Lake Forest Live Steamers Railway Museum Incorporated

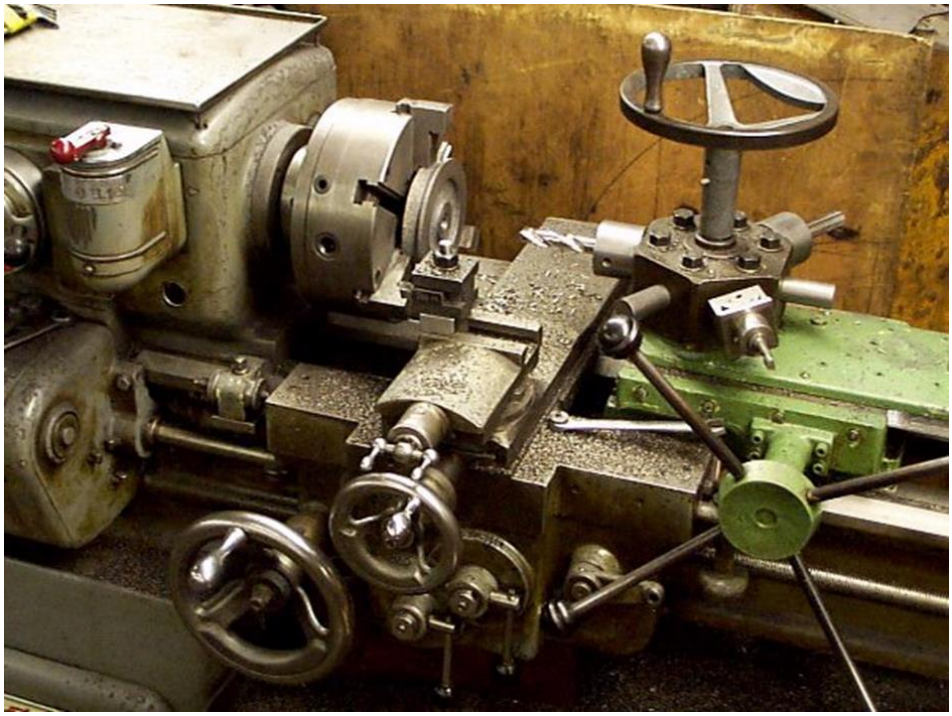
Deerfield and Roundabout Railway
New Car Wheel Manufacturing

Produced by Jeffrey G. Hook

Captions above illustrations.

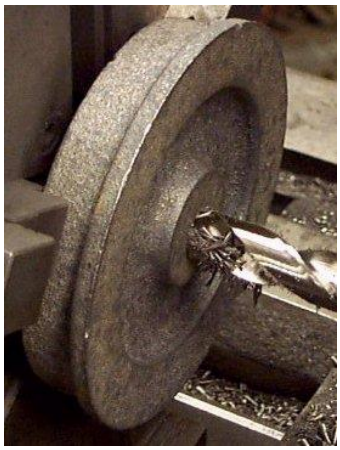
New car wheel manufacturing as practiced at the D&R requires that the cast iron wheel blank be mounted on the turret lathe spindle in three set ups. In the following descriptions "ipr." = inches per revolution, "sfpm." = surface feet per minute and "rpm." = revolutions per minute.

First set up for operations to perform hole drilling, inside flange facing, back hub facing, hole boring and hole reaming on 13 inch "Sheldon" gear head lathe equipped with six position hand feed turret attachment, cross slide twin tool bit holder and scroll chuck. Average first set up production rate 16 wheels per hour.

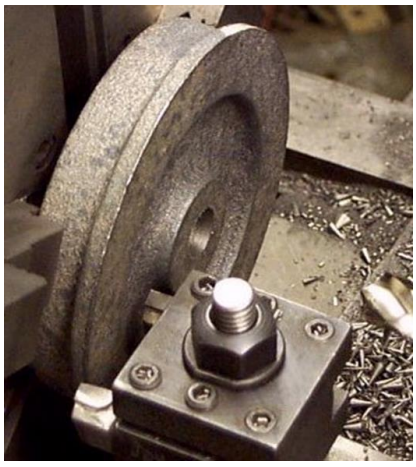


First operation. Mounting rough cast iron wheel blank on chuck and starting lathe.

