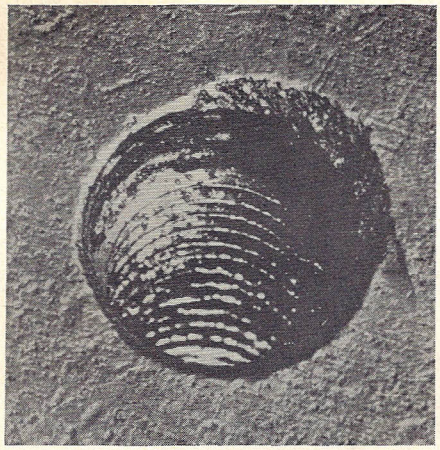


Fig. CS50 — Damaged threads in aluminum casting before repair. (Series provided by Heli-Coil Corp., Danbury, Connecticut).

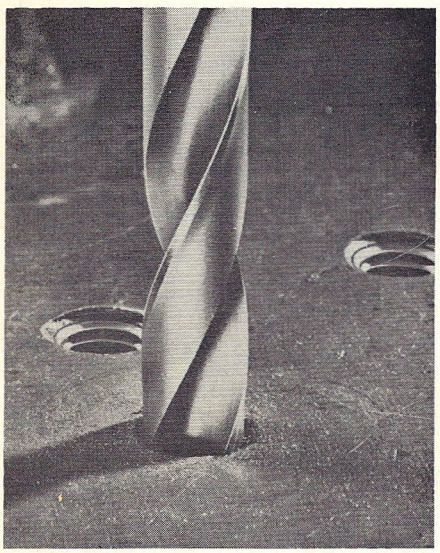


Fig. CS51 — Drill out the old threads or broken stud, using drill size recommended in instruction sheet which comes with kit. Drill all the way through an open hole or all the way to bottom of a blind hole, making sure hole is straight and that centerline is not moved in drilling process.

a greater amount than will steel under similar conditions. Because of the different expansion characteristics, heat is usually recommended for easy installation of bearings, pins, etc., in aluminum or magnesium castings. Sometimes, heat can be used to free parts that are seized or where an interference fit is used. Heat, therefore, becomes a service tool and the application of heat one of the required service techniques. An open flame is not usually advised because it destroys the paint and other protective coatings and because a uniform and controlled temperature with open flame is difficult to obtain. Methods commonly used are heating in oil or water, with a heat lamp or in an oven or kiln. The use of water or oil gives a fairly accurate temperature control but is somewhat limited as to the size and type of part that can be handled. Thermal crayons are available which can be used to determine the temperature of a heated part. These crayons melt when the part reaches a specified temperature, and a number of crayons for different temperatures are available. Temperature indicating crayons are usually available at welding equipment supply houses.

The crankcase and combustion chambers of a two-cycle engine must be sealed against pressure and vacuum. To assure a perfect seal, nicks, scratches and warpage are to be avoided. Slight imperfections can be removed by using a fine-grit sandpaper. Flat surfaces can be lapped by using a surface plate or a smooth piece of plate glass, and a sheet of 120-grit sandpaper or lapping compound. Use a figure-eight motion with minimum pressure, and remove only enough metal to eliminate the imperfection. Bearing clearances, if any, must not be lessened by removing metal from the joint.

Use only the specified gaskets when reassembling, and use an approved gasket cement or sealing compound unless the contrary is stated. Seal all exposed threads and repaint or retouch with an approved paint.

Damaged threads in castings can be renewed by use of thread repair kits which are recommended by a number of chain saw and chain saw engine manufacturers. Use of thread repair kits is not difficult, but instructions must be carefully followed. Refer to Figs. CS50 to CS53 which illustrate the use of Heli-Coil thread repair kits that are manufactured by the Heli-Coil Corporation, Danbury, Connecticut.

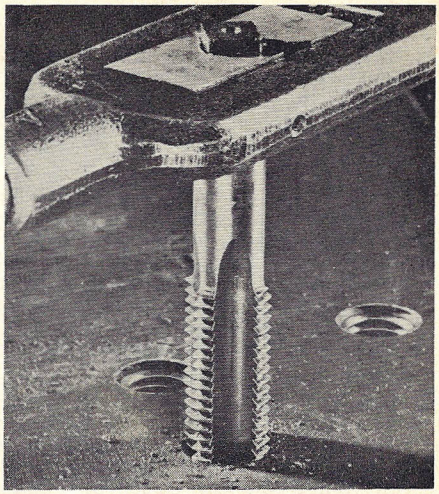


Fig. CS52 — Special drill taps are provided which are the correct size for OUTSIDE of the insert. A standard size tap cannot be substituted.

