

# Building a Butt-Welder for Band Saw Blades

By HAROLD P. STRAND

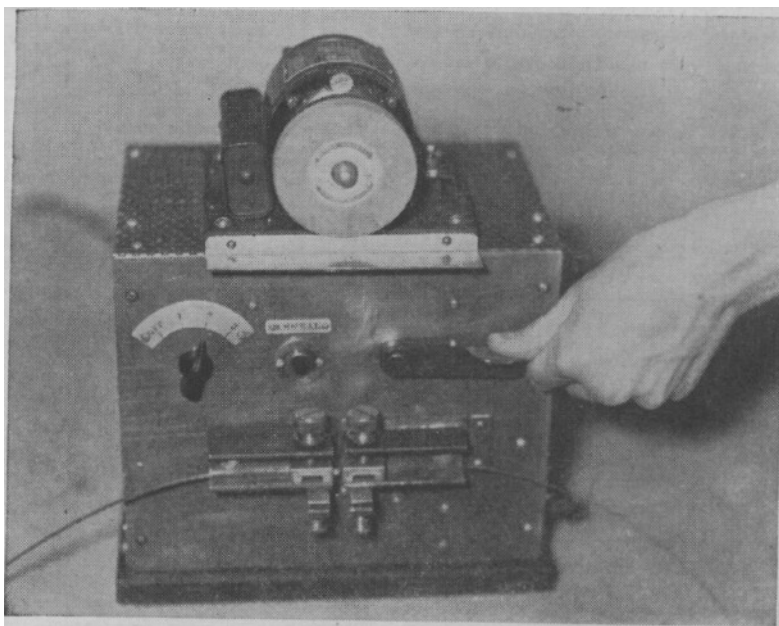


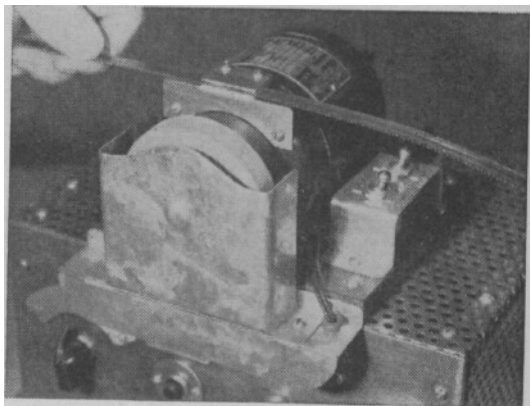
Fig. 1. Welding a band saw blade is easy with this handy unit. The white spot between the electrodes is the white hot steel at the moment of the weld.

**O**WNERS of band saws can use a butt-welder to weld easily and quickly the ends of blades varying in width from .125 to  $\frac{1}{2}$  in. A welder will allow the saw to do internal cutting, when it is necessary to cut the blade so it can be passed through a center hole in the work. Blade stock can be bought in continuous coiled lengths and cut off to the right measure, and welded. Broken blades can often be salvaged by cutting off new ends and welding, or damaged sections can be cut out and new pieces inserted. The welder can be used to join small steel rods, such as extensions to twist drill shanks up to about .188 in. in diameter. This feature is useful in model work for butt-welding small parts of similar type.

Operation of the welder is simple. Cut off square the ends of the blade to be welded, grind if necessary so they will meet perfectly. Then

Fig. 1A. Testing the welded blade in the gage after grinding. The blade, less the teeth, must be able to pass through the .027 gap of the gage, so it will not catch in the saw guides. Also note the guard for the wheel and the extra toggle switch for the light below, added later.

place them with the joint in the center of the gap of the main clamps and tighten the screws. Line up the ends, tapping them so they butt in good alignment. For blades of narrow width, such as .125 in., the #1 position of the selector switch will probably be best. For those up to about .438 in. use the #2 position, with #3 taking the oth-



# MATERIALS LIST—BUTT-WELDER

- 1 pc. cold rolled steel plate, 8" x 10" x 1/8" (panel)
- 1 pc. 3/4" plywood, 8 1/2" x 10 1/2" or larger to suit parts used (base)
- 2 pcs. 3/4" angle iron 12 1/2" long, cut and welded to form angle brackets (panel braces)
- 2 5/8" stacking of E laminations or strips of silicon steel, 1 3/4" wide as per drawing (transformer core). Angle iron as req. for side brackets
- 1 Struthers-Dunn or similar single pole relay, 115 volt A.C. coil
- 1 small receptacle and attachment plug (grinder motor supply)
- 1 single pole cartridge type fuse block and 10 ampere fuse
- 7 ft. #16 two-wire rubber cord
- 1 attachment cap
- 3 1/2 lbs. (approx.) #18 Formex magnet wire, cut and placed on two separate spools, half on each (transformer primary)
- 4 pcs. about 6 ft. long, Formex rectangular magnet wire, .105 x .165 or larger (transformer secondary)
- 1 pc. of extra flexible insulated wire, #1 size or larger (secondary jumper)
- 4 100 amp. copper solder lugs (secondary terminals)
- 1 pc. copper bus stock, 6/4" x 7/8" x 1/8" cut to make two pieces as req. (secondary terminals)
- 1 4-point Ohmite tap switch and indicating knob
- 2 Micro Switches, 3/16" dia. plungers, common, O and C terminals (control switches)
- 1 pc. flat brass stock, 3/8" x 1/2" x 1/8", bent and cut to fit, (lower switch operating arm)
- 1 pc. brass stock, 1/2" x 1/2" x 1/2" (block fitted to lower end of arm)
- 1 pc. 3/16" steel rod, threaded on end, 10-32 1/4" long, (lower switch adjusting screw). Also 10-32 nut and small compression spring to fit over rod
- 1 indicating radio knob to fit shaft
- 1 small flange type push button, commercial type, (annealing push button)
- 1 pc. mild steel, 4/4" x 3/4" x 1/4". (cut and shaped for inside vertical arm)