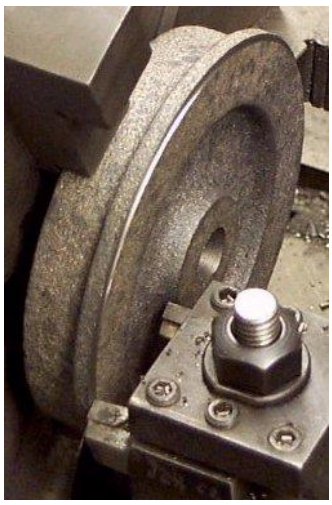
Second operation. Hole drilling with 21/32 inch diameter high speed steel "stub" twist drill mounted on turret. Spindle speed 370 rpm., 64 sfpm., turret hand feed.



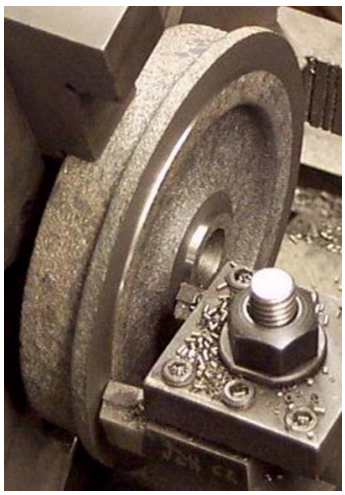
Third operation. Tandem facing of back of the flange and back hub with brazed carbide tool bits mounted on tool post mounted on lathe compound slide using lathe power cross feed. The cross slide is moved to a position where the outside tool bit will clear both the chuck jaws and the rough casting. The carriage is then moved to the left carriage stop and locked. The power cross feed is then engaged. Adjustment of the left carriage stop simultaneously controls the depth of cut of both tool bits.



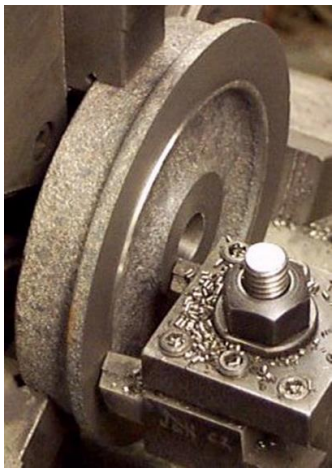
Third operation continued. The outside tool bit begins facing the back of the flange before the inside tool bit begins facing the back hub. Spindle speed 370 rpm., 494 sfpm. at the beginning of the outside tool bit cut, lathe power cross feed rate 0.003 ipr.



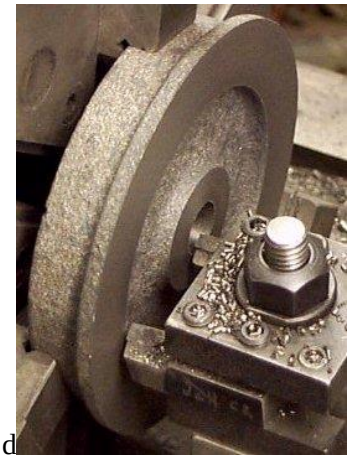
Third operation continued. Tandem facing of back of the flange and back hub. Spindle speed 370 rpm., 149 sfpm. at the beginning of the inside tool bit cut, lathe power cross feed rate 0.003 ipr. During the facing operation the turret is indexed from the twist drill to the boring bar.



Third operation continued. The outside tool bit continues facing the back of the flange after the inside tool bit has completed facing the back hub. The tool bits are mounted in such a way that the cutting of the inside tool bit was begun and completed during the longer cut taken by the outside tool bit.



Third operation continued. After the outside tool bit completes facing the back of the flange the power cross feed and carriage lock are disengaged. The carriage is moved to the right and the cross slide is moved to bring the tool post back to the original parking position which clears the tool post and tool bits from the chuck jaws and the ram of the turret.