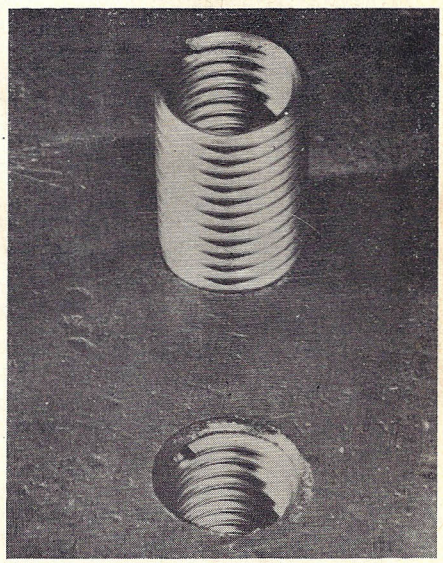


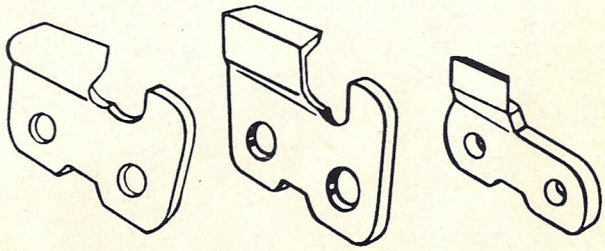
Fig. CS53 — Shown is the insert and a completed repair. Special tools are provided in kit for installation, together with the necessary instructions.

SAW CHAIN MAINTENANCE

This section on saw chain maintenance has been prepared to give information that will enable the small engine mechanic to service the cutting chain as well as the engine of the chain saw. Information for trouble-shooting saw chain problems is also given in this section.

SAW CHAIN TYPES. Saw chains now in popular use can be classified into three types as:

1. Chipper Tooth Chain or "curved L router."
2. Chisel Tooth Chain or "square L router."
3. Scratcher Chain or "crosscut."



CHIPPER CHISEL CROSSCUT

Fig. 1—Cutting links from each of the three types of saw chains.

The following practices (See Fig. 6) should be adopted for good results:

A. Have filing vise or guide bar about waist high.
B. Have well lighted work area.
C. Stand erect, not bent over the chain.
D. Push the file with shoulder of arm holding file; guide file with other hand.
E. Follow correct filing angles.

FILING CHIPPER TOOTH CHAIN. A full round file (not a rat-tail) is used to sharpen chipper (curved L router) chain. Different size and design chain will require different file sizes. If manufacturer's recommendations are not available, refer to the following chart.

SUGGESTED FILE SIZES FOR CHIPPER CHAIN

Chain Pitch	*Round File Size
3/8"	3/16"
.404", 7/16"	7/32"
7/16", 1/2"	1/4"
9/16", 5/8"	9/32"
3/4"	5/16"

*See Fig. 7. When cutter is about half worn away on some chains, the recommended size file will cut into the top of the drive links. At this point, use next size smaller file.

For average sawing, maintain the filing angles shown in Fig. 8 by holding the file in the position shown in Fig. 9. Do not allow the file to drag on the backstroke and rotate the file occasionally to increase file life.

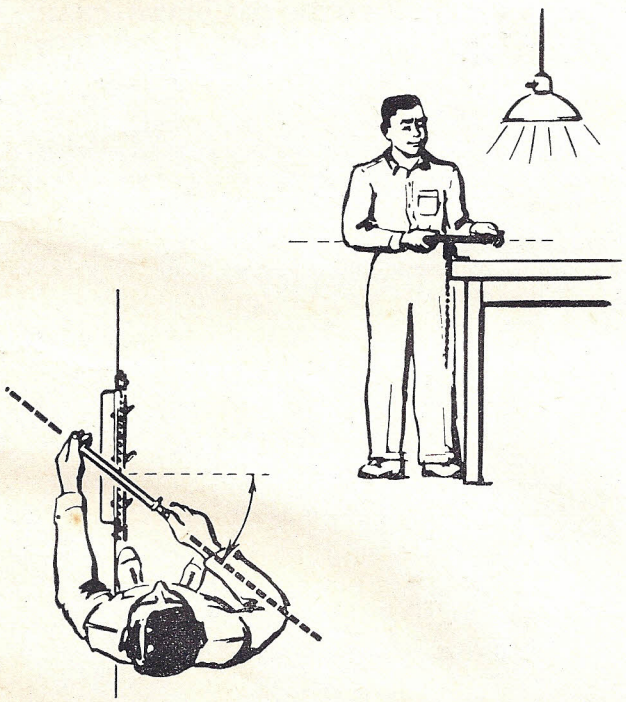


Fig. 6—Have well lighted work area. Stand erect. Swing arms from shoulder to keep file in proper position.

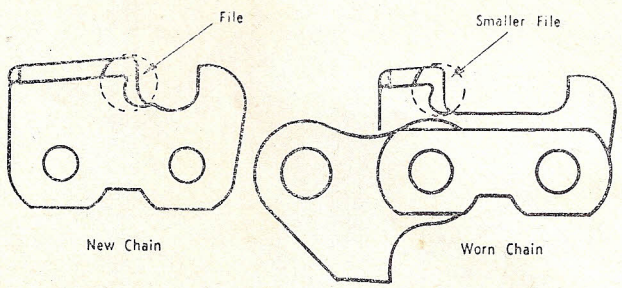


Fig. 7—Use next size smaller file on worn chains.

