

ciency value for a golf green would be considerably different than that for a roadside utility turf.

### Canopy resistance

The turfgrass canopy is the area of turf located from the thatch or soil surface to the tip of the blades. Canopy resis-

*Evapotranspiration could be considered to be a highly inefficient system, but it can be a driving force for nutrient translocation and plant cooling.*

tance is the mechanical impedance of water vapor and air movement by the configuration of the plants making up the canopy.

Turfs with dense, tight canopies have greater canopy resistance than those with open stands. Once water leaves the leaf blade through the stomata, it travels as a gas in a path of

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**TABLE 2.**

### A COMPARISON OF RELATIVE WATER USE RATES OF TALL FESCUE CULTIVARS

CULTIVAR	TYPE	WATER USE
Kenhy	Forage	High
Pastuca	Forage	High
Kentucky-31	Intermediate	Very High
Hounddog	Turf	Medium
Adventure	Turf	Medium to Low
Rebel	Turf	Low

Comparisons are based on evaluations conducted at the University of Nebraska.

**TABLE 3.**

### WATER USE RATES OF KENTUCKY BLUEGRASS CULTIVARS AND THEIR CANOPY RESISTANCE ASSESSMENTS

CULTIVAR	WATER USE	CANOPY RESISTANCE
Park	High	Low
Aspen	High	Medium to Low
Ram I	Medium to Low	Medium
Touchdown	Low	High
Sydsport	Low	High

Relative values are based on studies conducted at the University of Nebraska

least resistance to the atmosphere.

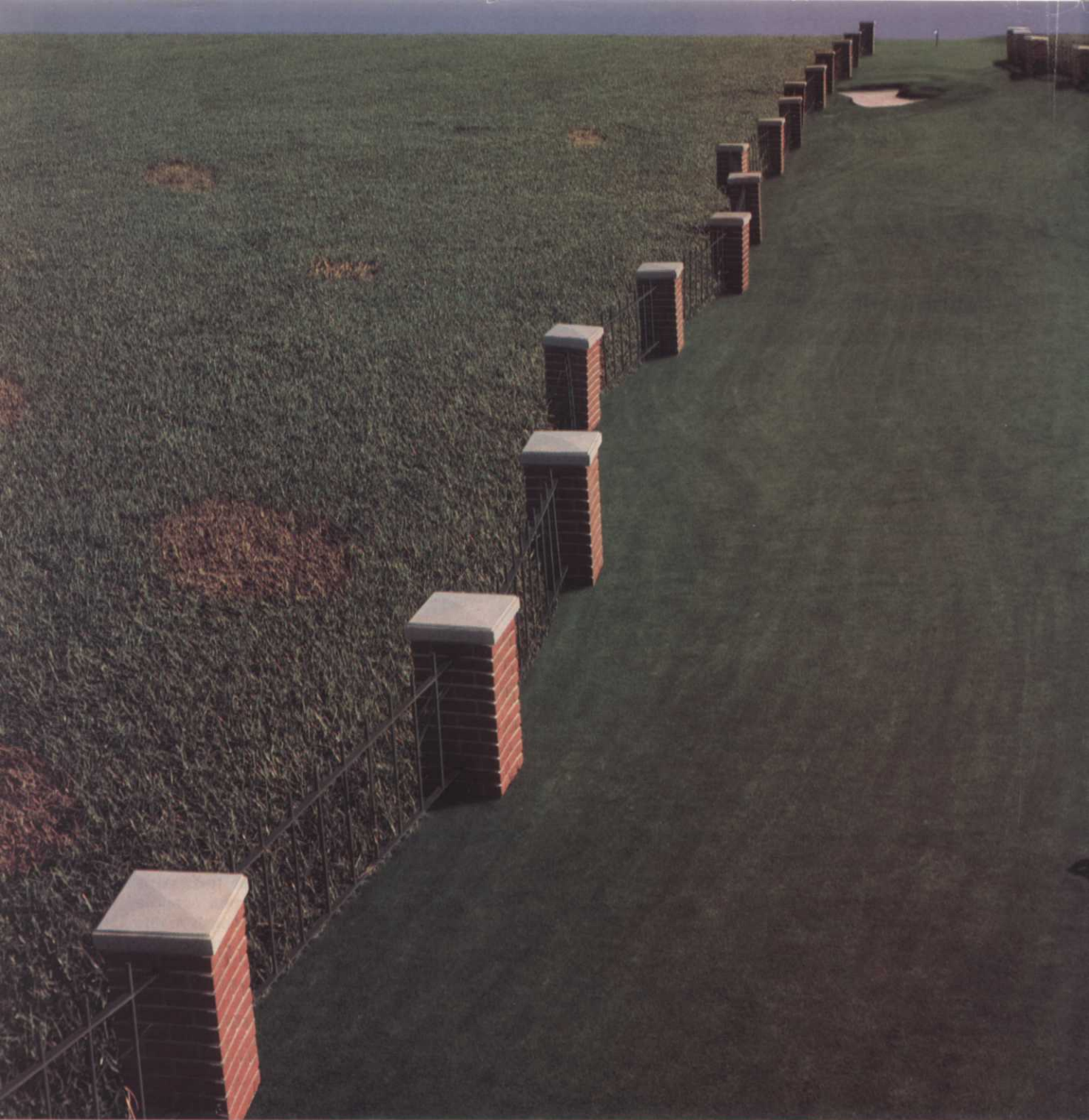
Water vapor gradients exist from the leaf surface, in the canopy, and to the atmosphere. Turfgrasses with low ET rates tend to be dense, low-growing types. Those turfs with high ET tend to have open canopies with a rapid vertical elongation rate. Canopy resistance plays an important role in water conservation of irrigated turfs.