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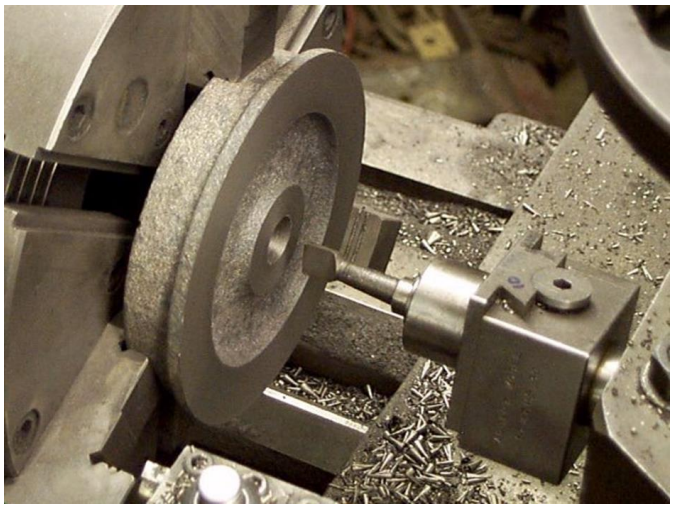
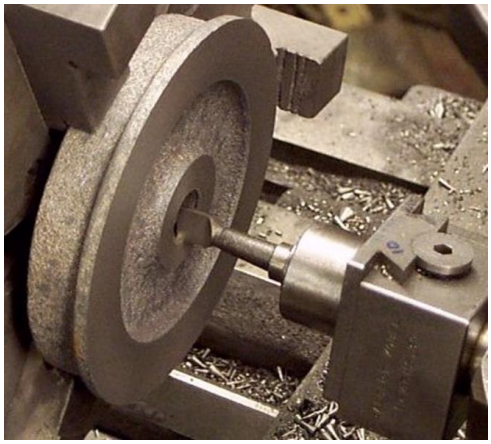
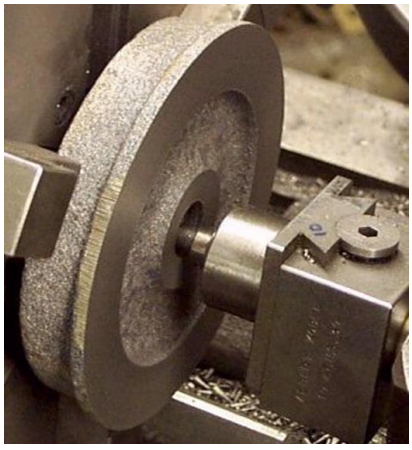
Forth operation. Hole boring with cobalt boring bar mounted in boring head mounted on turret. Spindle speed 370 rpm., 71 sfpm., turret hand feed. The boring operation makes the hole square to the face of the back hub and concentric with the centerline of the lathe. This corrects the typical inaccuracies produced by the twist drill used in producing the hole in the second operation. A conventional vertical milling machine boring head is used to provide a means of regulating the location of the boring bar to compensate for tool wear.



Forth operation continued. The boring operation is performed after the back hub facing operation in order to prevent the boring bar from starting on the rough casting surface.

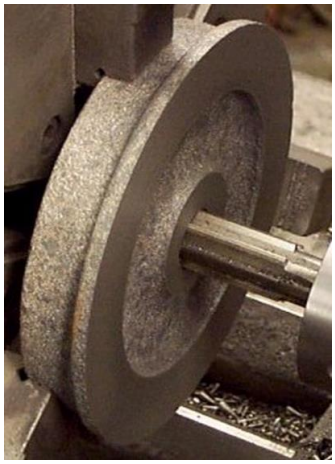


Forth operation continued. Boring bar at the end of the cut. After completion of the boring operation the boring bar is withdrawn and the turret is indexed from the boring bar to the reamer.