- 1 3/4" x 24 cap screw, threads not to run quite up to head, (operating arm shaft)
- 2 3/8" x 24 hex nuts (for shaft)
- 1 pc. 3/4" angle iron, 33/8" long, cut and shaped to form operating arm
- 1 3/8" steel collar to be welded to arm
- 1 10-32 and
- 1 8-32 Allen set screws
- 4 1/2" #20 flathead brass screws, 1 3/4" long (electrode clamping screws)
- 7 1/4" #20 brass hex nuts for same
- 2 steel spacer sleeves 9/16" O.D. 1/4" I.D. 1/2" long- (sliding electrode)
- 1 expansion spring 5/16" O.D. 1 1/8" long, about .043 wire (sliding electrode)
- 1 extension spring 5/16" O.D. 2" long, about .038 wire (vertical arm return spring)
- 1 compression spring 13/32" O.D. 1/2" long, 5 turns .054 wire (attaches to vertical arm)
- 4 pcs. 3/4 x 3/16" angle iron, 2 3/4" long (electrodes)
- 2 pcs. brass stock, 1" x 1/2" x 3/8" (electrode clamps)
- 2 brass thumb screws, 5/16" x 18, 1" long (electrode clamping screws)
- 2 pcs. mild steel, 1 1/2" x 1/2" x 3/8" (annealing clamps)
- 2 10-32 thumb screws 1/2" long (annealing clamping screws)
- 1 pc. steel plate, 3" x 1 1/2" x 1/8" (plate welded to back of sliding electrode)
- 1 pc. steel stock 1 1/2" x 3/8" x 1/8" (electrode stop)
- 2 pcs. Bakelite 3" x 1 1/2" x 1/8" (insulation of fixed electrode)
- 2 Bakelite sleeves 3/8" O.D. 1/2" I.D. 3/8" long (insulation of fixed electrode)
- 1 steel spacer sleeve 3/8" O.D. 1/4" I.D. .002 longer than thickness of panel, (sliding electrode)
- 1 capacitor motor, 1/30 H.P., 1725 speed with 3" fine grit wheel, fitted with switch
- 1 pc. 1/2" plywood 6" x 5 1/2" (motor base)
- Perforated sheet steel as required to box in unit
- Misc. bolts, screws, washers, etc.

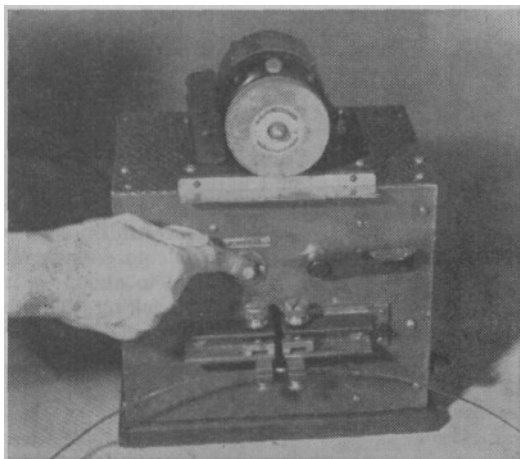


Fig. 2. Annealing is done in the lower clamps, with the selector switch on #1 position. The joint is allowed to reach a bright cherry red.

ers. However, an initial adjustment will have to be made on the small knob at the right side of the unit, which governs the timing of the automatic cut-off switch. Short pieces of blade can be used for a test, until the cut-off switch opens the circuit at the precise moment when the sliding electrode moves to make the weld. If this timing is too late, the blade will be burned off.

If it is too soon, the power will be cut off before proper temperature has been reached. Make adjustments on the knob, clockwise to shorten the timing and counter clockwise to increase it, moving it but the slightest amount, since the Micro Switch, which it operates, moves but a few thousandths from its *on* to its *off* position. After satisfactory adjustment has been made,

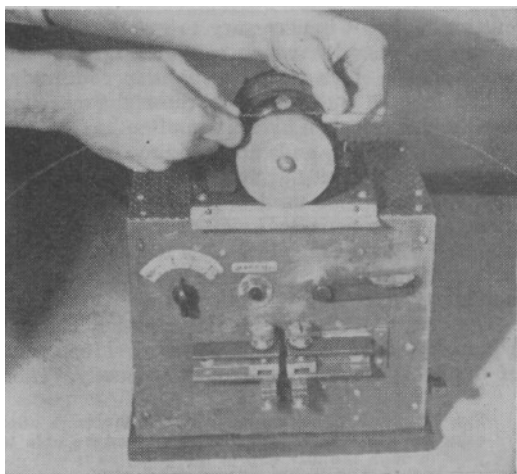


Fig. 3. The grinder provides a chance to grind off the rough edges of the weld at both sides of the blade.



