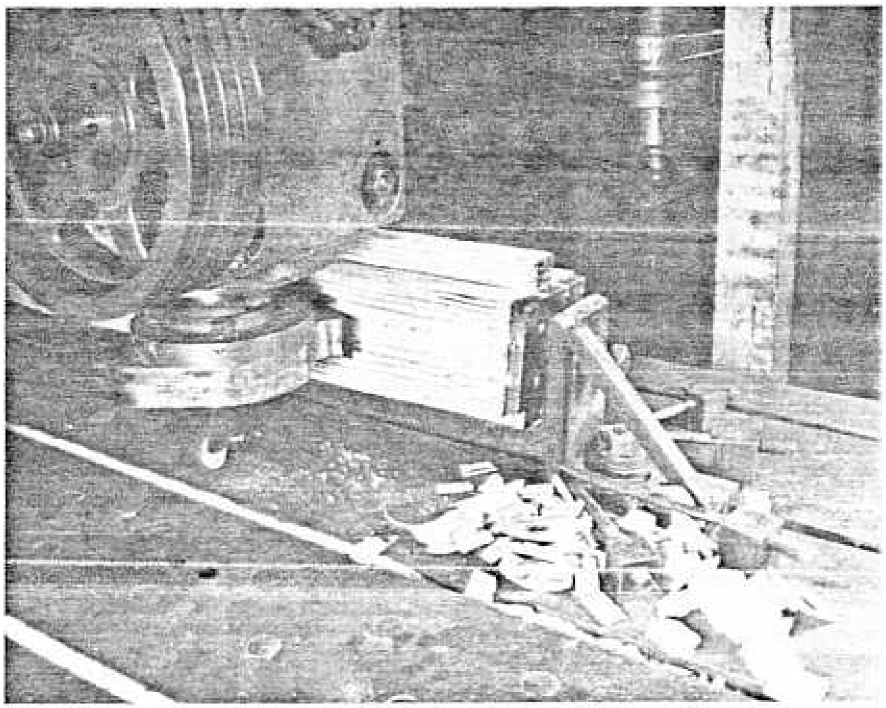

Fig. 1. Chipping with planing action — U. S. Forest Service Photos

Surface quality varies with headrig chipping

by G. E. Woodson and S. M. Rigby

Good surface quality can be achieved on both cants and lumber produced on chipping headrigs and on edgers, but meticulous maintenance of feedworks, setworks, knife sharpness, alignment, and security in the cutterhead is required. Straight logs with small knots yield cants with smoother surfaces than crooked, butt-flared, or knotty logs. Surface quality is also inversely proportional to pulp chip length in that feed speeds yielding short chips provide smoothest surfaces.

The chipping headrig is a device with rotating cutterheads that make chips of the rounded surface of a log and leaves a minimum face of lumber without producing sawdust or slabs. This machine has revolutionized the sawmill industry.

It has improved utilization of timber, increased sawmill productivity, decreased mill labor requirements, and increased the supply of chips for the paper industry. The impact on pulpwood procurement practices also has been dramatic. A study directed by the Southwestern Technical Division of the American Pulpwood Association,[1] concluded that the invention and widespread application of the chipping headrig has resulted in the establishment of more integrated utilization centers, caused a shift to tree-length logging, led to logging of smaller trees, increased number of logging contractors, enlarged wood procurement staffs, and raised stumpage prices.

Dr. Peter Koch reviewed the development of the chipping headrig, describing how both in his own work in the 1950's and in the work by Lionel Pease and Ernest Runnion in the late 1950's and early 1960's chipping headrigs were independently developed.[2]

Three types of chipper heads have been used:

- Drum type with planing action
- Tapered heads with knives in concentric circles
- Truncated cone with knives arranged in a spiral

Chipper heads of these types have various knife shapes, configurations,

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and arrangements to remove chips by either planing action or end-milling. See figures 1 and 2 for illustrations.

Machine configurations have been developed for these chipper heads. They are classified as four-sided canter, four-sided canter with profiler, and one- or two-sided slabber.[6] All of these configurations are in use throughout North America — particularly in plants that process small logs. However, increased use has led to problems. Dr. Koch lists some disadvantages of chipping headrigs as high initial cost, high maintenance expense, inability to handle crooked or oversize logs, inability to grade-saw, tendency to snipe the ends of cants, reduction in surface quality, and severely torn grain around knots.[3]

For southern pine operators, these should be offset by such advantages as reduction of sawdust production, reduction or elimination of labor, reduction of cost and maintenance for special slab-handling equipment, simplification of mill conveyors, increased headrig production with less manpower, and the economical conversion of small logs to lumber.