Research from Texas A&M university has demonstrated the importance of canopy resistance in irrigated turfgrasses, especially with warm-season turfgrasses. Studies at Nebraska pointed out similar responses for Kentucky bluegrass turfs.

Turfgrass managers should be aware of the plant growth characteristics that influence a potential low water use rate:

- high shoot density
- high verdure
- dense leaves of narrow width
- horizontal leaf formation, and
- a slow vertical leaf elongation rate.

Selecting turfgrass species and cultivars with these characteristics can be helpful in water conservation. These characteristics can be manipulated with cultural practices. Depending on their intensity of use, they can benefit programs interested in reduced water use. **LM**



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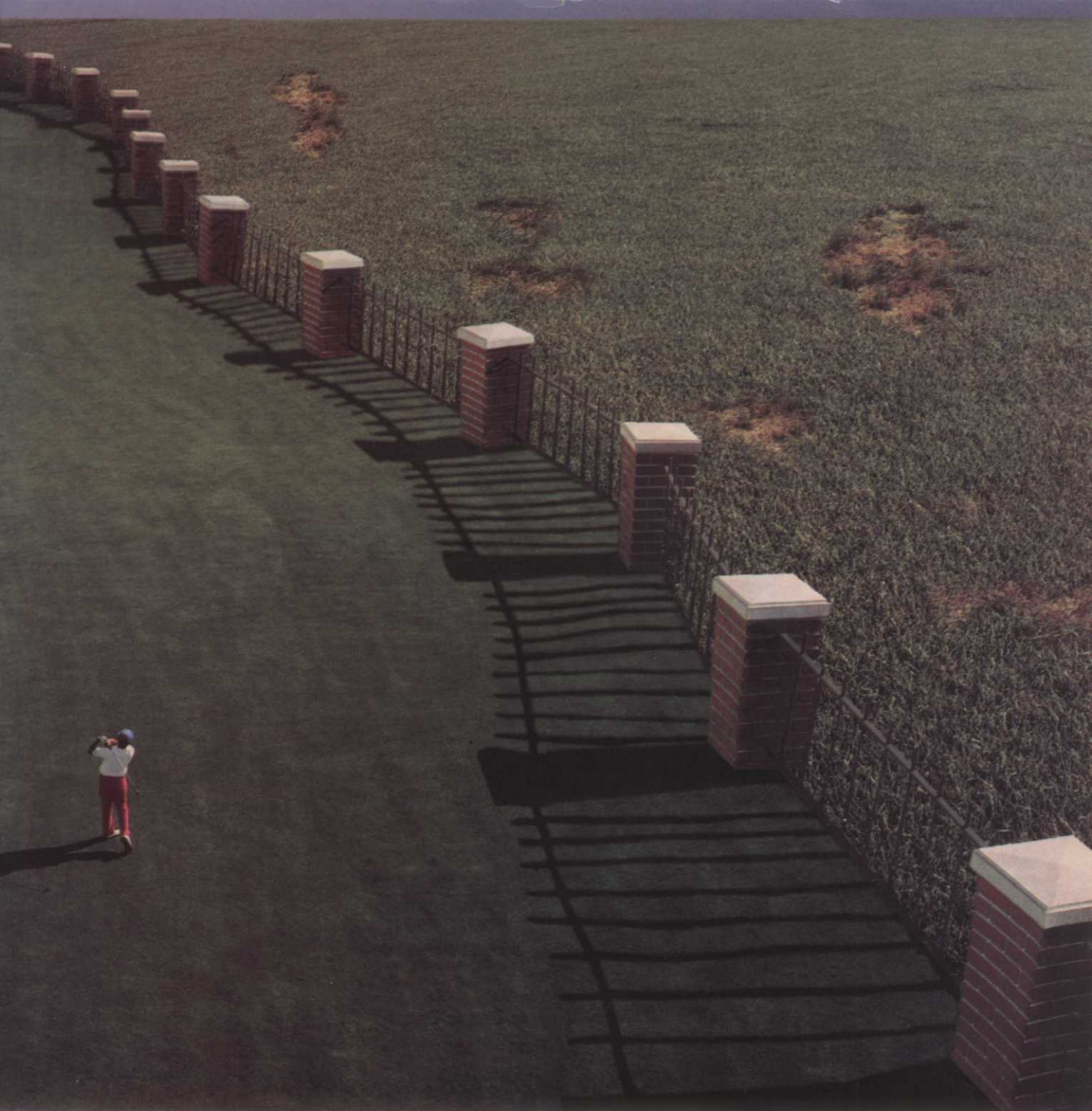
• a slow vertical soil elevation  
 • horizontal soil formation and  
 • soil  
 Selecting hybrid species and  
 cultivars with these characteristics  
 can be helpful in water conservation.  
 These characteristics can be managed  
 along with cultural practices. Depend  
 ing on their intensity of use, they  
 will perform best in  
 these water use

