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MACHINING OF URANIUM SLUGS FROM THE LACKAWANNA ROLLED RODS AT THE BLOOMFIELD TOOL COMPANY

SYMBOL: PO:HFR:vj

RESEARCH & DEVELOPMENT (GEN.) — 4 (Green)

On June 12 we observed an attempt by the Bloomfield Tool Corporation, under the supervision of Mr. Matthewson to machine 3/4" Savannah-type slugs from rods of Billet #4907 rolled at Lackawanna. During the time I watched, yields were very low, mainly due to the fact that the rods, as rolled, were somewhat under the nominal 13/16"-D, were out of round, and had deep laps and seams.

The work was started on a simple hand type South-Bend lathe, to permit Bloomfield to become acquainted with the machinability of material before setting up a turret lathe with roller back-up tool or an automatic lathe with backed up tools.

Following is the process used for all the finished pieces made from bars Nos. 4907. This is, of course, not a process which would be used for large scale production; the five foot long 13/16" nominal diameter bar, as received with an oxide coating was passed into the back end of the lathe chuck and cut off with a lathe tool to about 0.035" greater than the desired length. This cutoff and the subsequent turning was all done on a simple South-Bend lathe. The work was grasped by a 13/16" collet in a chuck with the tool acting on the piece without backup of any kind. The rough cut-off 6" lengths were individually chucked in a collet in the lathe with about 4 inches extending beyond the collet, in each case using a carboloy tool and a much finer depth and width (or pitch) of cut than in the Hanford operation. About a 4" length of the slug was turned in a series of two cuts about ten mils over the specified .750 final diameter. The slug was then removed, turned end-for-end, and placed in the collet. The other half was then turned to the same diameter and in the same manner. The turned lengths were then ground to finished diameter .750 on a No. 2 Cincinnati centerless grinder. A grinding wheel with a width of about six inches was used.

The grinding was done in four or five passes. "Straight thru" rather than "plunge" grinding was used. Difficulty was experienced in making the machine feed the pieces through by itself in the normal manner. Some pieces required pushing through by the operator, particularly in the beginning before the full width of the grinding and control wheels had gripped the piece. The operator blamed this on the high density of the material. I believe, however, that composition of the surface of the control wheel, its speed and angle, should be selected to give us a positive feed. This experience tends to favor "plunge" grinding. It took the operator nearly all the

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preceding day to get the grinder set up to make pieces with a uniform diameter along the full length. Initial pieces were thicker in the middle than at the two ends. In other words, a barrel type of shape which was caused by the entering and exit guide not being precisely lined up with each other. The metal piece was therefore not exactly parallel to the wheel upon entering but was slightly turned inward toward the grinding wheel. This resulted in a small diameter at the entering end of the piece. As the work proceeded and the piece was being acted on by both guides, it tended to straighten out, parallel with the wheel surface and a larger diameter was obtained. Toward the end of the passage between the wheels, the second guide came into full use and was turning the back end of the piece toward the grinding wheel, making a slightly sma diameter at the back end. However, all the pieces run during the time when I was there had diameter variations of less than .001 from one section of the bar to another. This ground finish is the one which remains on the sides of the finished pieces. The ground pieces were then returned to the same simple South Bend lathe for cutting to precise lengths and finishing of the ends. The piece was chucked with about 4" protruding from the 3/4" collet. An indicator was clamped to the tool post, brought up in contact with side of the bar near the outer end, and the chuck was then turned. A considerable wavering of the bar showed on the indicato The chuck was slowly rotated by hand until the plane of maximum deflection was noted on the indicator. The bar was gently tapped with a lead hammer several times at a point opposite this maximum deflection until it would show less than .001" deflection upon complete rotation of the chuck. That same end of the slug was then precisely faced off using a carboloy tool and a very light cut. A slight chamfer was then applied to remove the burrs around the edge, with the too at a 45° angle. The slug with one end turned was then removed from the chuck and measured for length with a microcrometer caliper. In every case it was found tha at this point something in the range of 25to 35 mils had to be removed from the length. The piece was then placed in a chuck with about four inches of the unfinished end protruding. The carboloy tool was then clamped in the post and brought up until it just contacted the end of the slug at this point. The micrometer adjustment stop was screwed up until it just touched the lathe carriage. The adjustment screw stop was then backed off just a few thousandths less than the length that would have to be removed. This amount was then cut off the piece.

