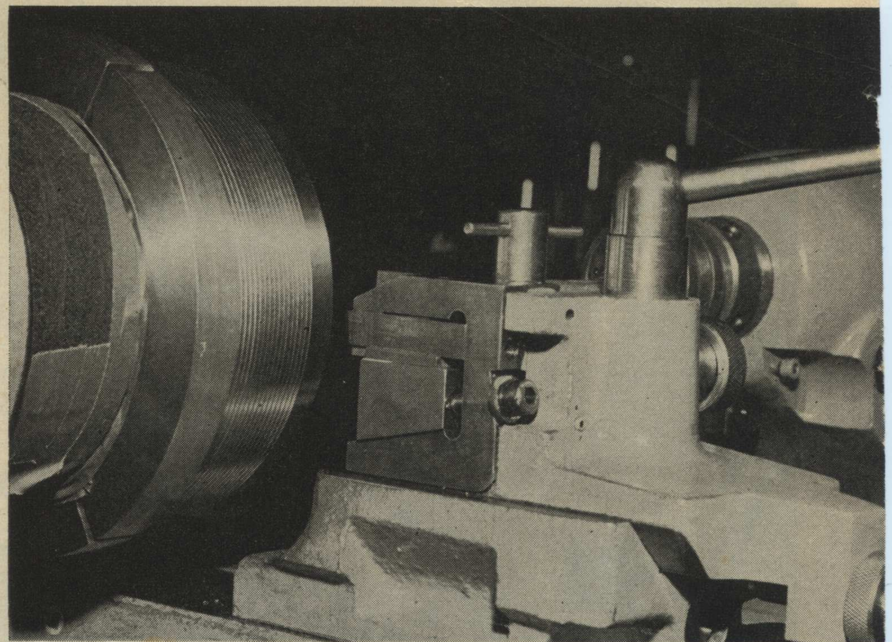
Production jumped when this 1-in. bushing was moved to a rapid-threading lathe with carbide tooling





6-in.-dia breech block for 106-mm recoilless rifle is threaded at 48 pcs per day

Cut all threads by "rapid threading" . . .



Eight-inch threads are cut by standard rapid threading lathe. Breechblock bushing for 106-mm recoilless rifle has a hardness of Rc 35-41

but in many instances it will permit multiple-machine operation by one man.

One good example of Watervliet's success with the technique is an internal threading operation on a 1-in. bushing. The part is made of either 1120 or 1130 stock and has four Acme threads per inch. The major diameter is 0.832 in.; the PD is 0.737 +0.020, –0.000 in.; and the thread depth is 0.080 in.

A thread mill could turn out only 80 to 95 of these parts per day (5 to 6 min each). Now, however, with a Cri-Dan Model B rapid-threading lathe, production has jumped to an average of 320 parts per day, or 1½ min per piece, floor-to-floor time. The actual cutting time amounts to only 28 sec, at a speed of 260 sfpm.

Tool life varies

Tool life on this operation has not settled down yet. It seems there is only a slight difference between a long-lasting tool and one that breaks up quickly. The first five pieces with a new one tell the tale. If it's still in good shape after those five, the men on the machine say it will probably do another 250.

On larger pieces, the technique has proved itself just as efficient. Two of them are the breechblock and the breechblock bushing for the 106-mm recoilless rifle.

This bushing screws into the gun tube to become a fixed part of the assembly. The block, in turn, mates with the ID of the bushing and is closed for each round fired and then opened to permit reloading.

The 8-in. OD of the bushing has a standard thread with a pitch of 8. Tolerances are 0.007 in. on PD and 15 min on thread form. The OD of the block is 6 in. across and has a pitch of 4 Acme threads per in. Tolerances are the same.

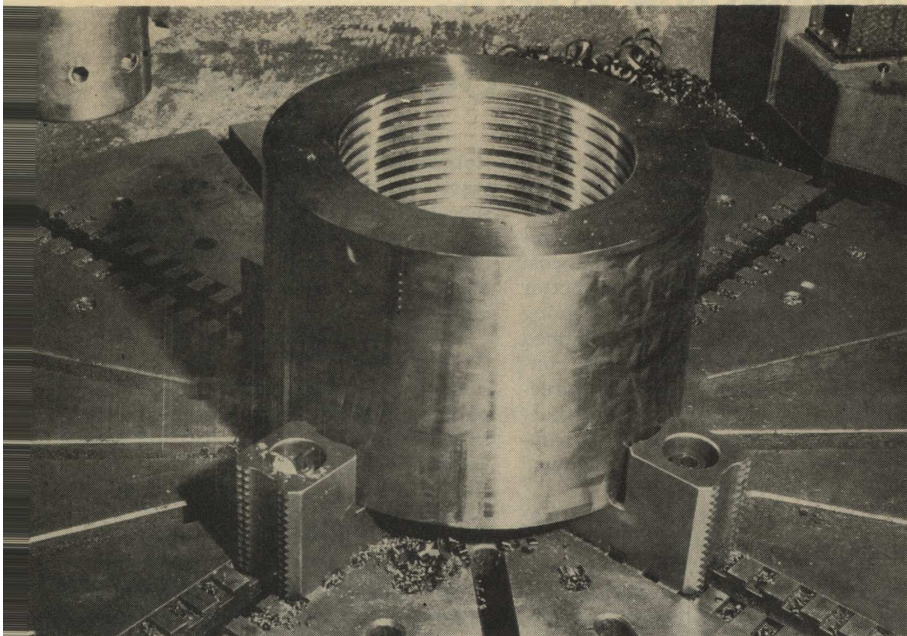
Both operations have been switched over from a thread grinder to a Cri-Dan Model D rapid-threading lathe. Output for each has increased to 48 pieces per day from the previous rates of 13 per day for the bushing and 14 for the block.