About 1/10 to 1/5 of the file diameter ("F", Fig. 9) should be above the cutting edge of the cutter. If the distance "F" is greater than this, the cutting edge will be too blunt; if distance "F" is less, a rapidly wearing feather edge will result. For convenience, file alternate (either all right hand or left hand) cutters; then reverse the chain in the vise or turn the saw around and file the remaining cutters. All cutters must be filed alike and the same amount to keep the cutting edges at the same height. Check this by laying a file or straight edge across the tops of the cutters. See Fig. 10. Continue filing high cutters in normal manner until all cutters are same height.

After filing the cutting edges, check the depth gauges, or riders as they are sometimes called, for correct distance below the cutting edges. (Distance "D", Fig. 11.) Depth gauges are generally checked with a jointer that is pre-set for the desired distance as the one shown in Fig. 11, or a jointer with an adjustable setting as the

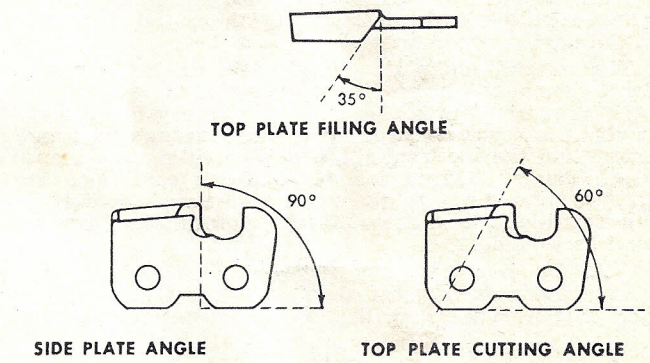


Fig. 8—Filing angles for chipper chain in average use.

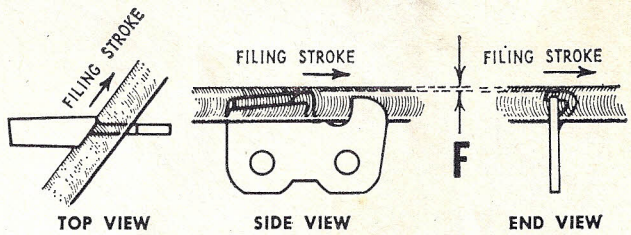


Fig. 9—File position for chipper chain. One-tenth to 1/5 of file diameter (F) should be above cutting edge.

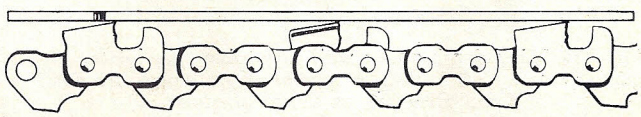


Fig. 10.—Check tooth height with flat file or straight edge. Continue filing high teeth in normal manner until all teeth are of same height.

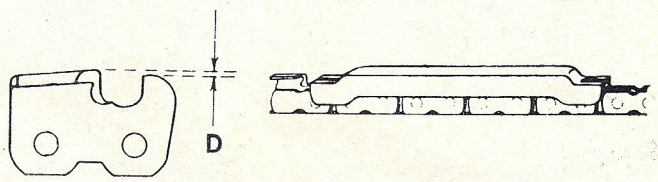


Fig. 11—Depth gauge distance (D) determines the size of chip that the tooth takes. At right, a pre-set type depth gauge jointer.

one shown in Fig. 12. Normal depth gauge distances below the cutting edges of the chain are given in the following table. Manufacturer's specific recommendations should be followed if available.

AVERAGE DEPTH GAUGE SETTINGS FOR CHIPPER CHAIN

Chain Pitch	Depth Gauge Distance Below Cutting Edge
3/8"	.020"
7/16-1/2"	.030"
9/16-5/8"	.040"
3/4"	.045"

Place jointer with desired depth gauge setting over chain with depth gauge exposed through the notch in the jointer. File depth gauge down to level of jointer. Be careful not to file on jointer. After all depth gauges have been filed or checked, round off the leading corner of each depth gauge with a file as shown in the insert in Fig. 12. Be careful not to file into the drive link or burr the cutting edges while rounding the depth gauges. Also, be careful not to file too much off of the leading corner. The width of the flat top on the depth gauge should remain at least 1½ times the thickness of the depth gauge material.

The normal top plate filing angle of 35° and the depth gauge distances for different pitch chain have been determined to be the most satisfactory for general sawing. However, the woodsman may, through trial and error, find the most suitable top plate filing angle and depth gauge distance for a particular condition. No specific figures can be given due to the variety of sawing conditions, but the following information can be used as a guide.

A. On larger horsepower saws and saws with slow chain speeds, the depth gauge distance may be increased which will allow the cutter to take a larger chip. The depth gauge distance should probably be decreased on small saws and direct drive saws.