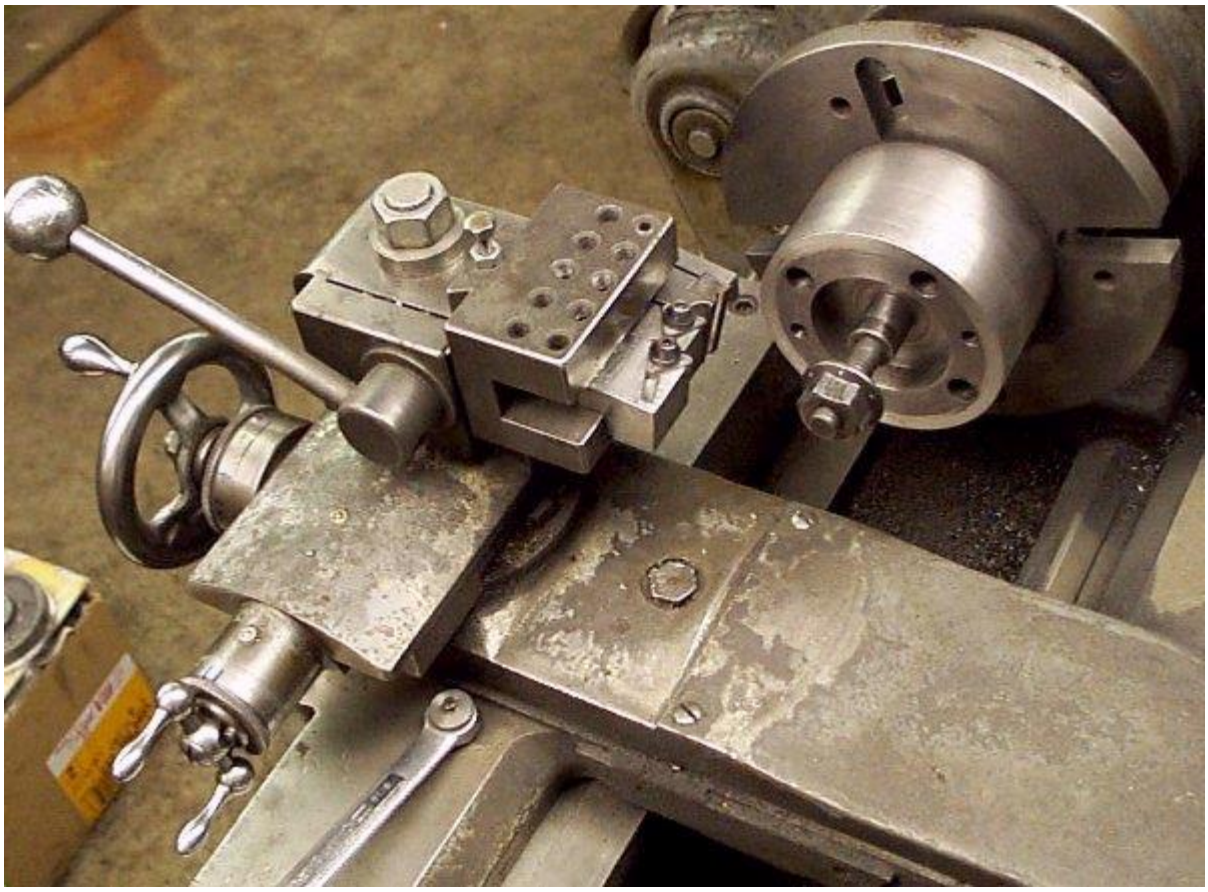
Fifth operation. Hole reaming with 3/4 inch diameter high speed steel "stub shank" reamer mounted on turret. Spindle speed 370 rpm., 73 sfpm., turret hand feed.

Fifth operation continued. The reaming operation produces the final hole diameter and maintains this diameter within close tolerances for each wheel produced.

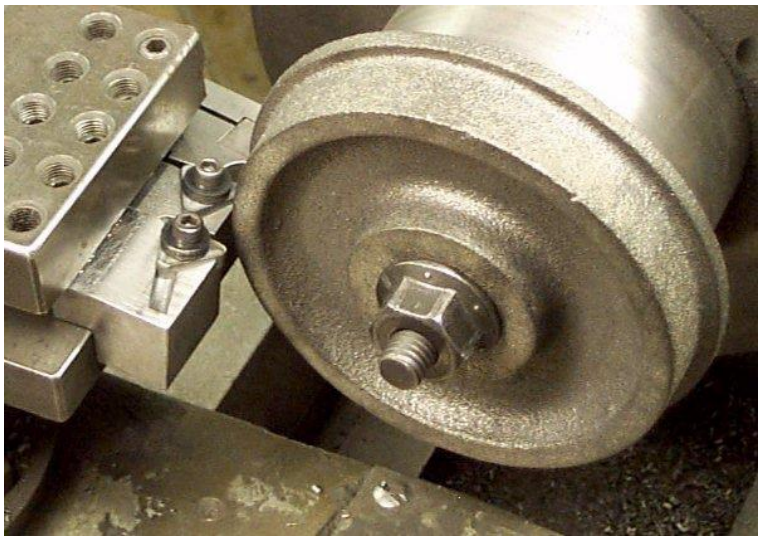


Sixth operation. After the reamer is withdrawn the turret is indexed from the reamer to the twist drill, the lathe is stopped and the wheel is removed. Average first set up production rate 16 wheels per hour.

