BD 31a/1

FROM:WISE FISHERMAN'S ENCYCLOPEDIA. U.S.A.

ROD A tube or shaft, mounted with guides, hand grasp, reel seat, and ferrules, which is used to cast, troll, or otherwise present a bait or lure to the fish. A rod may consist of one or more connecting sections although the number seldom exceeds three; its total length depends on a variety of special conditions, but the general range is 4–12 feet. Although a rod is progressively tapered from the butt end to the tip end its cross section is usually round or hexagonal (six-strip). However, a limited number of rods are made in square, pentagonal, and octagonal forms also. *See* Rod Building, Rod Repairs, Bait-Casting, Fly-Casting, Fly-Fishing, Spinning, Spin-Casting, Surf-Fishing, Ultralight Spinning

ROD BUILDING The art of constructing fishing rods. Since 1948 rod building has undergone a complete change, with impregnated glass fibers largely replacing the use of bamboo as the basic material—just as bamboo once replaced various hardwoods such as hickory, bethabara, and lancewood. These woods were tough, strong, and resilient. But they were also heavy and would take a "set" in use. With the discovery of bamboo for rod building, British craftsmen imported canes from India (so-called Calcutta cane) as early as 1850. At first, the bamboo was split and used only as rod tips of three-strip and four-strip construction. However, the rod butts were still made from hardwoods. The six-strip rod as we know it today appeared at a later date. Our modern precision-fitted nickel ferrule was unknown, and the British angler of a century ago laboriously had to splice together the tapered ends of his rod sections with strong twine—often while a hatch of mayflies was bringing brown trout to the surface.

The ascendancy of fiberglass rods is due to the material's resiliency, freedom from "set" even under hardest use, and, perhaps above all, its adaptability to mass-production methods. Glass fibers are woven into cloth, cut to patterns, wrapped around finely calibrated steel templates to provide a desired taper and size, and are then treated with heat and pressure. A second method is to apply a floss of parallel glass fibers about a light-weight core such as balsa wood, subsequently impregnated with liquid resin, wrapped with a thin film of cellophane, and cured with heat. This is a process which cannot be duplicated by the amateur rod builder. Of course, fiberglass "blanks" may be purchased and finished by mounting the appropriate hardware and reel seat, but rod building per se begins with the raw materials.

Split-Cane-Rod Construction

Fine rods are still being made from bamboo by both amateurs and a comparatively few skilled professionals. The cane rod is classical, traditional, and, from the standpoint of casting perfection, the experts' ideal. Bamboo is a giant species of grass which is imported in the form of canes of 6–8 feet in length and 1¼–2 inches in diameter. The best canes are straight, hard, and thick-walled. Bamboo is actually composed of multitudes of long, cellulose fibers, thinner than any hair, lying parallel beneath a dead, outer, enamel layer and bound tightly together by a substance called lignin. Progressing inwardly these fibers become coarser, and are separated by layers of pith which have no strength. Thus the sections which are to be shaped into rod splines are composed of the hard outer portion. The cane walls must be of sufficient thickness so that all of the pithy interior is removed during the shaping operation. It naturally follows then that a heavy rod, such as for saltwater use, must be started with the thickest walls available. Examination of the sawed end of a good culm will reveal the outer portion very dark, the fiber ends appearing as a homogeneous mass even under a lens of low magnification. But in large-caliber rods even the best bamboo will not provide a dense fiber to the core. This is compensated for by use of double-building or triple-building for added strength through the laminated construction. This is perhaps the most demanding of the rod builder's skills.

Raw culms are first split down the center with a heavy knife or motor-driven tool. Either method serves well. as the grain runs so straight that there will be little deviation from end to end to cause weakness. After halving, the inside, thin, solid partitions (where the leaf nodes occur) must be removed, either with a half-round chisel, or by other mechanical means. The finest canes will have nodes which are spaced 15–18 inches apart—and the exterior ridge of each should not rise much above the cane surface. While the leaf-node area may be the strongest part of the cane in its natural state it must be leveled down for rod building, and thus becomes the weakest portion because of the random local grain structure. To preserve the maximum strength of the glued-up rod section, these node areas must be staggered so that not more than one is found at any single point along the length of the rod. It follows that some trimming of length will be required. Usually an extra foot is allowed over the length of the finished rod. This is done while the strips are in the "as sawn" or "as split" condition.

Heat treatment is given the bamboo by many rod builders to stiffen the fibers. This may be done in the halved state, or preferably after splitting. The effect then is somewhat like that used by aborigines to harden arrow points by thrusting them into the hot coals of a fire for a few minutes. There is widely divergent opinion among expert craftsmen as to the degree of heat treatment to be used. The heat will stiffen it, but too much can also make the bamboo brittle. Commercial rod builders use various methods of heat tempering the bamboo; some use ovens for quantity production, others simply a blow-torch flame passed rapidly up and down a complete cane. Still others treat the roughed-out splines. A handy and sure method for the amateur builder will be described later.

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In addition to heat tempering, some makers use an impregnating process to soak or force a liquid plastic resin into the bamboo. The function is to waterproof the rod, making it safe from mildew and to enhance its compressive strength. The Orvis Company of Manchester, Vermont, employs this system, and any angler who has used one of their fine tools will attest to their power and fine action. The impregnating process seems to render a fly rod almost impervious to setting. Neither heat treatment nor impregnation can make poor bamboo good, but either process will improve quality bamboo.

Every manufacturer has his own method of charting, or planning, his machine setup for a given rod. But he works to a tolerance of .001–.002 inch in taking micrometer calibrations at any point along the stick. Each, also, uses one of the modern resin adhesives for the most important item in rod manufacture—a solidly glued stick, showing no "glue line" at any seam and one which will withstand both heat and moisture.

The oldtime bamboo devotee will recall that nasty set in his favorite rod after a hot, humid day. Or the rod that actually came apart after having been left in a damp case or rod tube. Those were the days of hot animal glue and then, later, casein, neither of which could stand heat and dampness. Modern resins are a boon to the rod builder, easy to apply, and permanent.

Many firms have designed their own pressure-gluing machines. All employ the same principle of applying heavy pressure to the freshly glued sticks, at the same time winding a strong thread spirally to maintain pressure on the glue line until the adhesive has cured. Such a device will be described later for use of the amateur rod builder.

After curing of the glued stick, the wrapping string is removed and the surfaces scraped or lightly sanded to remove adhering glue and the thin outer enamel of the cane, only enough to expose the beautiful fine and straight grain of the bamboo.

Ferruling is usually done with the rod held in a lathe, only the necessary length for the ferrule projecting from the chuck. It is by this method alone that the true cylindrical surface required for a good fit can be achieved. Fitting ferrules, building and shaping of cork grip, addition of reel seat, and final wrapping of guides may be done with machine help, but the willing amateur can secure the same result by hand.

Making ready will require some time and planning. First will be needed a special appliance, a steel or hardwood planing form with properly sized and tapered grooves, in which the rough bamboo strips are reduced to triangular shape with a sharp plane. Secondly, we will need the little pressure-winding machine mentioned above. Both can be built by a machine shop, total cost is not great, and fully justified if the amateur is serious in wishing to follow this absorbing hobby through with many rods of his own design.

The pressure-winding machine illustrated was designed by Robert Crompton, a craftsman of the old school, who delighted in helping amateur rod builders throughout the country some years ago. Drawings and advice were freely given; the machine was purposely not patented to permit its use by anyone.

The base is ¼ inch thick, cold-rolled steel 16 inches in length, bent at right angles to permit the bed, 4 inches wide, to be bolted to the edge of the work bench through two holes taking ¼-inch bolts. The vertical portion, 12 inches long, takes the slide ¼ x 4 x 10 inches, carrying two guiding bolts (set loosely) to slide in the channel milled in the standing section. A small pulley is grooved deeply, to drive an endless belt made of cotton "chalk line," the ends of which are spliced together or simply overlapped and bound with thread.