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TABLE 2.  
WATER USE RATES OF KENTUCKY BLUEGRASS CULTIVARS AND THEIR  
CANOPY RESISTANCE ASSIGNMENTS

CULTIVAR	WATER USE	CANOPY RESISTANCE
Park	High	Low
Acorn	High	Medium to Low
Blair I	Medium to Low	Medium
Toussaint	Low	High
Suburban	Low	High

These values are based on studies conducted at the University of Kentucky.



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# THE REEL ANSWER TO SPIN-GRINDING

Herein lies the evolution of reel mower blade grinding and sharpening. By looking back at past sharpening methods, golf course superintendents can decide which current method is best for them.

by Roger Rosenquist

**T**oday as never before, the question on the lips of golf course superintendents across America is: Which is the best way to sharpen the reels on our reel mowers?

Grinding equipment manufacturers continue to develop new and innovative equipment in response to the demands of getting the job done less expensively. With this development has come a confusing dilemma for the superintendent: the question of spin vs. relief ground mower reels.

Some point to the mower manufacturers and say they are spin-grinding their reels. Other point out, however, that most major manufacturers still provide reels with blade relief. The challenge is who is right, who do you—a superintendent—follow to get the best operating and most economical grinding job for your golf course.

To better appreciate how the controversy of relief and spun ground reels has come about, a review of the history and evolution of methods of grinding reel lawn mowers is the best way to explain the problem.

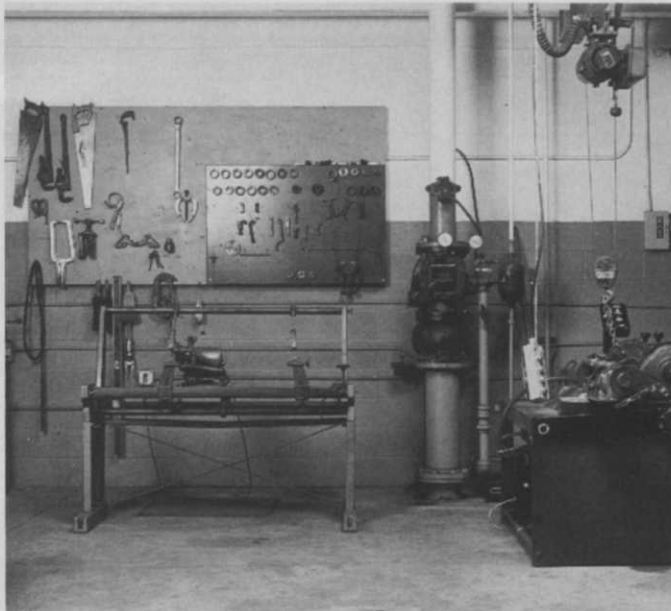
There are four shapes for reel blade cutting edges. Let's look at these shapes and examine how they are obtained. In the process, we will see the evolution of reel mower grinding.