B. When cutting continually in soft woods, the top plate filing angle can be increased up to 50° and the depth gauge distance can also be increased somewhat.

C. When cutting hard woods, frozen or resin timber, the depth gauge distance should be decreased and the top plate filing angle can be decreased to a minimum of 25°.

When sharpening the cutting edges on the saw chain, the drive tangs should also be sharpened to keep the guide groove clean, and any burrs on the sides of the drive tangs should be removed. See Fig. 13.

FILING CHISEL TOOTH CHAIN. Either a single bevel or a double bevel file may be used to sharpen chisel tooth, or square L router chain. Recommended files are Nicholson No. 565D or Heller No. 3849 double bevel, and Nicholson No. 887 or Heller No. 3571 single bevel.

For average sawing, maintain the filing angles shown in Fig. 14 by holding the file in the position as shown in Fig. 15. Do not allow the file to drag on the backstroke. Gradually increase the top plate filing angle from 15° to 20° as the cutting edge is worn back. The top plate cutting angle should be near 45° for frozen or hard woods, and can be reduced to a minimum of 35° in soft woods. Set the depth gauge distance below the cutting edge according to the following chart for average sawing.

DEPTH GAUGE SETTINGS FOR CHISEL CHAIN

Chain Pitch	Depth Gauge Distance Below Cutting Edge
1/2"	.035"
9/16"	.040"
5/8-3/4"	.045"

File depth gauges as explained in chipper tooth chain filing instructions. Depth gauge distance may be varied to suit different conditions as with chipper chain.

FILING SCRATCHER TOOTH CHAIN. Use a flat file of appropriate size to file scratcher tooth, or cross-cut

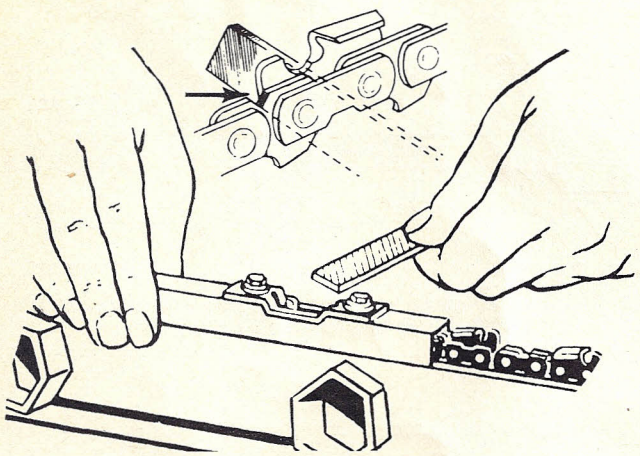


Fig. 12—Filing depth gauge with adjustable type jointer. Insert shows rounding off leading corner of depth gauge. Do not file into drive link as shown at arrow.

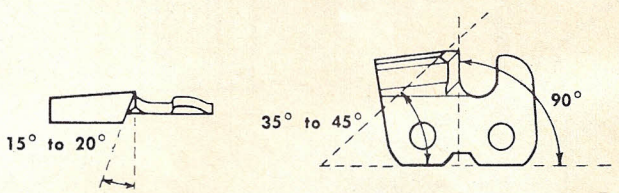


Fig. 14—Filing angles for chisel tooth chain.

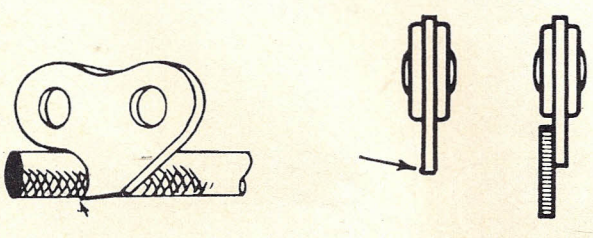


Fig. 13—Sharpen tangs of drive links to keep guide groove clean. Smooth burrs from side of tang with flat file.

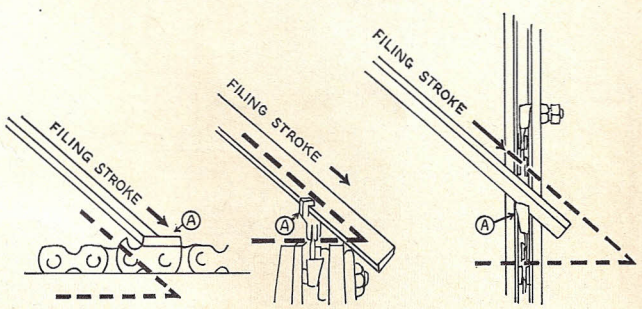


Fig. 15—File positions for chisel tooth chain.

type chain. File cutters as shown in Fig. 16 and file rakers as shown in Fig. 17. Check tooth height with a straight edge while filing and file high cutters or rakers in the normal manner to maintain a straight tooth line and profile as shown in Fig. 18. Sharpen tangs and smooth sides of drive links as shown in Fig. 13 for chipper chain.