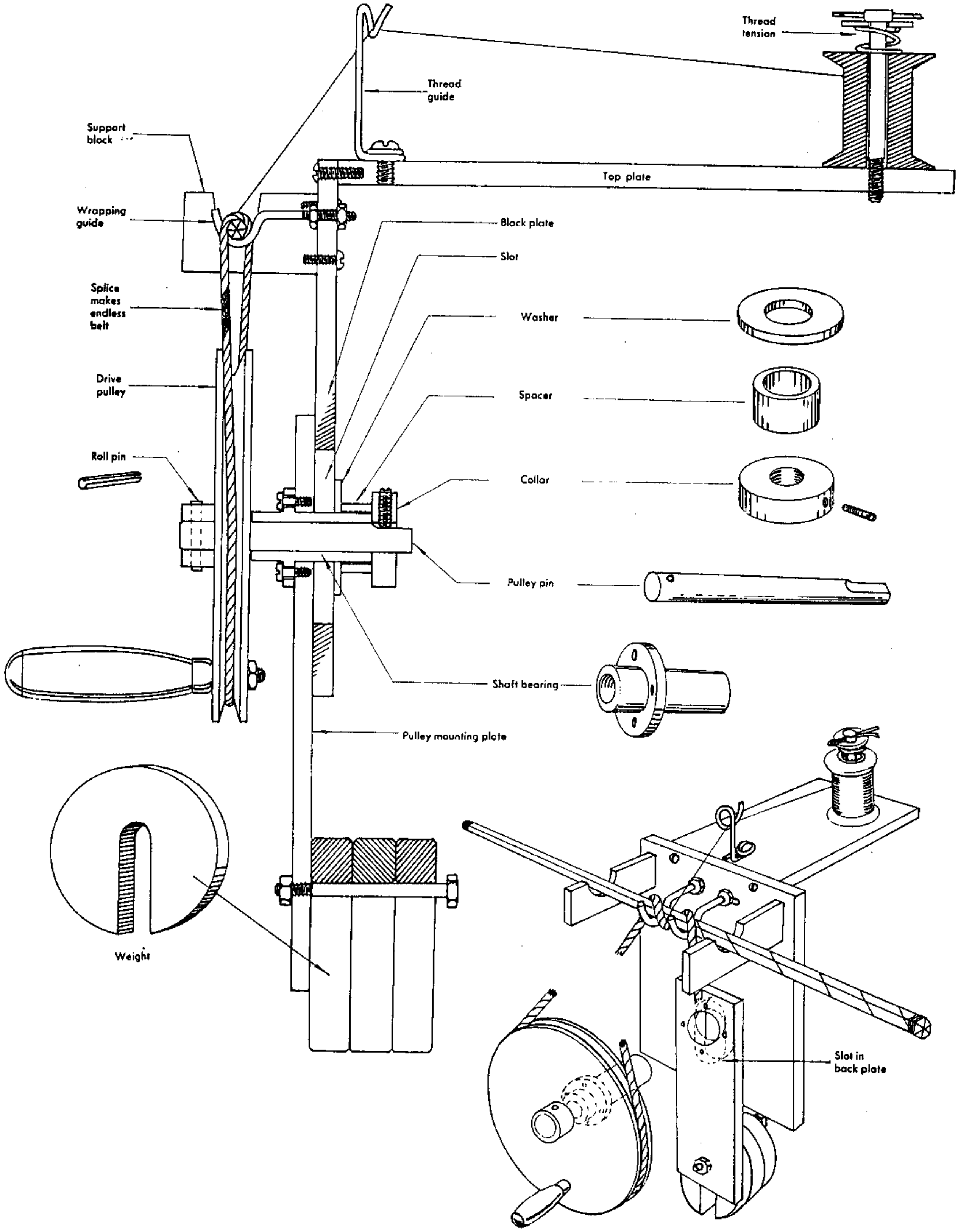
Note that at each side of the bed there is an attached block with half-round "U" about ⅞ inch across to support the rod stock as it passes through the two narrow "wrapping fingers" in the center. These are usually spaced to give a spiral wrap of about ⅜–½ inch. The endless belt is wrapped twice about the stick and propels it as the handle is turned. The principle of this machine is that a weight suspended from the slide applies compound force through the belt to provide a uniform and proper glue-line clamping pressure, maintaining this through tension of the wound thread. Tension from the spool is regulated by a sewing-machine tension plate, which can be purchased at any store supplying parts for sewing machines.

Before ordering or making a planing form, one decision must be made. Is the type of rod construction to be the conventional six-strip (hexagonal cross section) in which each strip is planed to an exact 60-degree angle, or of the five-strip (pentagonal shape) developed by Crompton. Many competent builders believe this design has definite advantages.

Briefly compared, the six-strip rod, having six sides, with the guides placed on a flat side, has opposite another flat side, a continuous glue line midway between them. In five-strip design, the glue line does not "divide" the stick as in the six, as each glue line extends only to the center. If we accept the fact that strain on glue line is important, pentagonal construction is to be favored. However, this is a matter of personal preference and experience. The six-strip method is employed by the majority of modern rod builders.

In the six-strip planing form your machinist will start with a slab of mild steel, 48 inches long and 4 inches wide, about ¾ inch thick, and space four 60° (included angle) grooves along its length.

Five-Strip Planing Form With the five-strip planing form, four pairs of grooves are required in the same type of mild steel, 42 inches long. Each



Pressure-Winding Machine

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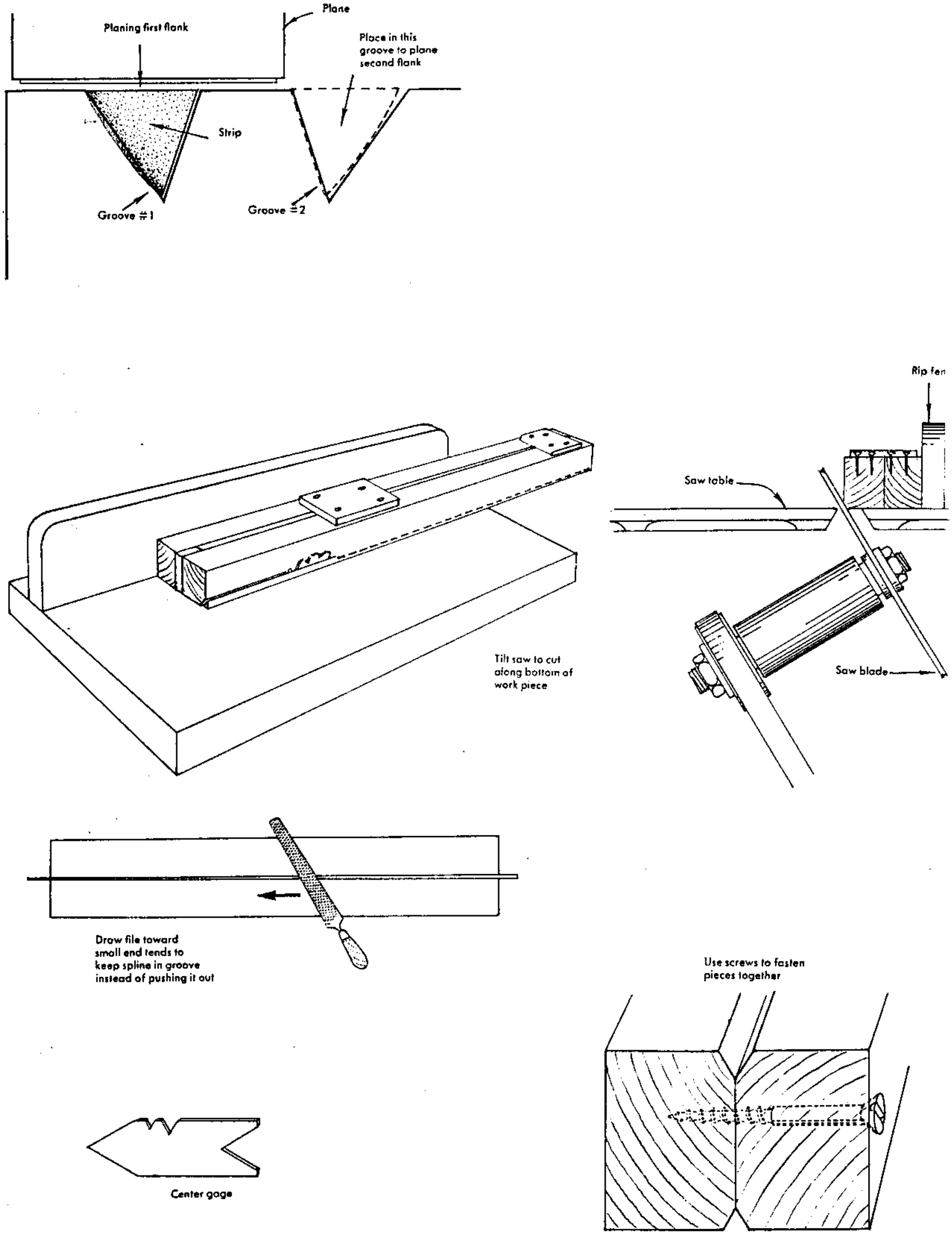
ROD BUILDING