This investigation details causes of poor cant surface quality in primary sawmill systems — chipping headrigs and slab chippers. Appropriate reference will also be made to chipping edgers.

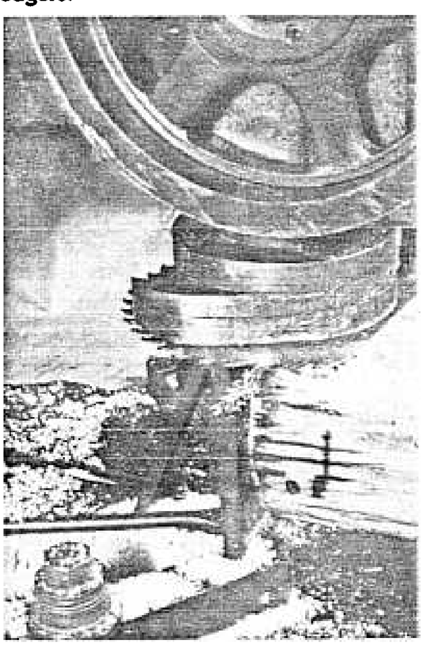

Fig. 2. Chipping with end-milling

Economic considerations

Manufacturing defects result from one of the following causes — operator error, machine malfunction, or low quality logs. Best results are achieved

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when correct decisions are made by a skillful operator cutting a uniform supply of good logs with well-maintained equipment. In many sawmills, however, success is measured only in terms of production,and surface quality is sacrificed to financial expediency. Wood recovery could be significantly increased if each log was accurately measured, catalogued, and sawn to its best configuration. Similarly, production, profit, and wood recovery could be further increased by reducing the chances for human error in the mill. But the sawmill industry has been slow to make changes, especially when large expenditures of capital are required.

Current economic conditions dictate that mill operators eliminate oversize lumber. Taking into account minimum allowance for kiln shrinkage and planing, an operator must be careful to maintain cant surface quality in order to utilize fully his wood supply. The priorities of the sawmill are to convert logs into lumber first, chips second, and sawdust and planer shavings last. Although subject to regional variation, a typical price difference among those byproducts makes evident the importance of maximizing lumber yield while minimizing residues of chips, planer shavings, and sawdust.

Product	Value FOB sawmill $/ovendry ton
Boards, mill-run	$160-256
Dimension lumber, random-length	$204-239
Pulp chips	$28
Planer shavings	$12
Sawdust	$5-15

The prices for sawdust and planer shavings do not reflect the recent interest in these wood residues for energy wood.

Manufacturing defects

A number of typical manufacturing defects caused by chipping headrigs result in production of more low-value products and less lumber. These include reduction in log/surface quality, splitting, rabbeted edges, miscuts caused by log in-feeding mechanism, miscuts caused by cant guidance rolls, miscuts from premature movement of chipping-head setworks, miscuts from incorrect knife alignment, and miscuts from saws. Although these defects are typical, some are characteristic of only one type of chipping headrig. A manual provided by the Southern Pine Inspection Bureau for operation and maintenance of chipping headrigs[5] reveals some of these defects.

Reduction in log/surface quality

It is often claimed that the chipping headrig produces poor surface quality compared to sawing. However,in a recent review[4] of lumber quality produced by chipping headrigs and edgers in eastern Canada, results indicated that chipping headrigs were capable of producing high quality chips and cants. Only if machine maintenance was neglected or if cutting edges were not properly sharpened and installed were chip and cant quality low.

Chipping headrigs are generally regarded as good for processing straight, small-diameter logs. But logs with excessive sweep, crook, butt-flare, and taper frequently jam the chippers and lower cant quality. Feathered surfaces are typically produced from logs with butt-flare (fig. 3A). Mismanufactured cants sometimes result when headrig slabbers pull the log from the carriage, and lumber of improper thickness is produced (fig. 3B).

Fig. 3. Typical surfaces produced from logs with excessive butt-flare and taper.