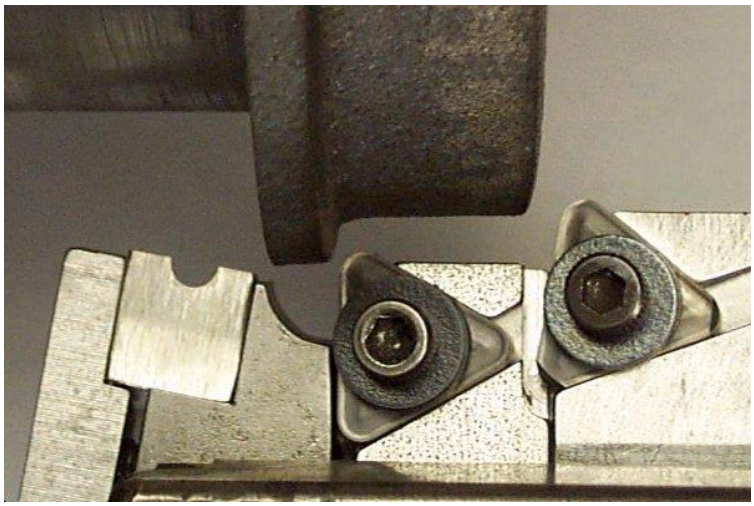
Second set up for turning operations to produce D&R Cylindrical Wheel Tread and Flange Contour having 4.500 inch diameter wheel tread, 3/32 inch flange throat radius, 5/32 inch flange width, 80 degree outside flange angle, 3/16 inch flange height and 3/32 inch flange radius on 13 inch "Sheldon" gear head lathe equipped with cross slide quick change tool post, multiple tool bit holder and wheel tread and flange turning fixture. Second set up average production rate 16 wheels per hour.



First operation. Mounting wheel blank machined in the first set up on the turning fixture and starting lathe.



Second operation. Machining of first rough flange diameter of 4.920 inches, rough tread diameter of 4.520 inches and finished flange width of 0.156 inches. The compound slide dial is set to reference "CP-A," the carriage is positioned for starting the cut, the cross slide dial is set to reference "CS-A" and the power carriage feed is engaged.

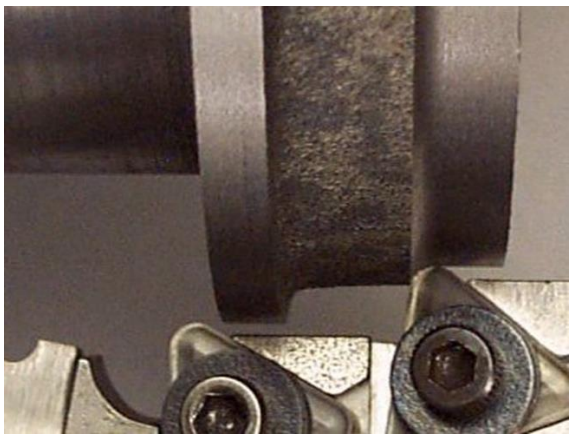


Below is an illustration of a typical machining chart that the turret lathe operator refers to when setting the cross slide and compound slide dials for the various operations.

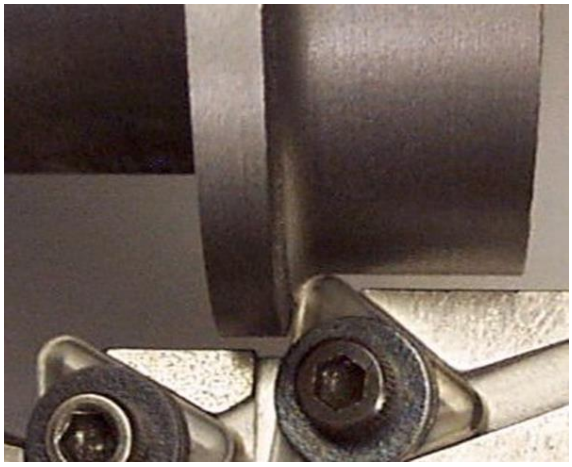
OPERATION	CROSS SLIDE DIAL	CARRIAGE STOP	COMPOUND SLIDE DIAL	SPINDLE SPEED	QUICK CHANGE
R. TREAD DIA. F. FLANGE WD.	T-58 (CS-A)	LEFT SIDE	32 (CP-A)	150	E-5
F. TREAD DIA.	T-68 (CS-B)	LEFT SIDE	27 (CP-B)	600	E-5
F. FLANGE RDS.	M. FEED TO F-34 (CS-C)	RIGHT SIDE LOCKED	27 (CP-B)	100	