The four cutting edge styles are:

- 1) single-point straight relief grind;
- 2) flat grind with relief;
- 3) cylindrical grind; and
- 4) cylindrical grind with relief angle.

## Types of grinding

**Single-point:** For a single-point straight relief grind, the blades are ground to a sharp edge one blade at a time. These are ground by manually traversing a carriage on a



North Coast Distributing in Cleveland, Ohio, uses both a single-blade relief-grinder (straight ahead) and spin-grinder (right), depending on the customer's preference.

single-blade grinder. The traversing speed varies as you enter and exit the blade, making it more difficult to control roundness. Roundness also is more difficult to control when grinding to a sharp edge.

After grinding the reel, the bedknife is adjusted to the reel. Backlapping is then done to obtain a land area on the tip and to create good cutting action. Backlapping takes more time, but it is necessary with this style of blade grinding.

**Flat relief grind:** For a flat grind with relief, the front edge is ground first to create a flat front land area. The land is to hold the reel roundness to a closer tolerance on the diameter. It also decreases

backlapping time. Here you backlap for proper clearance and roundness.

This method is also done with a single blade grinder. This is an improvement over the single-point grind, as it creates a land area to reduce backlapping time.

**Cylindrical grind:** For a cylindrical grind (spun ground), the reel is rotated as the grinding wheel is traversing. This is accomplished on a machine called a spin grinder.

Spin grind creates a more accurate diameter control of the reel. A properly spun-ground reel should not need backlapping.

**Relief cylinder grind:** For a cylinder grind with relief angle, grinding machines have evolved to a point where you can spin-grind the diameter. As a second step, relief-grind while the reel remains set up in the position used while spin grinding. As in the simple cylinder-ground reel, the cylinder-ground reel with relief and a straight bedknife should not need backlapping.

Relief grinding is used by most mower manufacturers for their reels. This is done for lower horsepower require-