Planing a 5-Strip Rod; Making a Wooden Form

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pair of grooves consists of an identical right- and left-hand groove, their angles and depths.

In planing strips for the five-strip rod, the spline is alternately placed in each groove every two or three strokes of the plane which develops the correct apex angles as the work progresses. If the builder wishes to try rod building "for size," so to speak, he can make an inexpensive wooden rod-planing form which will serve for two or three rods before it loses its accuracy. This can be done in any home workshop equipped with a circular saw. Birch or maple stand up very well, and the narrow mold is a better tool when draw-filing to final dimensions.

A very important item is a vise mounted on a workbench not higher than 32 inches from floor. The workbench should be made of heavy planking and be well-braced.

Tools Required

1. A pair of leather-faced gloves
2. 60-degree center gauge
3. Vise, heavy, 3–4-inch smooth jaws
4. 8-inch carpenter's plane for rough shaping
5. 6-inch "low-angle" plane for finishing cuts
6. Heavy (hunting) knife and mallet for cane splitting
7. Half-round gouge chisel for removing "dams" at nodes
8. Small hacksaw, fine-tooth (48/in) blades
9. 1-inch micrometer
10. 8–10-inch mill bastard file for leveling exterior nodes
11. Two 8-inch warding bastard files
12. Outside caliper for shaping cork grips
13. 8-inch fine-grain oil stone for sharpening plane blades
14. Fine grades sandpaper—
    220 (6/0) garnet paper
    280 (A) carborundum paper
15. Small carpenter's scraper
16. No. 00 steel wool for final polishing of sticks

Good rod-building canes may be secured from the Charles Demarest Co., Water and Bleecker sts., New York City, and a bale of perhaps ten, not at all expensive, will probably be supplied.

First split the canes in half, to prevent possible splitting later through drying out. Remove the inside dams; then prepare your chart for that first rod.

The Six-Strip Rod This rod has been almost the universal construction since the first was placed on the American market by H. L. Leonard of Bangor, Maine, in 1870. Their workmanship was superb, as anyone fortunate enough to own one still as a museum piece will testify. Also, the early makers, particularly in building fly rods, adhered to the early British idea of a "whippy" rod; but its casting ability is limited, and the modern fly rod possesses far more power for a given weight. Much of this improvement is in proportion to and placement of tapers.

We can give credit for improved rod design to members of many tournament-casting clubs, and, of course, to discriminating anglers who have applied scientific theory to their art. Old tournament records will show a champion distance fly-caster achieved 80–90 feet. Today that is "fishing distance," and the tournament man can cast a fly 200 feet.

Many innovations have been worked out by rod builders in an effort to secure more power. While actual weight, as such, is not too important in heavy-duty saltwater service, the lightest possible rod for the intended job is appreciated by the experienced angler. The hollow-built principle has been applied, in which the inner apexes of the shaped strips, which are of coarser fiber than the exterior, are cut away, leaving a hollow interior. We then have a "tube" which, for its weight, is stronger than a solid stick. But a thin-walled tube is easily collapsed; so when the hollow is considerable some sort of internal support is needed. Thus, hollow-built fly rods, such as those of E. C. Powell, of Marysville, California, include internal bulkheads of softwood, glued in place at intervals. The result is a beautifully light, but powerful stick. A fly rod of 9 feet weighs less than 5 ounces, but is capable of handling a moderately heavy tapered line. Improved methods of rod-building, smooth-flowing line through the guides—such as monofilament—and ability to shoot it strongly, all have contributed to these phenomenal distance casts. But in the final analysis, it is the rod which propels the cast.

In saltwater work, we are continually amazed at the mighty fish weighing hundreds of pounds, taken on 20-pound-test line, the rod a mere wisp of bamboo or glass. Similar records are going to light spinning tackle.

Perhaps best, for six-strip design, is to copy a favorite rod after first becoming acquainted with the micrometer, which should be used for all future calibrating. A little practice will indicate how the instrument is read. Care must be exercised that the spindle is not screwed too tightly against the 60° (or 72°) apex causing it to be crushed and resulting in a grossly erroneous reading.

Lay the rod you are measuring beside a scale and take the over-all calibrations at 6-inch points along its length. Then note ferrule size, and make a chart as on page 737. This is a chart of "diameters" for a fine commercial 8-foot-rod.

With an 8-foot cane split in half, dams removed, and outer nodes leveled with the 8-inch warding bastard file, the butt portion of one-half may be split into six or eight sections, for the butt joint of the rod, doing this by splitting the halved cane along the middle successively until the desired rough width is attained. Normally after the knife starts the split the two portions may be grasped and quickly separated. A good rule in sawing or splitting butt segments is to have the rough seg-

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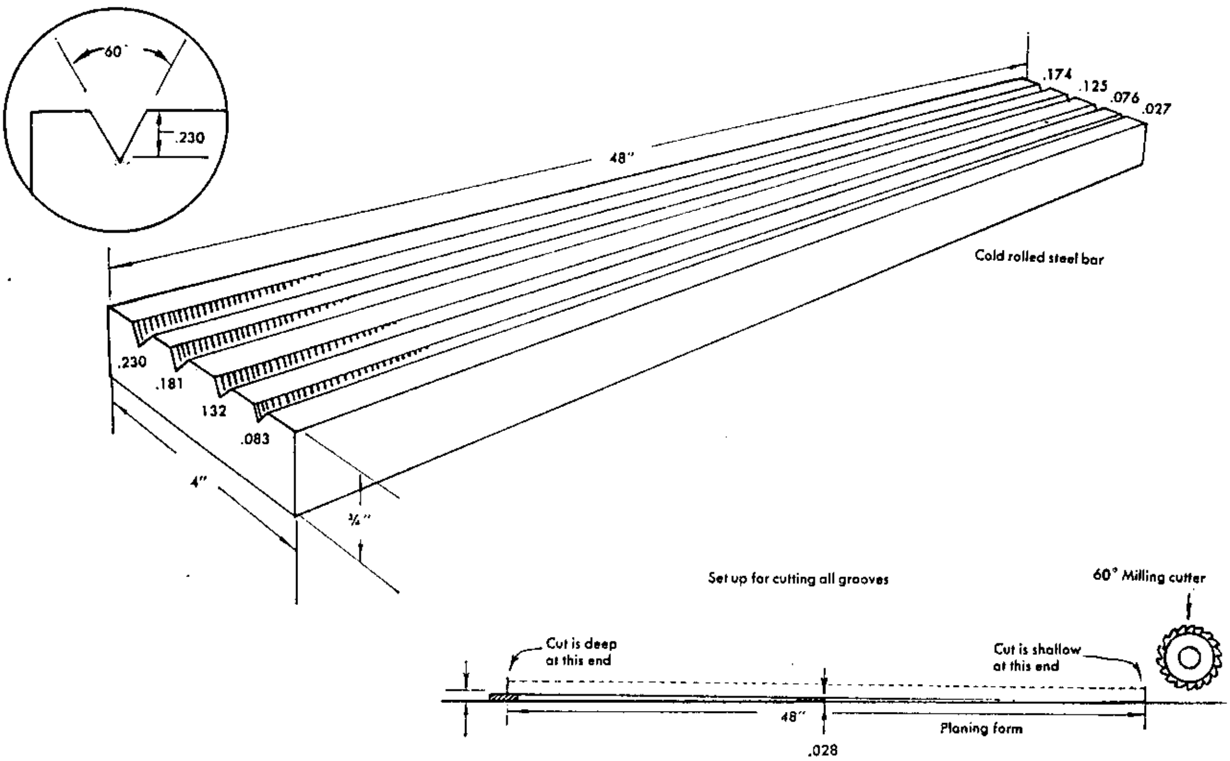