The piece was then removed from the collet, again checked with a micrometer and it was found in every case that just a few more thousandths had to be removed. The piece was then rechucked in the same manner as in the preceding step, the tool brought very carefully up until it just touched the end of the piece, and the micrometer stop adjustments made very carefully this time to bring the length exactly to the desired finished amount. The final cutoff was then made with the tool in the carefully adjusted position.

The next step was to make the 30° angle cone end on the slug. This was done by using the long side edge of the carboloy tool making a nominal 30° angle with the face of the slug and then "plunge" cutting with a carriage motion parallel to the axis of the slug.

The next step was to make certain that the cutting tool was making exactly a 30-1/4° angle with the face of the slug (30-1/4° was the target because the specification called for 30° plus 1/2 - 0). An indicator was clamped to the end of the slug protruding from the chuck. The tool was loosely clamped in the post with the cutting side edge lined up approximately parallel to the face of the slug by eye. The carriage was then brought over until the dial indicator on the slug touched the edge of the tool. The tool carriage was moved in and out parallel to the face of the slug and the angle of the tool and post adjusted until no significant deflection occurred on the indicator. The set screws were then loosened and the whole center portion of the carriage rotated until the adjustment scale showed a 30-1/4° turn. When the carriage was moved to bring the tool into cutting position it was found that the tool was now considerably below the center line of the slug and therefore the actual angle it made with the slug was very much in question. This was because the plane of the top of the tool was apparently not horizontal at the time the initial setting was made and therefore the tool moved to a lower position after a 30° rotation. The position of the tool was then completely reset but it was first placed exactly at the height of the center by giving the tool an approximate 30° setting before turning the post parallel to the slug face and setting exactly for the 30-1/4° adjustment.

After the tool had been precisely set it was used in the same position for finishing all the succeeding slug ends that day. This operation was carried out by moving the carriage until the tool just touched the outer corner of the slug. This adjustment was made very carefully, by slipping a thin tissue paper between the tool and the slug while slowly moving the carriage in toward slug end. The micrometer adjustment stop was then backed away from the side of the carriage a considerable distance.

A .0200" Johannson Gage Block was then slipped between the carriage stop and the edge of the carriage and the micrometer screw moved up until the block would just squeeze into position between it and the carriage. The Johannson Block was then withdrawn and this stop setting used to obtain the height of the cone as specified. The cone cutting tool was moved slowly in to cut the cone until it reached the pre-set stop.

After the cone was cut it was noted that there was a slight burr around the edges of the base of the cone. A fine hardened steel file was used with the piece turning in the lathe to remove this burr. The piece was then taken out of the chuck and considered a finished product. In view of the low yield, I inspected the remainder of the bars rolled from #4907. They were sufficiently undersized and contained enough bad laps and seams that I told them not to cut off and turn any more pieces from this billet.

The next material I'm going to have them work on is a rod from Billet #6531. This rod came from a bar which had been machined intermediate between roughing and finished rolling and was finished rolled with a salt preheat. The surface of the rods is therefore very smooth and relatively free of laps and seams. In addition, it has a larger diameter than the rods from 4907, namely ranging from

0.81" to 0.82" or larger. A much higher yield of high quality slugs should therefore be obtained. Bloomfield is going to turn a few slugs from #6531 on June 13 by using the process described above.

I believe we should hold up the job at Bloomfield at that point and measure warpage and dimensional uniformity on the pieces made thus far preferably with the help of the special jig we might borrow from Frank Danewood. If the pieces appear to be dimensionally satisfactory, I believe we should then proceed at Bloomfield and American Machine & Foundry to machine on a Warner swase turret lathe using a roller back-up on the tool, if possible making some pieces by turning only without any centerless grinding to finish to final dimensions.

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