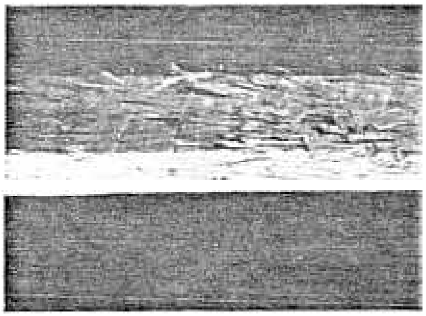

Fig. 3A. Featured surfaces

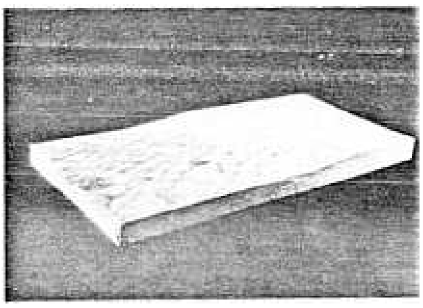

Fig. 3B. Improper lumber thickness.

Surface gouging around knots in lumber produced from chipping headrigs is a common defect found in the South. In a study of eastern Canada mills,[4] it was found that chipping heads did very little damage around tight pin knots, but gouging increased as knots approached one-inch in diameter. It was noted that the loss in revenue was negligible because large knots are rare in small spruce or balsam logs. Southern pines in the 6 to 10-inch diameter class frequently have knots exceeding one-inch in diameter, but chipping headrig manufacturers disagree about the effects of knot size. Some manufacturers claim that torn grain around knots is more related to the kind of knot than to the size. Others insist that torn grain is related to knot size and chip length. The amount of torn grain probably increases as knot size increases simply because the area of cross-grain wood around a knot is proportional to its size. In several southern pine sawmills cant surface quality varied greatly. Knot-free surfaces ranged from smooth (fig. 4A) to rough (fig. 4B). Similarly, surface quality around knots ranged from good (fig. 4C) to bad (fig. 4D).

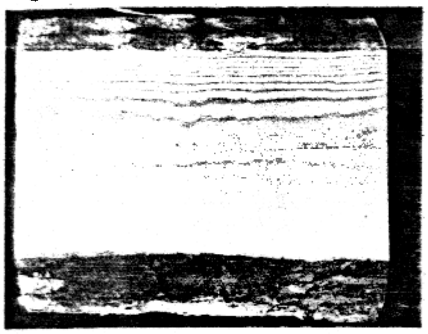
Fig. 4 A. Good knot-free surface.


Fig. 4B. Poor knot-free surface.

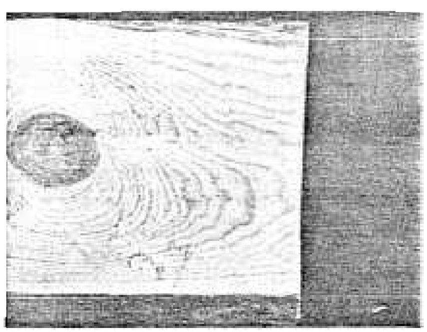
Fig 4C. Good surface with knot.


Fig. 4D. Poor surface with knot.

Tear-out around cross grain is also common. Grain defects typically appear on boards edged with chipping heads (fig. 5), and, while not all can be eliminated, most can be minimized. When knives are kept sharp, set at appropriate cutting angles, and aligned for accurate tracking good surfaces are produced. Also, smoother surfaces are produced

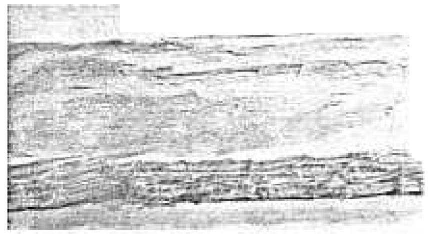
Fig. 5. Chipping edger fiber tear caused by grain deviation.

by headrigs cutting short pulp chips than by those cutting long pulp chips. Both carriage speed and cutterhead speed can be regulated to ensure proper chip length. Effective and regular maintenance of cutterheads is essential. However, any good maintenance practices can be frustrated in the mill. At one location, a mill manager, when asked about frequency of knife change,

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responded that knives were replaced each shift. But his filer reported that they were changed once a week, "if needed."