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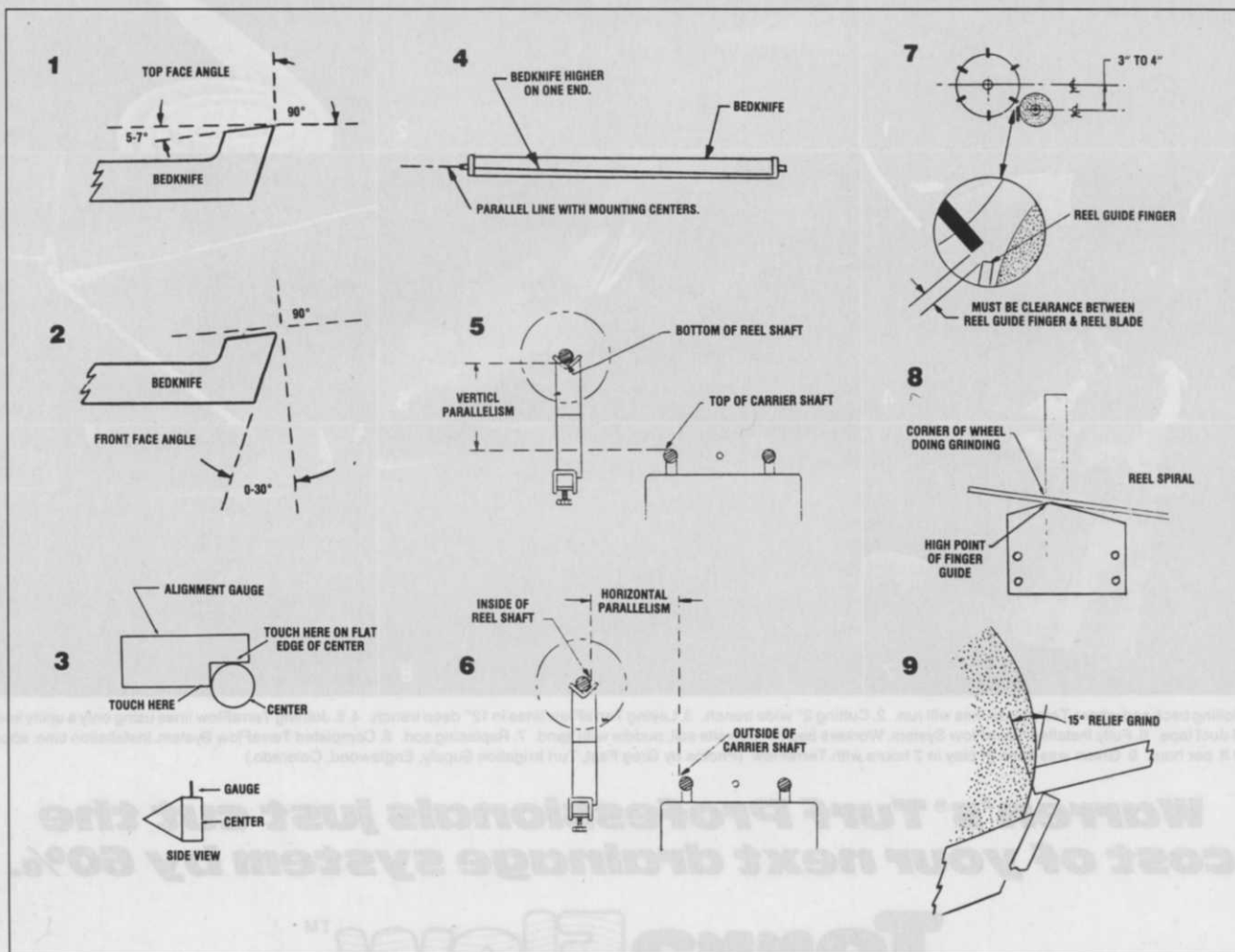
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ments and less friction contact area for longer wear between bedknife and reel. A spun-ground reel with relief angle creates the ultimate in reel and bedknife life and performance.

To recap, we see the evolution in styles of reel grinding as the search for mower performance and grinding efficiency takes place. First came the straight relief ground and backlapped reel; then the flat-ground relieved and backlapped reel; next the cylindrically ground to improve roundness and straightness; and finally the cylindrically-ground reel with relief for the best advantages of all types.

Here again, a properly spun-ground reel with a good straight bedknife should not need backlapping.

This, basically, is the four-step evolution of reel grinding. Here now is the procedure to grind a mower unit. There are five steps to the proper basic maintenance of a mower unit.

For all four types of blade grinds discussed, there is a five-step procedure resulting in proper mower maintenance and a well-ground reel.

**1. Maintenance:** Before grinding reels, first clean and service the mower unit according to manufacturer's specifications.

**2. Grind the bedknife** to the manufacturer's recommendations of top and front face angles (Fig. 1). Position the bedknife into the grinding machine using the bedknife's mounting holes (Fig. 2).

Next, use the set-up gauge supplied with the machine to position the bedknife parallel (in vertical and horizontal planes) to the grinding head carriage (Fig. 3). This is necessary, as it is important to grind the bedknife straight as

some manufacturers have only a 1/32nd adjustment allowable for setting the bedknife in contact with the reel at each end.

After set-up, grind the bedknife. Use only grinding wheels recommended by the grinder manufacturer. Grind the top-face edge first, then the front edge if necessary. On an automatically traversing grinder with a speed control, traverse at a slower speed on the last pass for the right surface texture of the grind. Always "spark out" the grind on the last pass. This means no in-feeding of the grinding head while the grinding wheel is traversing the knife blade.

A properly-selected grinding wheel and traverse speed should result in minimal wheel dressing to prevent surface glazing. Also, the in-feed amount controls dressing action on the grinding wheel to eliminate manually dressing the wheel.

Coolant is recommended for faster stock removal and to reduce heat build-up. If the blade edge gets too hot during grinding, without coolant you may have to let it cool before the final pass to hold straightness. Never get the knife edge too hot. That will cause the bedknife to lose its temper.

(A quick and easy way to check straightness of the top edge is to use a precision straight edge. Lay the straight edge across the top surface and check for gaps using a feeler gauge.)