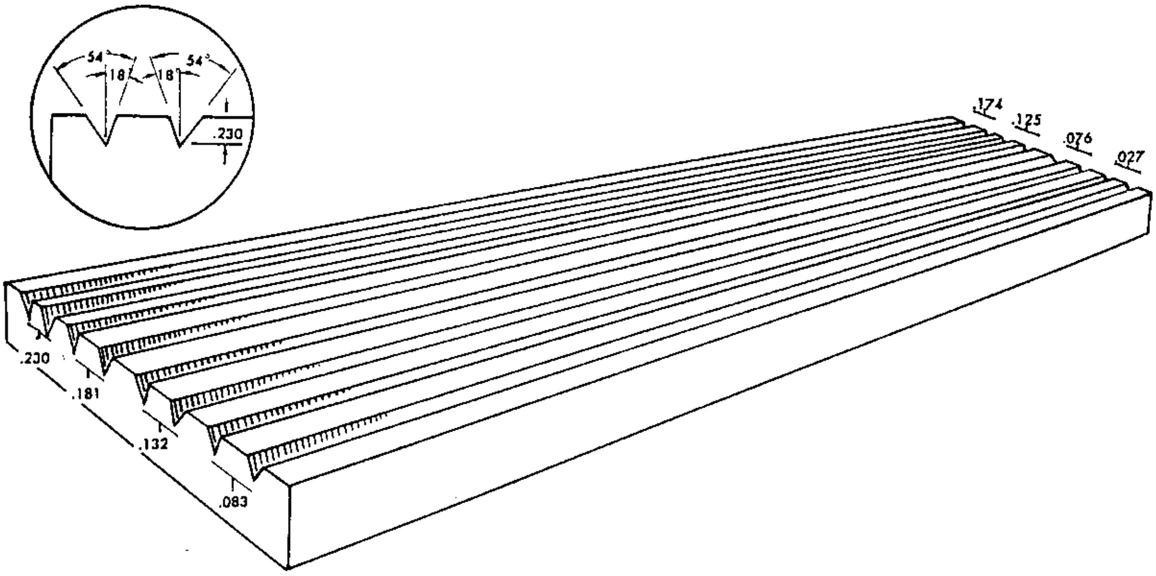

5-Strip Planing and 6-Strip Planing Form

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8-Foot, 2-Piece Fly Rod

			6 in.	12 in.	18 in.	24 in.	30 in.	36 in.	42 in.	48 in.
Diameters	Butt	.350	.350	.320	.290	.280	.270	.255	.255	.220
	Tip	.220	.210	.200	.185	.165	.140	.115	.100	.085

For comparing calibration of the five-strip with six-strip construction, following is a chart for a rather powerful five-strip eight footer. It might serve for the amateur deciding upon the pentagon rod and having none for copying.

			6 in.	12 in.	18 in.	24 in.	30 in.	36 in.	42 in.	48 in.
Diameters	Butt	.360	.360	.350	.335	.320	.295	.275	.250	.235
	Tip	.235	.220	.200	.180	.160	.140	.115	.095	.075

ments or sections at least ⅛ inch wider than anticipated finished dimension. Allowance should be 3⁄32 inch wider than large end of finished tip segment.

Lay the strips side by side on the bench, slide each until the nodes are separated by at least 4 inches, and cut off the projecting ends, leaving the strips 50–52 inches long. Note that the butt portion of the cane will have thicker walls—necessary for the rod butt—than will the end. If the cane is without flaws, use the upper, or thinner part for rod tips. Next flex each spline, feeling for "soft" or lifeless areas which may indicate injury or inherent weakness of the cane, which should be rejected.

After splitting, each strip will be somewhat crooked. This is easily corrected by wearing gloves, passing the strip over a gas flame until quite warm, then straightening. Upon cooling it will remain straight. At this stage these rough strips are to be heat treated to remove excess moisture. If done later, work might be spoiled through uneven heating at the thin-planed edges of the splines.

Heat Tempering There are several methods, and a good one is the use of a length of 1½-inch iron pipe, several inches longer than the rod sections, hung on a pair of looped wires. Each end is fitted with a wood plug through which an ⅛-inch hole has been drilled.

Place the strips in the pipe, and with a blow torch apply the flame back and forth along its length, turning the pipe frequently with gloved hands. In ten minutes or so steam will issue from the vent holes in the plugs—showing that water is being driven out of the bamboo. Continue to heat and turn another 10–15 minutes; note now the vapor has lessened, has a slight "wood" odor. Remove a plug for inspection, and if the strips show a light brown or dark tan color, the tempering is completed.

It is best to plane down the butt strips first, starting each in the largest groove, taking several cuts from each upturned edge—with the enamel side always against the groove side, since the enamel side is not to be touched. As the strip is reduced, in planing the upturned corners, it will of course become roughly triangular, and, as work progresses, sharpen the plane blade, and take lighter cuts first on one flank then the other.

The slots in the mold position the segment while planing and draw filing and also give one a rough check on size and taper as the segment or spline is being worked.

Frequent use must be made of the center gauge and micrometer when segment is planed to approximately 1⁄32 of the anticipated finished diameter. The segments must be equal on both angles, and if any light is to show when checking with center gauge it should be very slight at apex.

A No. 0 Stanley scraper mounted in vise can help to cut down and hold segments to proper 60°. There is a limit to the accuracy of planing, and the time will be well spent with the use of scraper and draw filing with a 10-inch mill bastard file. An 8-inch warding bastard file will cut the nodes better than a mill file. Thus, an accurate triangle will result, the groove helping bring this about—*if* the plane is always kept level with the work.

Previously, the form should have been lightly marked with a narrow file across its face at 6-inch intervals. Thus, as each strip is reduced an approximate idea of the dimension is constantly at hand. This should be frequently verified by use of the micrometer. Six-strip splines should measure just half the diameter of the finished rod, and the necessary spline diameters can be noted below over-all dimensions on your chart.

Five-Strip Calibration Here, the "one-half" reading will not do. A rod measuring .290 over-all would have a strip diameter of only .130, rather than .145, as for the six-strip. The factor for converting strip diameter is 2.236. Thus, for a five-strip rod butt of .290, we divide .290 by 2.236 and come out with .130 inch. Using this method, any six-strip rod may be used as a pattern for the five-strip. But, noting the comparison in calibrations of the six- and five-strip 8 footers, over-all dimensions of the five-strip design are greater, particularly in the lower portions.

Before the strips have reached finished size, change to the little low-angle plane, with the blade kept very sharp and set for the lightest possible cut to prevent possible tearing of the bamboo at the cross-grained nodes. If this becomes apparent, use a small, flat mill file or sandpaper block to smooth.

With all strips reduced to exact size (try to achieve a variation of not more than .002 inch at each 6-inch station) wrap them together in proper

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position with strong cotton string, wound spirally. Examine for close fitting, and measure the over-all dimensions for comparison with the chart. Any slight sign of poor fitting can be marked, the strips laid out again, and the "bad" spot corrected with plane or file.