Some chipping headrig manufactures offer a surfacing sawblade mounted on the face of the chipper head (fig. 6) to improve surface, reduce fiber tear, and reduce knot pulling. These units have proved to be unacceptable for most operations because they make too much sawdust.

Splitting

Sometimes the quality of the chipped surface is acceptable, but tearing or splitting occurs on the bottom edge of the trailing end of the cant. At one mill, splitting has been observed in as many as 50 percent of the cants processed. Most problems occurred when lower cant corners were wane-free. Splintering and splitting were least severe when wane appeared between bottom and side surfaces (fig. 7). Deep side cuts increased frequency and severity of splits. Splitting appeared to be a function of the depth of cut. It was also caused by the lack of a support anvil adjacent to the cutting action. Edges with wane were less likely to split because the cutting action was reduced in the critical region. The side chipping heads in this case were truncated cones similar to the one in figure 6, but without sawblades. On large cants splitting was very costly because it reduced usable length of the outermost lumber of highest grade. When the machine was replaced with a type that provided a support anvil adjacent to the chipping action, splitting was reduced. Chipping edgers may also splinter unsupported lower edges.

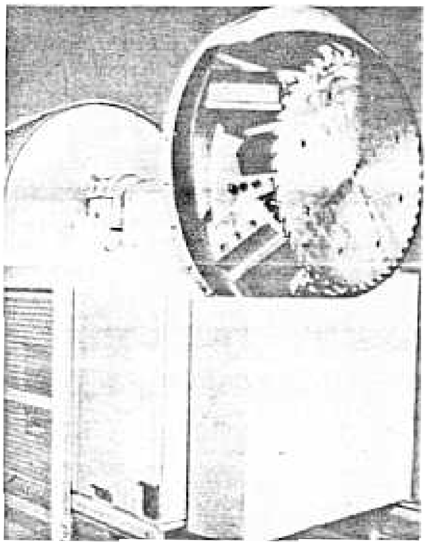

Fig. 6. Surfacing sawblade mounted on face of chipper rotor (courtesy of Filer and Stowell)

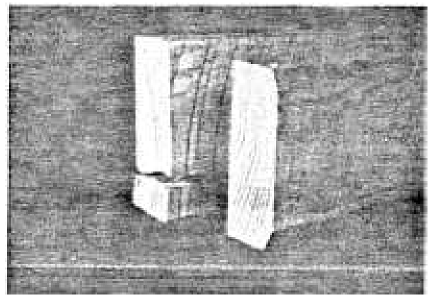

Fig. 7. Splitting in board (left) cut from cant with wane-free lower corners. No splitting in board (right) cut from cant with wane between the bottom and side surfaces.

Rabbeted edge

Rabbeted edge (fig. 8) is probably the most common manufacturing defect on lumber produced from four-sided canters with profilers.[5] If the rabbeted edge runs for a short distance on either end or in the middle, the miscut was probably caused by a crooked log and can be eliminated only by reducing the amount of crook in logs admitted to the headrig. If the rabbeted edge runs the full length of the piece and is cut at a uniform depth, it was probably caused by a knife set in improper cutting position. If the rabbeted edge varies in depth and the piece appears to have been cut from a straight log, the fittings on the fixed bearing in the cutting head may be loose.

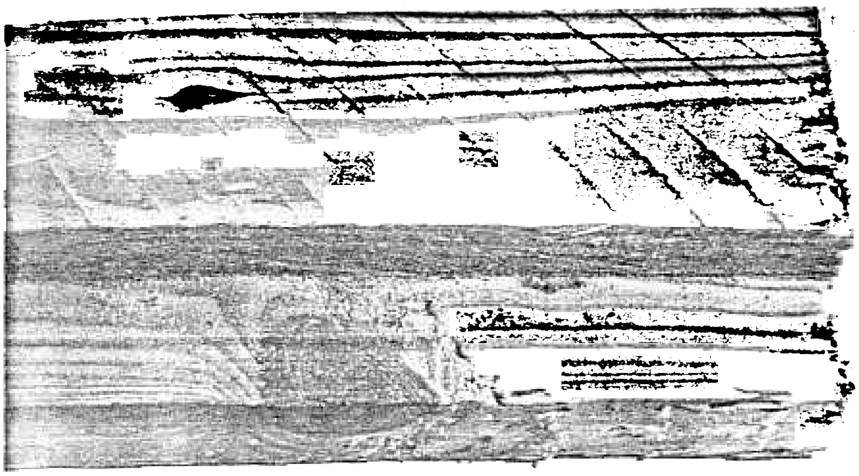

Fig. 8. Rabbeted edge.