Second operation continued. The left carbide insert cuts the first rough flange diameter. The right carbide insert cuts the rough tread diameter. Spindle speed 150 rpm., 197 sfpm., lathe power carriage feed rate 0.008 ipr.

Second operation continued. As the carriage moves to the left the flange radius tool and the left carbide insert pass into area between the face plate and the back of the wheel provided by the fixture. The right carbide insert continues cutting the rough tread diameter.

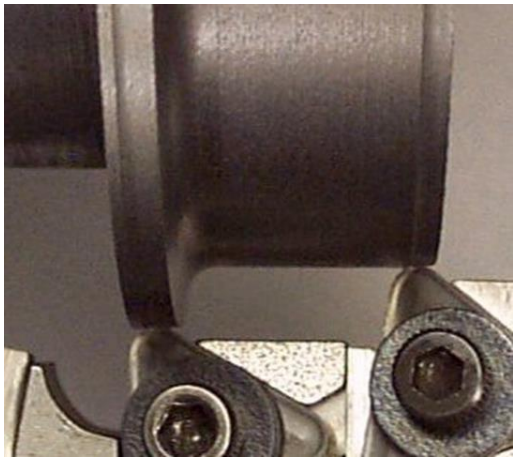


Second operation continued. When the right carbide insert nears the outside of the rough flange the power feed is disengaged. The carriage is then fed manually to simultaneously cut the outside of the flange and continue cutting the rough tread diameter. Manual feed rate is approximately 0.004 ipr. The right carbide insert is set to produce an 80 degree flange angle.

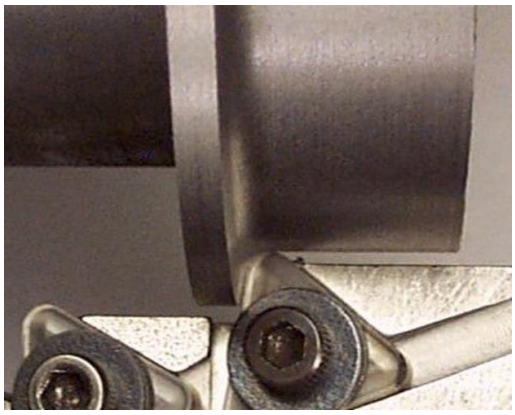


Second operation continued. After the carriage reaches the left side carriage stop, it is held there until the carbide insert no longer produces any chips. The carriage is then moved to the right to the previous starting position. Completion of the second operation produces the finished flange width. The compound slide dial reference "CP-A" controls the finished flange width and is adjusted in order to compensate for tool wear.

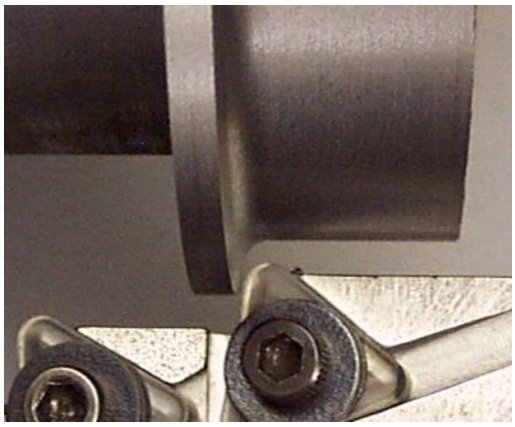
Third operation. Machining of second rough flange diameter of 4.900 inches and finished tread diameter of 4.500 inches. The compound slide dial is set to reference "CP-B," the cross slide dial is set to reference "CS-B" and the power carriage feed is engaged. Spindle speed 600 rpm., 786 sfpm., lathe power carriage feed rate 0.008 ipr. Setting the compound slide dial to reference "CP-B" moves the tool bits 0.005 inches to the right thereby preventing the right carbide insert from contacting the finished outside of the flange when the carriage reaches the left side stop. The cross slide dial reference "CS-B" controls the finished tread diameter and is adjusted in order to compensate for tool wear.