REPAIRING SAW CHAIN. Individual drive links, cutters, rakers or tie straps can be replaced in a saw chain. Rivets are removed with a chain breaker as shown in Fig. 19. Be sure new parts are of same design and pitch as the removed part. The holes on outside links are countersunk on one side only, and this side should always face outward as shown in the "right" view in Fig. 20. File bottoms of new tie straps or cutters to match worn parts of the chain as shown in Fig. 21. Peen rivets with ball end of ball-peen hammer. Use light blows to peen the rivet, not crush or flatten it which would result in a cracked rivet or tight joint.

Check the remainder of the chain for tight joints which will not straighten and would cause chain damage as shown in Fig. 22. Remove wood fiber from joints

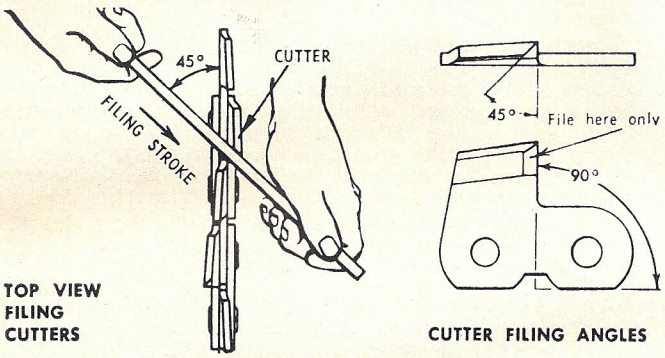


Fig. 16—Filing cutters of scratcher type chain.

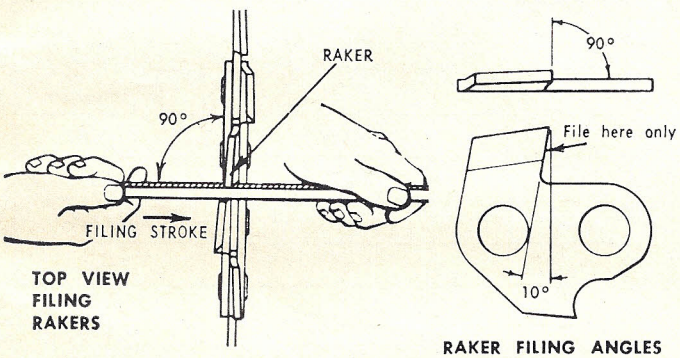


Fig. 17—Filing rakers of scratcher type chain.

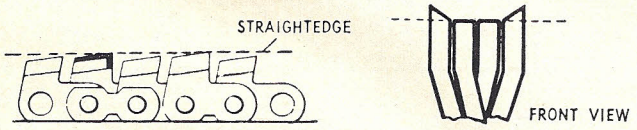


Fig. 18 — Checking height of cutters and tooth profile of scratcher type chain.

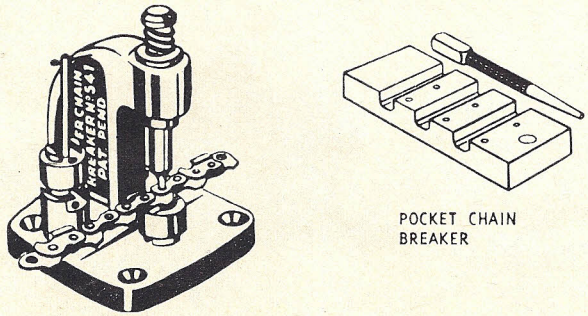


Fig. 19—Bench and pocket type chain breakers.

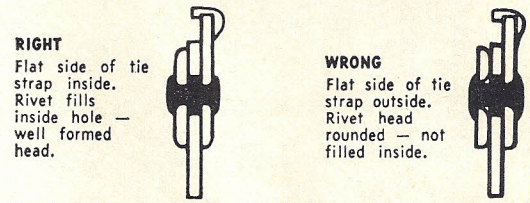


Fig. 20—Countersunk side of tie straps face outward.

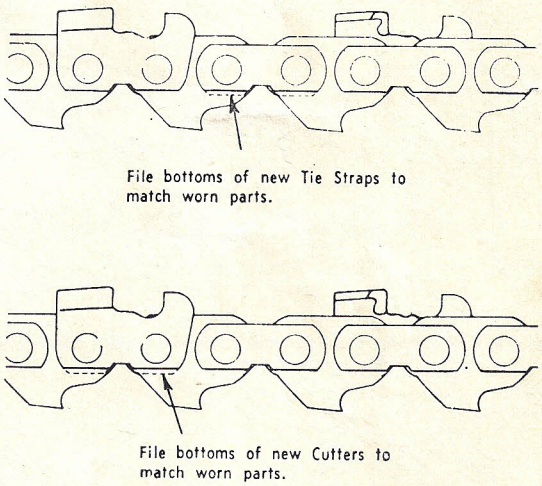


Fig. 21—File bottoms of new parts to match worn parts when installing repair links.