Miscut caused by log infeeding mechanism

Another common type of miscut (fig. 9) is caused by movement of the bottom infeed chain while a log is still being cut by the bottom chipping head. The operator should avoid repositioning the bottom chain until the log has cleared the bottom head. Machines operating in the automatic mode have built-in safeguards to eliminate this problem.

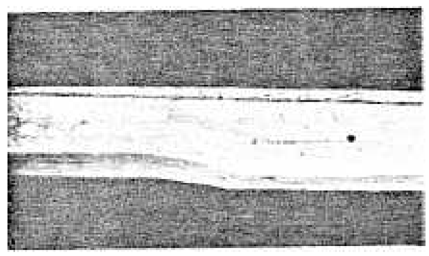

Fig. 9. Miscut caused by log infeeding mechanism.

Miscuts caused by cant guidance rolls

Feed rolls are designed with teeth for gripping and applying pressure on the partly machined cant to feed it through. Gouges occur (fig. 10) when the feed rolls continue to run after a log has stopped or gotten caught in the machine. If roll rotation is allowed to continue, gouges will be dug into the log as far as movement permits (sometimes 3/4-inch or more).

Fig. 10. Gouges caused by cant guidance rolls.

Miscuts from premature movement of chipping head setworks

A common miscut that occurs at the bottom head results from inadequate pressure applied by the infeed pressure shoe, spike feed rolls, or press roll. Improper adjustment of any of these parts allows logs to bounce or vibrate slightly over the bottom head and causes a

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miscut (fig. 11A). Once the log reaches the side heads, the cutting action aids in holding the log down firmly on the lower guide bar.

Other miscuts are caused by the heads shifting in or out while the log is being chipped. These miscuts appear as a bite where the head moved in or was too late moving out and as an excess of wood where the head moved out. Miscuts by side heads (fig. 11B) and top chipping head (fig. 11C) are shown.

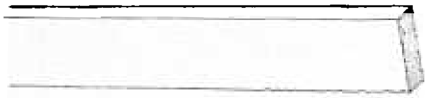

Fig. 11A. Miscuts from bottom head.

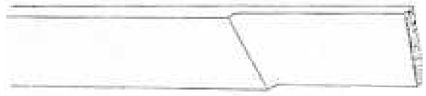

Fig. 11B. Miscuts from side head

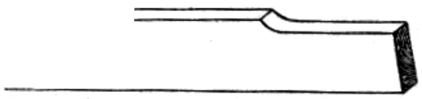

Fig. 11C. Miscuts from top chipping head.

If the machine is operating in the automoatic mode and all switches and controls are in good working order, these miscuts should not occur. If the machine is in manual mode, however, care should be taken to avoid feeding logs into the cutterheads until they are properly positioned.

Miscuts attributed to incorrect knife alignment

Knives occasionally become loose either from fatigue in the clamps or from stretching of the studs that hold both the knife clamp and the knife in position. Such looseness causes mismanufacture of cants. Improper babbitting in the filing room also causes knives to cut out of square and to yield defective surfaces (fig. 12).

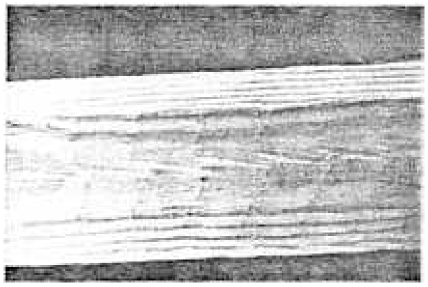

Fig. 12. Miscuts from incorrect side head knife alignment.

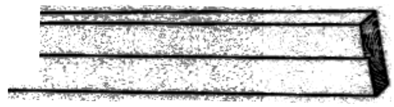

Fig. 13. Miscuts from saws.

Miscuts from saws

Another common miscut involves misalignment of the saws on the top-saw arbor with those on the bottom-saw arbor. This misalignment causes a surface defect on the wide faces of the lumber (fig. 13). Overheated or warped saws will also cause a similar defect. ■

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