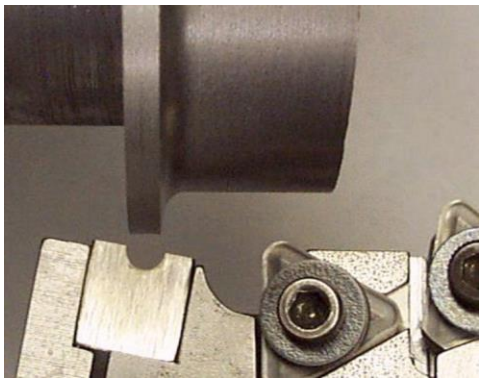
Third operation continued. When the right carbide insert nears the flange throat radius the power feed is disengaged and the carriage is fed manually to continue cutting the finished tread diameter. Manual feed rate is approximately 0.004 ipr. After the carriage reaches the left side carriage stop, it is held there until the carbide insert no longer produces any chips.



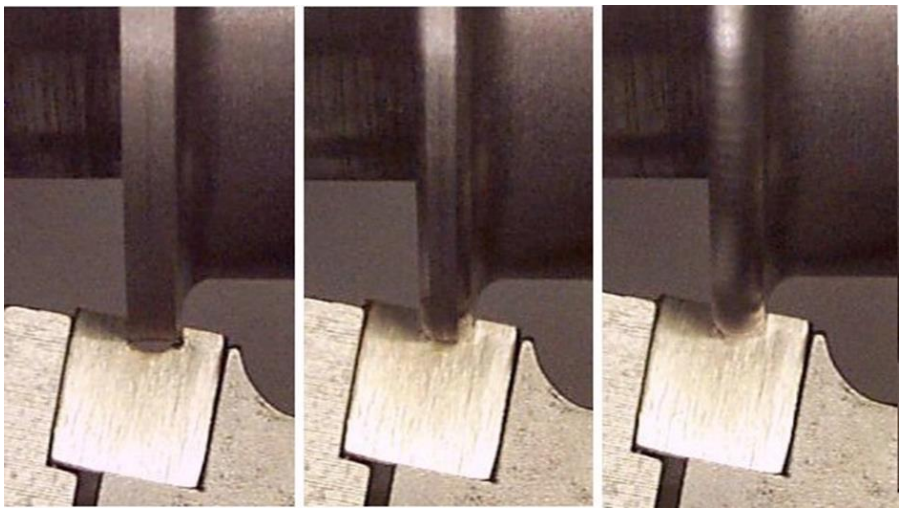
Third operation continued. The cross slide is moved to bring the tool bits away from the work. The carriage is then moved to the right side carriage stop.



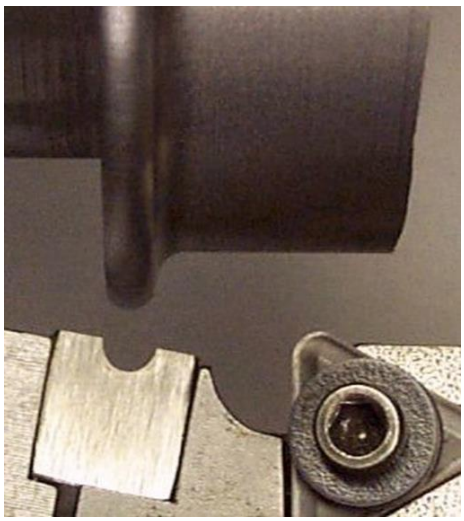
Forth operation. Machining of 0.094 inch flange radius and finished flange height of 0.188 inches. The carriage is locked against the right side carriage stop which is adjusted to bring the flange radius form tool into proper location with the compound slide dial setting remaining at reference "CP-B." The cross slide is manually fed into the work and is stopped when the cross slide dial reading reaches reference "CS-C."