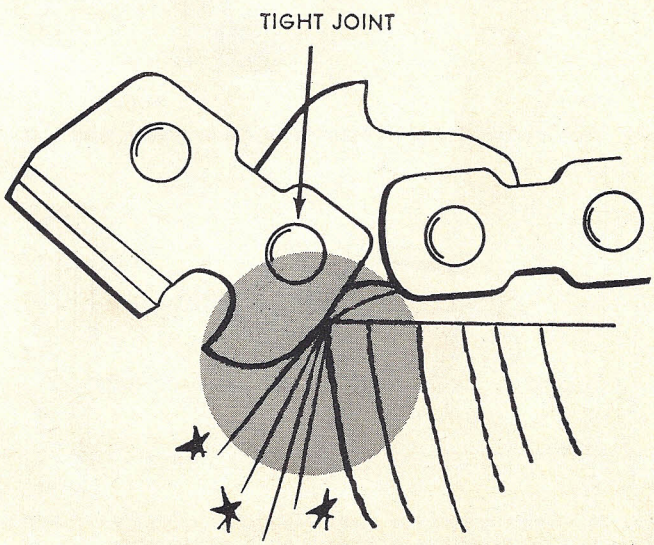


Fig. 22—Tight joints will cause chain damage.

with a knife point or similar tool. Remove burrs by placing chain on support and driving flat with a hollow punch or pipe. See Fig. 23.

GUIDE BAR REPAIRS. If guide rails of bar are spread, they may be closed as shown in Fig. 24. Lay the bar on a flat piece of heavy iron or on a large smooth anvil. Insert a shim of steel, about six inches long and .004" thicker than the drive tangs of the chain, into the guide rail groove. Close the guide rails down on the shim with a heavy hammer; then drive the shim to a new spot and repeat until guide rails are closed all around the bar.

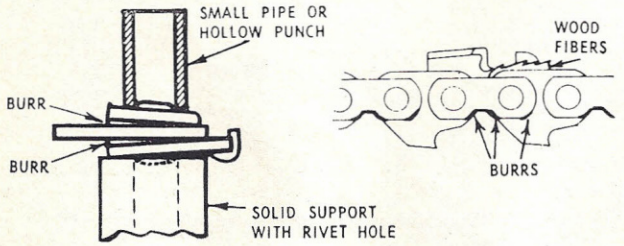


Fig. 23—Relieve tight joints by removing burrs and wood fibers.

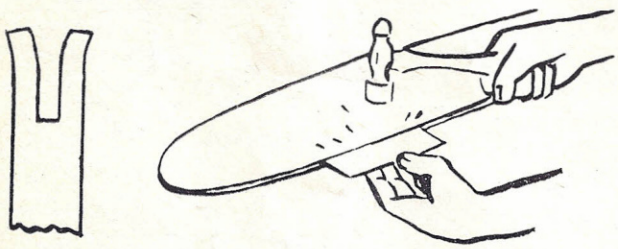


Fig. 24—Closing spread guide rails. Use steel shim .004" thicker than drive link tangs.

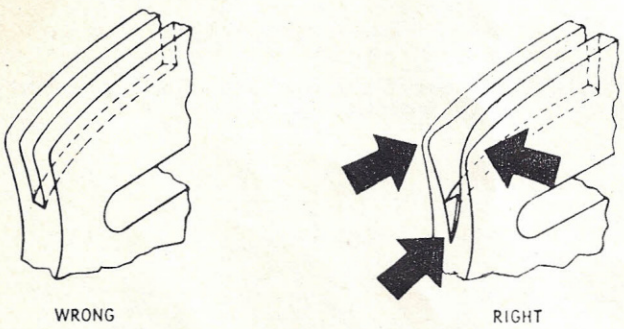


Fig. 25—Cut funnel shaped opening to guide groove with file.

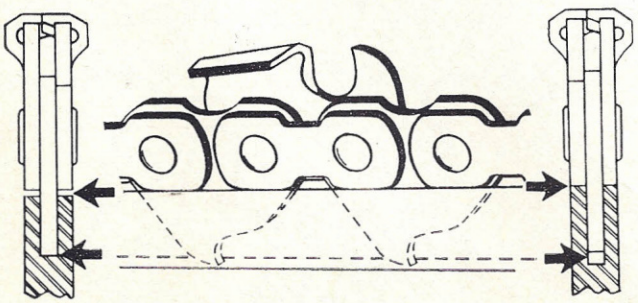


Fig. 26—Guide groove too shallow in cross section view at left. Tang must clear bottom of groove as in cross section view at right.

Guide rails are sometimes split from the bar being pinched while the saw is hung up in a cut. Splits of two inches long or less can be repaired by using ordinary welding methods on bars with non-hardened rails. Repairing splits on bars with hardened rails requires special equipment for re-hardening the rails.