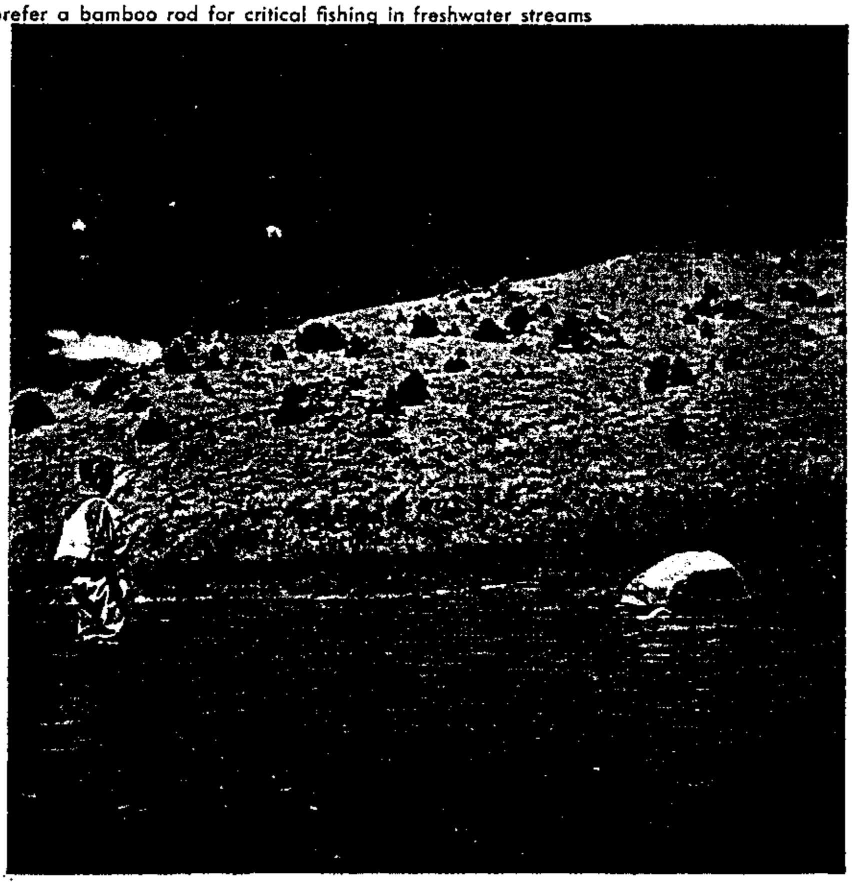
Gluing Several fine glues of the "resin" type are available for the amateur, simply to be brushed on the splines. One of the most satisfactory is Borden's "Elmer's Glue" which can be obtained in almost any hardware store in small cans. The liquid in one is a deep wine color, to which is added the powdered catalyst as directed on the can. With the splines for a rod section properly placed, roll them together with short strips of Scotch tape around them at about 18-inch intervals. Now open them up and place them back down on the bench. Apply the glue to the upturned flanks, brushing to coat all surface area thoroughly. Roll the splines together, and start, butt first through the pressure-winding machine, the endless belt passed twice around the stick as described, the wrapping cord under the belt. A weight of 5 pounds on the sliding member should be sufficient for fly-butt joints, particularly if Epoxy resin is used. Recently Epoxy adhesives have been developed. They are suitable for rod building as they are water- and heatproof. More importantly, they do not set by drying, losing moisture. Therefore there is no shrinkage. Any gap or void is filled. A weight of 2–3 pounds will be ample for tips.

Tie off the cord with a few half hitches when this first wind is completed; then rewind the belt—in opposite direction—for the second wrapping, the cord thus going on "crisscross," and removing all, or most, of the twist resulting from the first winding. Sight down the wrapped stick, and straighten any slight deviations; also correct any twist which may remain while the glue is still soft. (If, after drying, the sticks show twist or a slight bend, these may be corrected by passing finished rod section over gas burner until hot to touch. Reverse twist, and hold until rod joint cools.)

It may be found that for most sticks, a greater weight may be necessary for the second winding to correct the twist resutling from the stick's first passage through.

Glue should set in 24–36 hours, with the sticks suspended in a warm spot; then the wrapping cord may be removed and the exterior faces gently scraped down to remove adhering glue and *only* enough of the enamel to show the fibers beneath. A final light sanding with 280 (A) carborundum paper wrapped about a wood block, followed by burnishing with fine steel wool, and the rod is ready for finishing.

Expert anglers prefer a bamboo rod for critical fishing in freshwater streams



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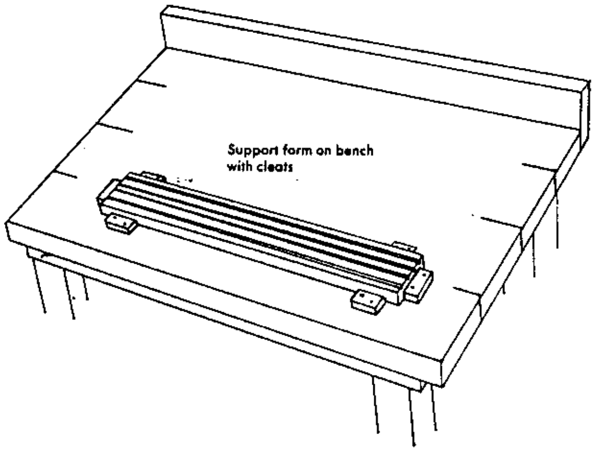

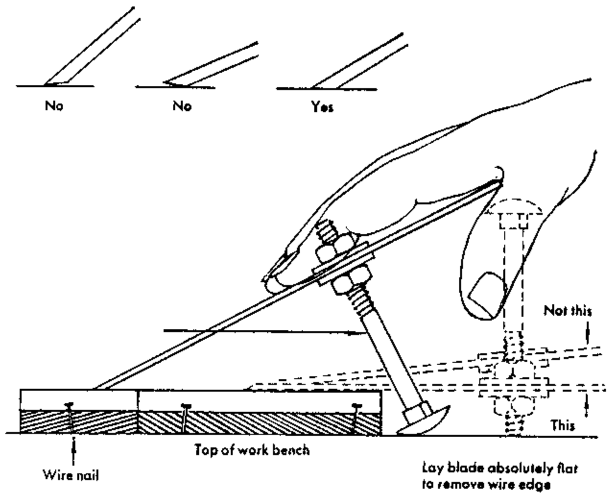

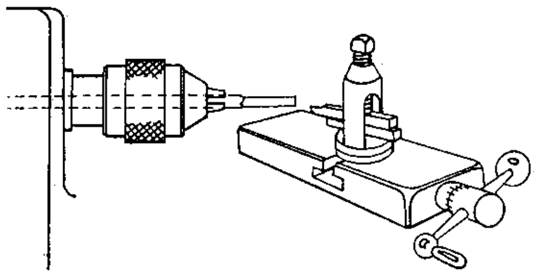

Workbench—Turning Ferrule Diameter

Ferruling and Finishing Only high-grade, nickel-silver ferrules should be used, these with tapered, split (or serrated) ends. Such can rarely be found in tackle stores but may be ordered from several firms. The fine ferrules by Super Z. Co., South Shore Building, State Highway 71, Manasquan, New Jersey, and those by the Orvis Rod Co., Manchester, Vermont, are to be recommended.

Ferrule sizes are indicated by the inside diameter of each, in sixty-fourths of an inch, this being .0156. Thus, to determine proper size for a given rod, measure the six-strip across the flats at the end, and order a ferrule size to match this, which will just permit a true circular seat without cutting into the outer fibers. The 8-foot, six-strip rod charted above, then, is .220 at the ferrule end of the butt stick, and a $^{14}/_{64}$ ferrule (.218) will be required.