Next, to grind a reel, mount the bedknife in the mower unit. To grind a reel mower, the entire unit must be mounted into the grinding machine. Before positioning the unit, however, some mowers need the bedknife to be mounted in part of the mower's main structure. In other

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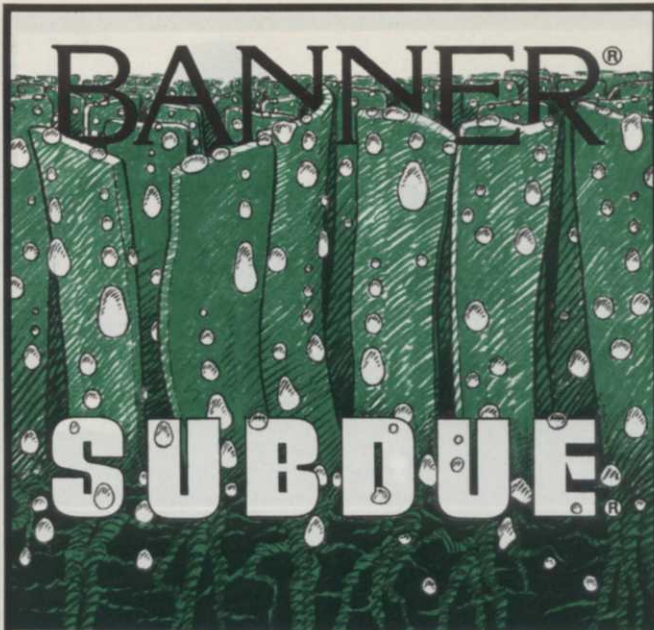
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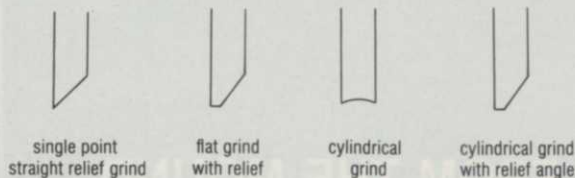
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## TYPES OF GRINDS

### reel mower blades



cases, the bedknife doesn't have to be remounted, such as when grinding wheel clearance is needed or the bedknife is ground during the reel grinding operation for efficiency.

When mounted, use the mower unit fixturing provided with the grinder. Next, use a set-up gauge to set the horizontal and vertical planes of the mower unit to the grinding wheel carriage traverse rails (Fig. 4, 5). Use the reel hub to check the reel's positioning. The more accurate this set-up, the less conical shape the reel is ground. Newer set-up gauges are using dial indicators rather than the touch method to hold reel positioning accuracy.

Now that we have a reel mower positioned for grinding, let's look at two types of reel grinders.

**Single blade reel grinding:** A single blade grinder grinds one blade at a time. These are manual traverse machines. This method uses a reel guide finger mounted on the traversing grinding head (Fig. 6). The reel blade rides on the high point of the guide finger.

For spin grinding, grinding the reel while in the cutting unit is preferable. The reel is rotated by a separate drive system. It rotates while the grinding head traverses to grind the outside diameter of the reel (Fig. 7). Spin grinding is for holding roundness accurately. Check reel roundness with a set-up gauge after grinding. Set the indicator rod on the reel's outside diameter and rotate the reel by hand to check blade-to-blade height variation.

It is now possible on at least one manufacturer's grinder to add a back relief grind (while maintaining the same mower position) to each reel blade after the reel is spun ground (Fig. 8). The back relief should conform to the manufacturer's original equipment design.

For controlling grinding dust, a collector chute is provided for a vacuum system. On some reel grinders, dust control is essential while spin grinding and relief grinding.

### Clearance adjustment

To check reel-to-bedknife clearance:

First, position the bedknife in contact with the reel. Fold in half a piece of paper about .003 inches thick and, while rotating the reel, slowly cut the paper. Pass the paper down each blade the full length. At least one paper should be cut off.

If so, the reel is set to within .003 inches.

Backlapping may be required for whisper-quiet operation of the mower unit and also during summer use for minimal re-sharpening of reels. If a reel is spun-ground and the bedknife is ground properly, backlapping should not be needed.

Grinding machines for today's mower maintenance market have progressed such that spin grinding with the added final relief grind have accomplished two things: grinders that produce (1) near-original performance (2) at affordable costs.

LM

Roger Rosenquist is product engineer for Foley-United, Industrial Products Division, Minneapolis, Minn., a leading manufacturer of mower sharpening equipment.





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