Small kinks or bends in guide bars can be removed by laying the bar on a large true anvil or other similar work surface and using light hammer blows to bring the bar back into shape. Technique is very similar to straightening other flat metal pieces.

Use a file to funnel the entrance to the guide rail groove of the bar as shown in the "right" view in Fig. 25. If the guide rails are as in the "wrong" view in this illustration, damage to the chain can occur as the chain enters the groove.

Check the fit of the chain to the guide bar as shown in Fig. 26. If the tangs of the drive links touch the bottom of the guide rail groove, poor cutting and damage to the chain will result. The side links of the chain should ride on the rails and the tangs should clear the bottom of the guide groove. When replacing a chain or a guide bar, the length of the tang and the guide bar groove depth should be checked as in Fig. 27.

If the guide rails are worn or rough, they can be ground smooth and the groove deepened on a special bar grinding machine.

DRIVE SPROCKET REPLACEMENT. When sharpening or repairing chain and guide bar, inspect the chain drive sprocket for wear. See Fig. 28. When the tips of

If Chain Pitch "A" Is:	And Length of Drive Link Tang "B" Is:	Bar Groove Depth "C" Should Be At Least:
7/16"	17/64"	21/64"
1/2"	17/64"	21/64"
9/16"	9/32"	11/32"
3/4"	3/8"	7/16"

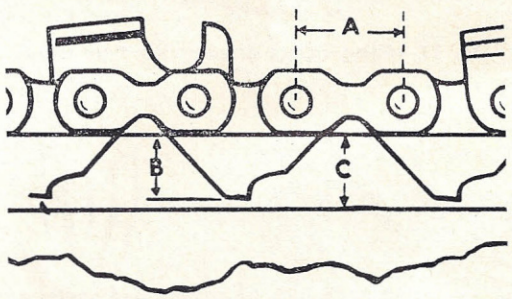


Fig. 27—Proper groove depth for different chains.

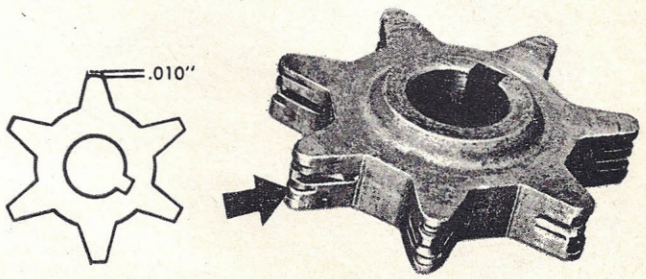


Fig. 28—Wear limit on tips of sprocket teeth is .010".

the sprocket teeth are worn excessively, the sprocket becomes out of pitch with the chain and this will cause chain chatter and breakage. Replace the sprocket if the tips of teeth are worn .010" or more. Always install a new sprocket whenever installing a new chain. Care should be taken that the sprocket is of the correct size and pitch for the chain and the bar. See Fig. 29.

CHAIN WEAR AND BREAKAGE PROBLEMS. If chain wear or breakage is encountered, compare a section of the chain with Figs. 32 through 34 for cause.

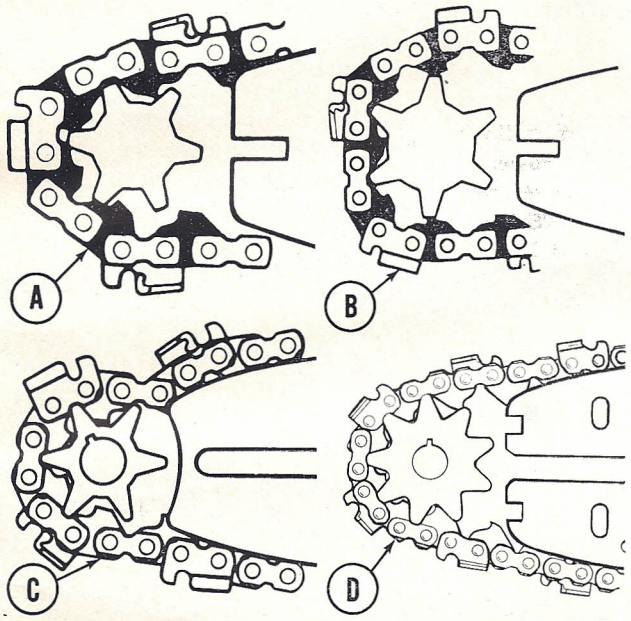


Fig. 29—A. Pitch of sprocket too small for chain. B. Pitch of sprocket too great for chain. C. Pitch of sprocket and chain match, but sprocket is too small for guide bar. D. Correct match of sprocket and chain pitch and of sprocket and bar size.