The five-strip, because of its shape, will have more taken off for a ferrule seat, the corners more prominent; so note, in the five-strip rod charted, the diameter of the stick's end is .235, to take the same $^{14}/_{64}$ ferrule.

A bench lathe is ideal for fitting ferrules (note illustration) and for holding the section in the lathe chuck while the ferrule is forced home with the tail stock. Acceptable work can be done, however, holding the section in a padded vise, shaping with a strip of sandpaper wrapped around it. Take care to prevent crushing the section by too much force. The micrometer should be used often to prevent a loose fit. Rather than the hot stick cement, a better preparation is a rubber-type cement, such as Goodyear's Pliobond, and with it a barely snug fit (in which you can force the ferrule into place with the fingers alone) is sufficient. Then, with a thin application of the cement the ferrule is easily forced home in the lathe, or alternatively by pressing it firmly in place by hand.

With ferrules fitted, assemble the rod, and sight down its length, and any deviation at the ferrules can be overcome by turning one section, a "flat" at a time, until the whole matches up.

Reel Seat and Cork Grip These can usually be found in sporting goods stores, the latter with rings ready glued together and shaped, with a hole to fit the rod butt. Lacking the finished grip, cork rings may be had, which you force onto the butt section, glue together, with pressure (the lathe here

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excellent) applied. After the glue is set, the grip then may be shaped with sandpaper strips to suit the fancy of the user.

Applying Guides and Finishing The best hardened steel guides should be used, those of "snake" type for fly rod; ring guides, chrome-plated, for fly-rod butts and for spinning rods, the latter of light-weight, large size. Spacing will depend upon rod taper; but ten, for example, will serve nicely on an 8-foot fly rod.

The guide positions may be positioned by trial and error, keeping in mind the need to reduce the spacing toward the tip. Generally the distance between last guide and tip should be not more than 4–5 inches. No. "0" wrapping thread in nylon or silk, color as desired, is best for light rods, size "A" or heavier for larger rods.

No wrapping jig is needed for home work, and the spool mounted on a nail driven into a heavy block will feed the thread, one hand holding tension, while the other revolves the stick held under the arm. Starting a few turns from the end of the guide foot, take five turns over the thread end, trim it with a razor blade, and proceed to the end of the foot, always crowding the thread closely. When a few turns from the finish, lay a loop of thread along the flat, wrap over it; then cut the wrapping thread, insert the end in the loop, pull under, and trim flush.

Ferrule wrapping should start a few turns from the serrated end and finish snug under the tiny shoulder turned on the barrel. And a second wrapping may be advisable to prevent cement showing through at the serrated end after varnishing.

Thread should be given three coats of thinned clear lacquer using a small brush. This preserves the color of windings which, if varnished directly, would become transparent. Ten minutes between coats will be ample.

Any good, light spar or rod varnish will serve, applied in long strokes with a ⅜-inch wide brush, kept well-filled, and the varnish actually "flowed" on. But this only after the sticks have been carefully wiped with a cloth to remove finger marks, then brushed clean to remove adhering lint.

Two coats of varnish are sufficient for a long-wearing, glossy coat; too much can slow and "deaden" the action of a light rod. An additional coat may be given the wrapping, if necessary, for protection. —C.M.K.

—L.B.F.

Fiberglass-Rod Construction

Fiberglass rods are made of finely drawn glass fibers bonded together with a thermosetting resin. There are two basic forms. The first is simply a tapered hollow tube made by wrapping woven glass fiber about a metal mandrel, impregnating with resin, and then curing with heat. The second form consists of placing parellel fibers (floss) along the length of a round, tapered balsawood core, then impregnating with resin. A wrapping of cellophane tape is then applied in spiral fashion to bind th glass fibers to the core. Heat cures the plastic. Th balsawood core performs an important function. I acts as a continuous internal support for the fiber glass layer which encloses it. This prevents collaps of the wall when the rod flexes in use, and is con sidered to be a more efficient arrangement than th hollow form. The latter, being easier to make, ar usually lower priced.

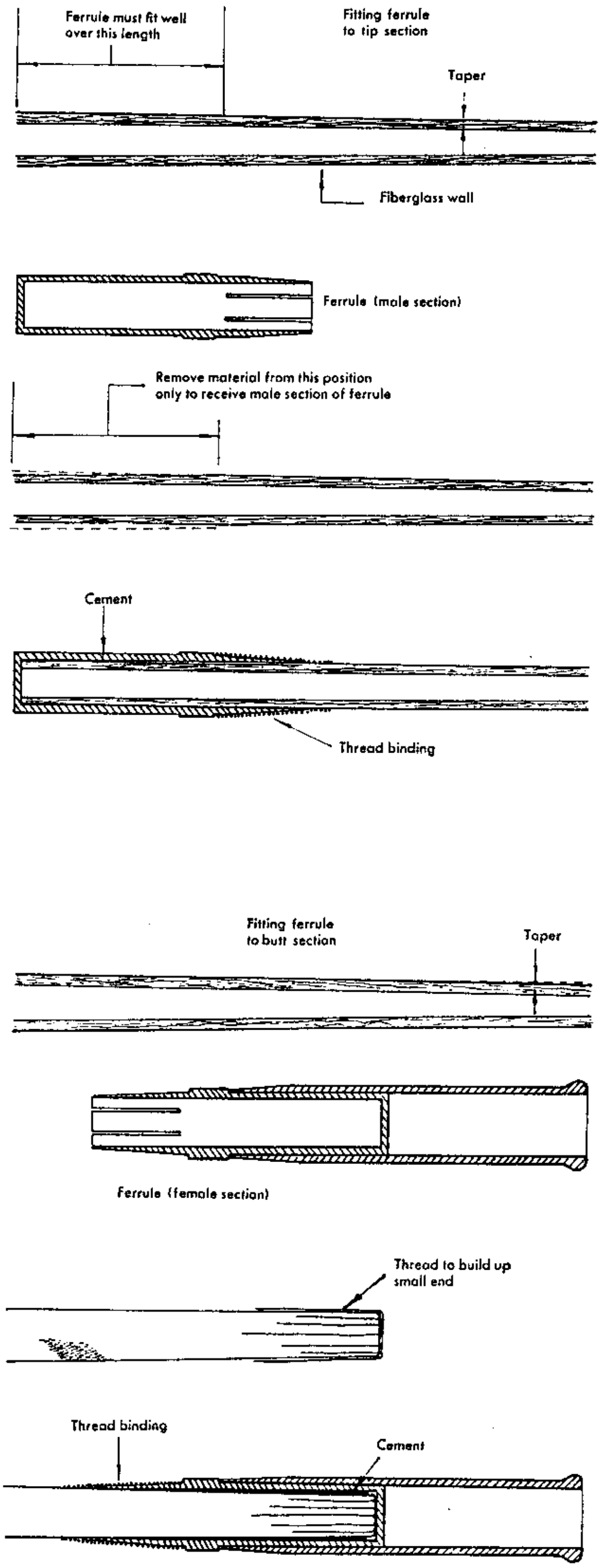
Fitting ferrules, handles, and guides to fiberglas sections is no more difficult than other materials One must remember that the strength and dura bility of these rods are concentrated in the outer most fibers. It follows that an absolute minimum o cutting, turning, and the like is tolerable. All o these sections are tapered and are seldom perfectly round as they come from the curing ovens. Some truing of the ferrule stations, for example, must be done. It is usually possible to do this without dam age to the rod strength. As shown in the accom panying drawing, it is not necessary to remove any material at all from that portion of the section near the open end of the ferrule. As in bamboo construction, the fit between ferrule and rod should be firm; .001-to-.002-inch (interference) tight fit is correct. Sealing wax-resin-base cements should be avoided. Use instead a modern adhesive.

No straightening is possible after ferrules are mounted. Any attempt to soften a cured thermosetting resin will ruin it. The rod should be trial assembled to discover the straightest configuration. A very light, center punch mark should be made on the rim of the female ferrule (rod assembled) and a second punch mark opposite on the body of the male ferrule. When assembling your rod, simply align these marks.