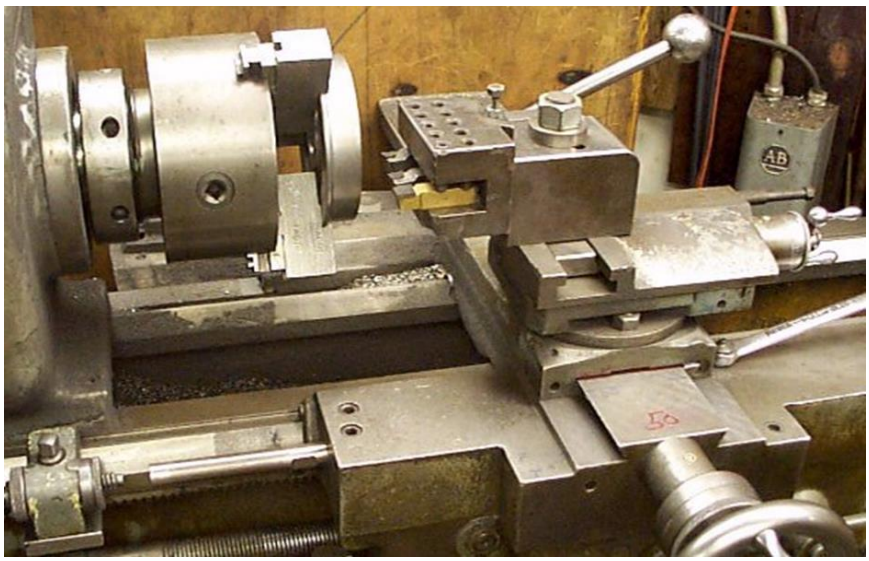
Forth operation continued. Three views showing the radius form tool at the beginning, middle and end of the cut. Spindle speed 100 rpm., 131 sfpm., manual cross slide feed rate approximately 0.004 ipr. The cross slide dial reference "CS-C" is adjusted in order to compensate for tool wear.



Fifth operation. After the flange radius has been machined, the cross slide is moved to clear the tools from the work, the lathe is stopped and the wheel is removed from the turning fixture.



Third set up for operations to perform front hub facing, rim facing and rim chamfering on 13 inch "Sheldon" gear head lathe equipped with cross slide quick change tool post, multiple tool bit holder and scroll chuck. Third set up average production rate 55 wheels per hour.



First operation. Mounting wheel blank machined in the second set up on chuck and starting lathe. The chuck is equipped with mild steel jaws that are machined in order to grip the flange of the wheel without marring the surface.

Second operation. Tandem facing of rim and front hub with brazed carbide tool bits mounted on tool holder mounted on lathe compound slide using lathe power cross feed. The carriage is moved to the left side carriage stop and locked and the power cross feed is engaged. Adjustment of the compound slide simultaneously controls the depth of cut of both tool bits.

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Second operation continued. The right tool bit begins facing the front hub before the middle tool bit begins facing the rim. Spindle speed 370 rpm., 196 sfpm. at the beginning of the right tool bit cut, lathe power cross feed rate 0.003 ipr.

Second operation continued. Tandem facing of rim and front hub. Spindle speed 370 rpm., 460 sfpm. at the beginning of the middle tool bit cut, lathe power cross feed rate 0.003 ipr.

Second operation continued. The right tool bit continues facing the front hub after the middle tool bit has completed facing the rim. The tool bits are mounted in such a way that the cutting of the middle tool bit was begun and completed during the longer cut taken by the right tool bit.

Third operation. Rim chamfering with brazed carbide tool bit mounted on tool holder mounted on lathe compound slide using manual cross feed. Spindle speed 370 rpm., 460 sfpm. After the right tool bit completes facing the front hub, the power cross feed is disengaged and the cross slide is fed manually to machine the rim chamfer with the left tool bit.

Third operation continued. Manual feeding of the cross slide is continued until the cross slide stop is reached. The cross slide stop is adjusted to maintain the required chamfer dimensions for whatever setting the compound slide dial is set for.

Fourth operation. The cross slide is moved approximately 0.100 inches from the work, the carriage is unlocked and moved approximately two inches from the work. The cross slide is then returned to the starting position for the first operation. The lathe is stopped and the completed wheel is removed. Third set up average production rate 55 wheels per hour.

Combined average production rate for all operations 6.98 wheels per hour.