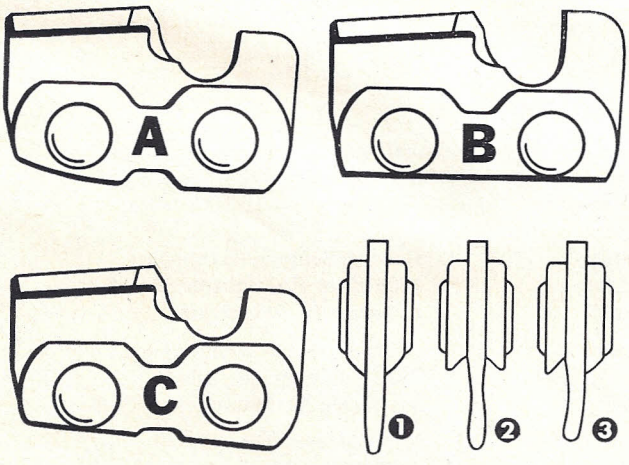


Fig. 30—A. Bottoms of chisels or side links worn due to too much back slope on chisels, very blunt cutting edge, or depth gauge too low. B. Wear caused from heavy pressure on bar generally as result of trying to saw with dull cutters or too high depth gauge setting. C. Wear due to low depth gauges, too much back slope on chisels and tight chain. 1, 2, & 3. Bent or unevenly worn drive tangs caused by uneven filing of cutters which allows chain to wobble or wander.

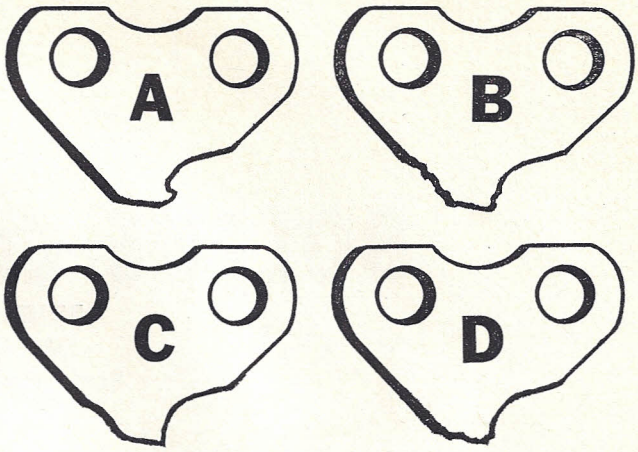


Fig. 32—A. Drive link tang point turned up from striking bottom of improperly fit sprocket. B. Front and back of tang battered by improperly fit sprocket or loose chain. C. Back of tang rounded or peened by undersize or worn sprocket. D. Tang battered or broken by wrong size sprocket.

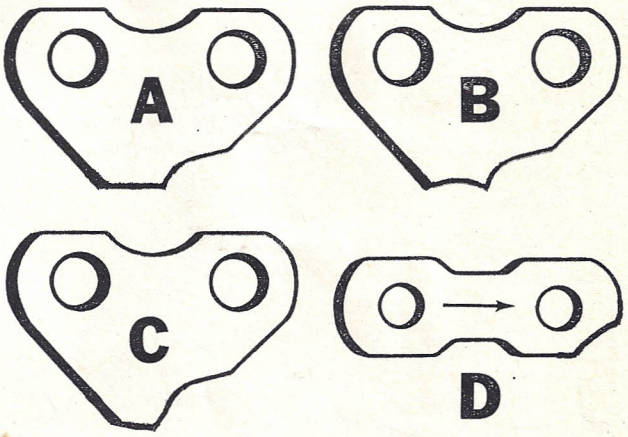


Fig. 33—A. Tang worn flat from dragging on bottom of shallow guide bar groove. B. Tang curved on bottom from shallow groove at nose of drive bar. C. Point of tang worn or battered by square corner at groove entry. See Fig. 25. D. Front of side links battered by tang catching on square bar entry. See Fig. 25.

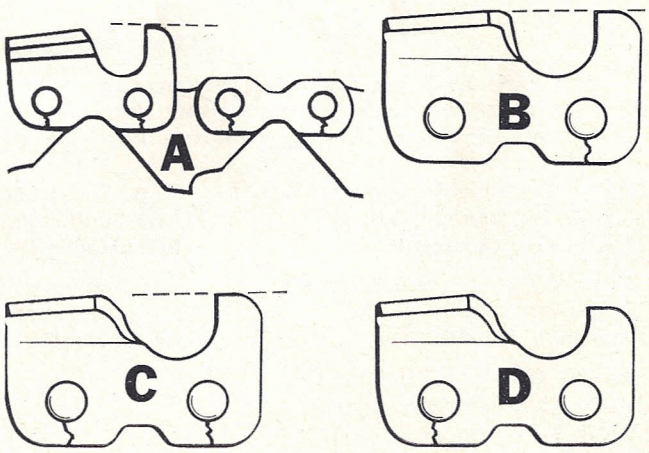


Fig. 34—A. Cracks under all rivet holes due to tight chain with dull cutters and/or high depth gauges. B. Crack under front rivet of cutter and side link caused by high depth gauge. C. Crack under front and rear rivets caused by high depth gauge and dull cutter. D. Crack under rear rivet of chisel and side link caused by dull cutter.