Installation of handle guides follows the same procedure, spacings as for bamboo construction. Since there are no flat sides against which guides are placed, it is wise to tape all guides in position, sighting along rod to make sure they are not arranged in a spiral fashion. Recheck this as the winding progresses. After color preserver (clear nail polish) on windings has dried thoroughly, the rod may be varnished if desired. If you decide to omit the varnish in order to secure faster rod action you may use instead a penetrating sealer such as is used on hardwood floors (omitting filler). This is applied very sparingly using a pad of soft cloth. Two or three coats are required. Guide and ferrule bindings should always be varnished for protection.

Fiberglass Saltwater Rods Fiberglass has been a boon to the saltwater angler. The combined effects of sand, saltwater corrosion, humidity, and rough handling require a unique material. Incredible strength and toughness and the waterproof character of fiberglass make it ideal for saltwater.

There are two strictly basic saltwater-rod types. Trolling and bait-fishing rods are most numerous, taking a great variety of length and weight forms. Surf-casting rods are generally similar in length and



Fitting Ferrules

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weight regardless of whether a spinning reel or a standard casting reel is used.

Ferrules are seldom fitted to the working length of bottom-fishing or trolling rods. It takes a strong rod to hoist an 8-pound codfish aboard a party boat. In nearly all cases the rod consists of a two-handed butt and a separate tip section. The butt is fitted with a locking reel seat and ferrule. The tip is made of a piece of solid, round fiberglass inserted into an adapter plug, over which the male ferrule is fitted. Two to four guides and a top are the usual complement. These are always ring guides of sturdy construction and heavily chrome-plated. The best have rings of tungsten carbide. When attaching guides to saltwater rods, a solid layer of thread is usually applied. The foot of the guide is placed on this "pad" and wound in the usual fashion. Subsequent application of color preserver and varnish prevents saltwater from getting beneath the windings to corrode the guide supports.

Most dealers handling saltwater rod-building material carry shaped handles, ferrules, cork for grips, as well as the working tips. From this the angler can secure the components to suit his fishing requirements.

Although it is possible to cast with a long boat rod, somewhat more specialized equipment is called for. Traditionally, surf rods are quite long, tips of 10-foot length being quite common. A somewhat springy ash or hickory handle of 18–30-inch length is attached to the tip by means of a ferrule. More recently one-piece tubular fiberglass sticks have become available. In the simplest form the reel and guides are simply taped on with plastic electrical tape. Four or five guides plus top are used for free-spool and spinning rods, the first guide being placed one-half the distance from butt to tip, the remainder arranged in diminishing spaces toward the tip. For casting reels, the first guide should be about ¾-inch diameter inside, diminishing to ⅜-inch diameter at the tip. Due to the severe conditions of use, tungsten carbide rings are strongly recommended.

Spinning rods for surf-fishing are similar except that larger guides are used. Spacing is identical, but larger diameters are employed. The first guide is 2–3 inches in diameter, the other guides are graduated in steps to ¾ inch at the top. Ring guides in these large sizes cannot be obtained in tungsten carbide. They must be chrome-plated in order to resist the abrasive action of the line. Tungsten carbide tips are available in the recommended size and should always be used on rods of this type. All windings should be done in the manner previously described using nylon or Dacron thread of at least size "A." Since a coat or two of varnish does not appreciably affect the action of these powerful rods, it is good practice to include this extra operation. Untreated, the fiberglass rod takes on a genuinely battered appearance after only one season of use, even though it might still be structurally sound.

A light class of fiberglass saltwater equipment i becoming more popular. One is the 9–9½-foot fl rod equipped with stainless steel guides. These ar used in salt-and brackish water for bonefish, tarpo and other game species. Construction follows tl usual bamboo conventions. Another light class saltwater equipment is the use of medium-weig spinning rods for the same purpose.

—L.B.

The Theory of Rod Function in Casting

The purpose of any casting rod is to take muscular impulse and use it to propel a weigh Obviously, if that impulse were applied directly t the weight without a rod, it wouldn't be nearly efficient. A fisherman has cast a 4-ounce sink more than 900 feet. He has also cast a fly li over 200 feet. This cannot be done by the han alone. Thus we may assume that the flexing of rod allows a much longer power stroke, and tl sum-total energy that goes into the cast is increase as a result. So the prime function of any rod is bend, and the ability to send a weight through tl air is called recoil power.

It is not a hypothetical spring. If a rod were weightless and inertialess spring, it would hav maximum deflection at maximum acceleration an would have theoretically no deflection at maximu velocity; the original stretch of the spring would l given back to the projectile. But a rod has bot mass and inertia as well as spring. As a result it h a typical way of vibrating at a specific rate. Max mum recoil power depends on two factors that a built into the rod—its stiffness, or "moment of i ertia," and its distributed weight. If our rod build somehow adds stiffness to a rod without addin weight, the result is a faster rate of recoil—which i the reason for hollow-built bamboo rods, tubul glass rods, and heat-treated bamboo rods. These a a few of the methods used to stiffen a rod withou adding weight. In the old days, steel-cored bambo rods were made in an attempt to get a faster reco vibration rate, but conversely, adding weight wit out increasing the stiffness resulted in a less powe ful rod. What pioneer bamboo builders failed t see was that the stiffness of a rod at any point in i length is a function of the cross section at that poi and of the material's characteristics. Eventuall arguments were advanced for the six-strip, fiv strip, four-strip, ad infinitum. Rods have been mad in every form from a solid to one of twelve strip Many fine rods are built in the United States toda in all cross sections from hollow to solid, includin those from two-strip to six-strip.

Rod Action

Fly rod action may be even less comprehensib to most fishermen than an explanation of how th modern computer or rocket missile works. Bu being a functional tool, like the refrigerator or vacuum cleaner, the angler will soon learn whethe or not the fly rod is producing.

Fly rods are usually identified as being wet-fl

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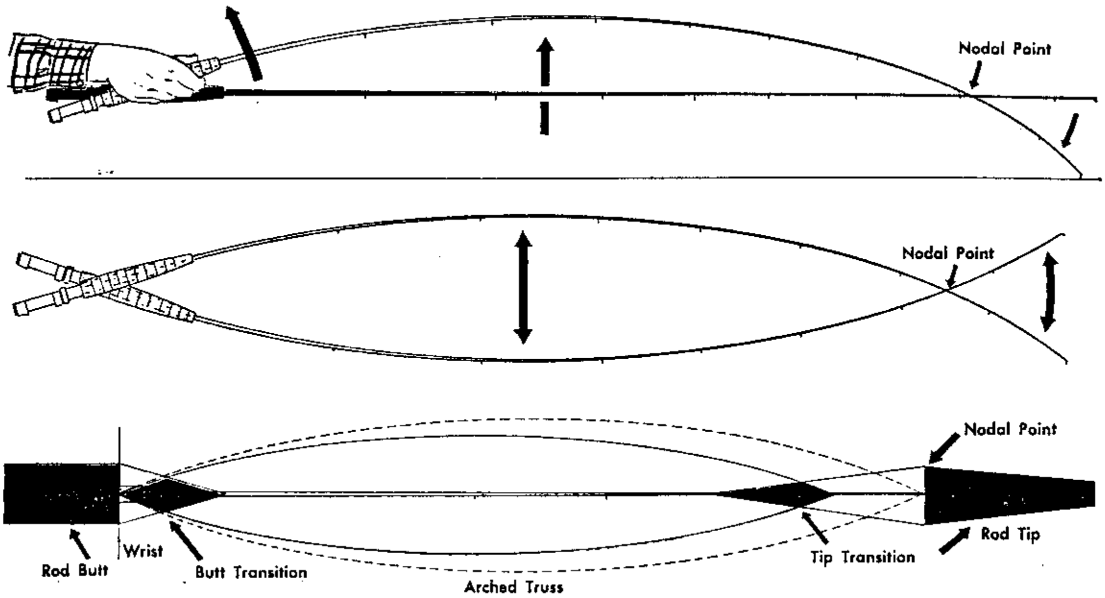