Heavy parts: new approach

But, when it came to applying the technique to even larger pieces such as the 800-lb breech ring of the 90-mm cannon, the Watervliet engineers found they had outgrown the capacity of the available machines. However, the attractions of rapid threading were so great that they decided to figure out a way to make it work.

Because of the size and weight of the breech ring casting, they reasoned that it would be easier to handle the piece and chuck it accurately if they could machine it in the vertical position instead of the horizontal. This was a new departure in rapid threading but one that looked promising.

A vertical turret lathe can do thread chasing, and there was a



800-lb casting required new approach to single-point threading. This breech ring for 90-mm cannon was machined in VTL equipped for automatic threading

56-in. Cut Master Model 75 that could be assigned to the job. Still, a large part of the potential savings from the technique would be lost if the operator had to manipulate the machine manually. Therefore, Watervliet discussed the problem with The Bullard Co of Bridgeport, Conn., and made arrangements to convert the Cut Master to automatic operation.

The company shipped its standard conversion unit and a thread-cutting and drum-scoring attachment. These were installed at Watervliet by a Bullard service engineer, and the Cut Master actually became a Man-au-trol Model 75, Bullard's automatic VTL.

Conversion decision

The conversion could have been made on a 46-in. Cut Master Model 75 that was also available, and the smaller machine could have done the job at hand. However, the decision went to the 56-in. machine for several reasons.

For one, the bigger machine has more power and can make heavier cuts. For another, it provides more flexibility for future experiments on even larger pieces.

Just as important, however, is the larger, heavier faceplate that acts as a flywheel and smooths out the rotation of the part. This flywheel effect has been put to good use in all the recent work here on ceramic tools (AM—Jan 26, '59, p100), and it has almost become an axiom that a larger faceplate or chuck will give better results than a smaller one.

When the converted Man-au-trol is set up to thread the breechring, 35 of the 39 functions on the control drum are devoted to locating the cutting passes: 10 passes at 0.005 in. each, and 25 at 0.004 in., for a total depth of 0.150 in. to the bottom of the Acme threads. The major diameter is 10.000 in.; the thread length is 6 in.; and the pitch is 2.

Each function commands the following movements of the main turret: feed to depth of cut; feed downward through the piece; withdraw tool; and rapid traverse to top of piece where next function repeats at the new cut depth.

The material has a Brinell hardness of 320, and the cut is made at 150 sfpm with a carbide tool ground to the shape of the thread.

Each pass takes 35 sec, of which 12 are devoted to cutting and 23 to repositioning the tool for the next cut. The complete threading operation takes 20 min—quite an improvement over the 88 min formerly required for cutting these threads on a thread mill.

And still, the tool is a flexible machine, able to perform, either manually or automatically, any work normally put on a vertical turret lathe, as well as the special rapid-threading operations.

In an effort to introduce this same flexibility into horizontal rapid threading, Alf Miller, project leader of the Machine Tool and Process Development Section, was assigned the project of designing an attachment that could be installed on standard lathes.

Since a lathe is capable of cutting threads with carbide tools, the goal was to automate the motions of the operator. The attachment that has been designed does this with a system of hydraulic cylinders, solenoids, and limit switches, plus a cam mechanism to establish cut depth.

The operator loads the part and manually positions the tool for the first pass. Then he presses the start button, and the automatic cycle takes over.

Here's how it operates

The first pass starts when a hydraulic cylinder engages the lathe's half-nut with its lead screw. These two parts must engage at the proper moment, so the function is under the control of a timing switch. The switch gets its signal from a pin on the threading dial of the lathe.

The cut is made in the normal manner, with the lead screw moving the carriage down the ways at a predetermined speed. At the end of the cut, the carriage hits a limit switch: the tool is withdrawn, and a series of hydraulic cylinders and limit switches disengages the half-nut, returns the carriage, and positions the tool for the next cut.

The return is quite fast, so the carriage is cushioned at the end of the stroke by a hydraulic cylinder with a small independent oil reservoir. The depth of cut is established by a cam which is operated through a sprauge-type clutch. This device is advanced for the next pass by the linkage that withdraws the tool from the previous cut.

As the unit is sequence operated—one action triggering the next—the only limit to the speed of operation is the length of cut on the workpiece. The electrical circuits are interlocked to prevent any lead error; the tool cannot move into the workpiece if the half-nut is not completely engaged.

The attachment still has to be proved out and debugged, but Watervliet hopes to produce a piece of equipment that will turn out threaded parts as fast as the special-purpose machines on the market—without interfering with the flexibility of a standard lathe.

In all probability, the device will first be patented for the Government and then made available to manufacturers.