A simple test will demonstrate that rod action is controlled by the stiffness of the middle portion. Hold a rod parallel to a table top, as in the top drawing. Raise the butt sharply as if to flip tip upward, as in a cast. The butt part will come up with your hand, but the tip will move in the opposite direction, striking the table top before rebounding and following the direction taken by your hand. In the second test, hold the rod horizontally, and set up a side-to-side vibration with your wrist, as shown in the middle drawing, and observe how the tip fans out. Note the nodal point and the shape of the vibrating middle. The diagram on the bottom shows theoretical dynamic "linkage" between the three rod portions. Stiffness of the mid-portion governs rod action.

action, dry-fly or trout action, bass-steelhead action, and salmon action. These terms are descriptive enough for the novice, but more precise information is desirable for the experienced angler because these terms are interchangeable. A dry-fly "action" is quite suitable for sunken fly fishing, and a quality wet-fly action often makes a perfect rod for floaters. For salmon, never use anything heavier than a bass-steelhead action; perhaps best for salmon, though, is a light dry-fly action. The wet-fly rod is a lighter rod at any given length than a comparable dry-fly rod. Rods for the wet fly are soft, as there is little false casting to be done. A stiffer rod would dry the fly while false casting and is therefore less desirable. So the dry-fly rod is comparatively stiff and has a more pronounced tip movement, quality that is built into the rod rather than added to it by increase in weight.

Bass-steelhead rods are heavier and stiffer because the flies and rods used for these fish are heavier and more wind resistant. Essentially they are slow but powerful. Salmon-action rods are the heaviest and stiffest by far because of the weight of line and the size of the flies these rods must throw. But if the fisherman chooses to ignore the traditional large double-hook salmon flies and has the skill to lay out a long line with a light rod—any of the other rods can be used.

These terms, then, are simply a guide for the beginning angler.

A rod is really a simple beam with cantilevers at both the ends. It is a subject of dynamics rather than static mechanics. When put in motion it acquires properties of acceleration, impact, rotation, and momentum. There are two supports: the hand which is supporting the butt section and the nodal point in the tip. The nodal point is the area of transition where the force applied to the butt of the rod is being translated into motion. This can be simply demonstrated by holding a fly rod a few inches over and parallel to a table. When the rod is raised sharply to flip the tip upward, as in a cast, the butt portion of the rod comes up with the hand, but the tip moves in the *opposite* direction, striking the table top before rebounding and following the direction taken by the hand. This can also be seen by holding a fly rod horizontally in the air and setting up a side to side vibration, observing how the tip portion fans out.

A rod, therefore, can be divided into three convenient and easily recognized sections: the tip, mid-section, and butt. In actual casting the hand drives the butt, the butt drives the mid-section, the mid-section drives the tip, and the tip drives the line or lure. The tightness or looseness of this linkage is the action of the rod. Thus, rod action is controlled largely by the stiffness of the mid-section. The butt is the driver; the tip its translator; and the mid-section is an arched truss between the two.

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The Stiffness Factor The stiffness of a rod at any point of its length is a function of the cross section at that point and of the characteristics of the material from which it is made. This became apparent during the years when steel was a popular rod-building material (1920–1947). Steel rods were strong, but they lacked casting "power." The decline of steel, however, was largely due to metal fatigue. With the advent of fiberglass the limited-life steel rods gave way to the new material. But steel did illustrate that there is a vast difference between a material's tensile strength and its stiffness factor; where the former resists breaking, the latter resists bending. Weightwise, solid steel was the least efficient rod material. If you bend a rod downward, all the surface on top is under compression; inside the rod there exists a point where there is neither tension or compression. This center is called the neutral axis. It exists as a solid or empty space. Under dynamic conditions (i.e., casting) it is also the location of maximum horizontal shear, which is the tendency of fibers to slip past neighboring fibers. Actually, it may be viewed as induced stresses working down and up the length of the rod. Some idea of the force can be realized when a rod "mysteriously" snaps in two at the peak of a cast. The impulse that bends a rod butt in casting is the momentum of the moving tip and the lure; when the cast is checked, this momentum travels down the rod to the butt by way of the ferrule. The bamboo or fiberglass that is under the ferrule takes a terrific pounding because the force is exerted across its diameter, and to compound the stress, the ferrule must bend the butt section. In a bamboo rod, this longitudinal shear sometimes pulverizes the wood under the ferrule. With hollow-glass rods, the force just breaks the joint square off. Solid steel didn't break very often, but it had one major failing in that the extreme or outer working fibers were in close proximity to the neutral axis. The stiff, thin, steel shaft fought a vibrational war within itself.

In order to eliminate the literal core of the problem, one manufacturer originated a system of making tubular rods by stepping down a steel tube in repeated drawing operations. Each die thus successively reduced both the outside diameter and the wall thickness. Solid steel continued to have a large market among trollers and sinker bouncers, but casting men found that in tubular form, steel had some of the "life" of bamboo. Tubular steel rods competed strongly with the cane market. But after World War II, fiberglass appeared, and steel vanished; glass is stronger for its weight and is not subject to rust or wall collapse. Furthermore, both the stiffness and the strength of a fiberglass rod could be controlled by its bonding agent, or the thermoplastic substance that holds the glass fibers together. But the problem that has perplexed rod builders through the ages is that using the structure and material that you would expect to produce maximum recoil is not the answer to a perfect rod. If so, all rods would be made of tubular glass and have a profile that looks something like the Eiffel Tower. It would be the stiffest and lightest rod ever made, yet not be efficient for casting. The Eiffel Tower profile is for a static cantilever beam—not a vibrating casting rod.

Luxor Method In 1936, the French tackle firm of Pezon & Michel adopted a spinning-rod classification system known as the Luxor method. This is predicated on the strength of a rod. Under the Luxor system, it is assumed that the optimum lure weight should be 1/50 of the static resistance of the rod. This is expressed in grams; thus a spinning rod of "400 grams strength" is calibered to cast a lure of 8 grams (eight times the unit of 50 equals 400). Obviously, the 400-gram rod can cast lighter and heavier lures, but 8 grams is optimum for perfect casting. Factory checking is done on a graph board with the rod clamped in a horizontal position; a cord is run from the rod handle through the guides, and weights are attached to the cord until it forms a tangent to the rod tip. The total weight that creates the tangent is the grams-strength measurement, which may be 200, 300, 400, and so on. This is some index of net recoil power.

The argument against graph-board data is that while it may be the best way of determining a rod's strength it does not reveal the moving curve of the rod. The graph board provides a purely static measurement, which isn't enough to explain how the rod will act. The location of the ferrules, for instance, greatly affects rod action, and their influence doesn't show up on the graph board at all. At best, the board can only indicate which rods are downright poor. It cannot take into account the response of a rod in suddenly applied rapid motion. We learn nothing of the rod's action. Is it fast or slow? Three men who tried to carry the graph board to a logical conclusion were the Englishman Hawksley and two Frenchmen, Robin and Biscarbelcha. They recognized that the rod is not a static beam nor the commonly conceived spring, but a vibrating cantilever beam. Accordingly, they further measured their rods in wave lengths. The conclusion drawn by wave-length researchers was that a good casting rod vibrates in quarter wave lengths.

The Ideal Rod in Theory Velocity is the end product of casting, which you achieve through muscular impulse (acceleration) multiplied by the time of the cast. The action of the rod to a large extent determines the time factor (fast or slow). Action is controlled by the rod's taper. Thus, the ideal rod is one that is harmonically sound and whose effective bending length is *longest* for the weight being propelled—be it frog, plug, spinner, sinker, or fly. This doesn't mean that long rods are better than short rods, or light ones are better than heavy ones. It means the slowest rod to reach an hypothetical maximum of recoil power is close to, if not actually, perfection.