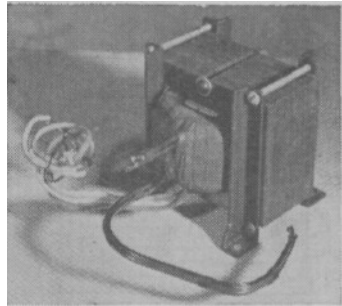


Fig. 10. Completed transformer with side supports of angle iron.

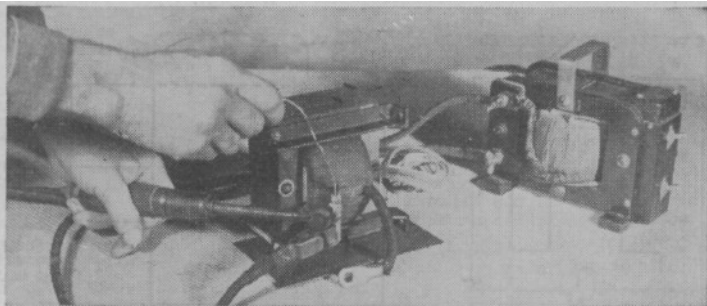


Fig. 11. Use your 6-volt soldering iron transformer to solder the heavy copper lugs to the secondary.

steel, 26 gage, to build up a core (Fig. 7).

### Winding the Coil

Be careful to make the center block of the coil form slightly larger than width and stacking of core, so coil will fit over this leg properly. Block should be about .125 in. shorter than depth of window space so coil will fit down in position just below the ends of the E.

The primary consists of a total of 354 turns of two #18 Formex wires wound on together in parallel, or one #15 can be substituted. Loops are brought out at the 150th and 200th turns, as taps about 8 in. long. Both the taps and the start and finish ends should be equipped with cotton sleeving of different color for identification and added insulation. With a turn of .015 Duro or similar insulating paper over the form block before winding, place another layer over the finished primary, and secure with Scotch tape. All leads must be brought out at one of the narrow sides of the form, or it will not be possible to install the coil on the core later. Then tie up the coil, through the slots provided in the form and remove the sides. Tap out the center block carefully and place four added tie strings around the coil at the four corners, then replace the block for support while the secondary is wound on.

The secondary wire used by the author consisted of four rectangular Formex wires, .105 x .165, laid together, taped lightly at intervals, and wound on as one heavy conductor. Four turns are required and as this wire is quite stiff, it can best be put on by hand. If laminations with a greater window area are on hand, use wire of greater size if possible, but in the case illustrated the finished coil would not have fitted in the core. Start by bending one end of the four strips, which should be cut about 6 ft. long, to 90°, about an inch from the end. This is then tightly tied around and over the insulated primary coil. Wind on the four turns carefully, shaping the wire as you go. The end is also bent and tied to the start with a strong string. This finish end should be cut off with a hacksaw to about an 8 in. length for the present. Later it is cut again to fit correctly up to one of the electrode terminal bolts. Then tightly wind the coil with white cotton coil

tape and dip in insulating baking varnish. After draining, bake it in an oven for 3 to 4 hours at 200-275° F. Lacking oven facilities, dip the coil in air drying insulating varnish and hang up in a warm place for a day or two. Fig. 8 shows the coil after winding, just prior to taping. Strings placed around coil keep secondary in shape; all leads come out at narrow side of coil.

### Stacking the Core

When stacking the core (Fig. 9), place the E pieces in alternate position, so that the butt joints of the preceding layer will be covered by the next. A wooden V block under the coil greatly facilitates this work. Stack the core, in the case of the laminations detailed, to 2.625 in., which, with a center leg of 1.625 in., gives an approximately 4 sq. in. cross-sectional area to the core. Should the width vary somewhat from 1.625 in., the height can be adjusted to give around the same area. Strips cut 1 1/4 in. wide and stacked to about 2 1/4 in. will also give an area close enough to 4 in., if a core of this type is selected. If it is found that the finished coil is too large to fit in between the outside legs of the E laminations, place it in a vise with two blocks of wood and compress it carefully. Usually it is possible to do quite a bit of compressing before the I.D. of the coil is reduced so it will not fit over the center leg, since coil may spring out after removal from form.

Fig. 10 shows the completed transformer with its side brackets of angle iron. Wooden wedges have been driven between the ends of the coil and the core center leg, to tighten the laminations at that point. At the sides of the coil, where it made close contact with the core, thin fiber was used when stacking to avoid having a grounded coil. Solder the heavy copper lugs to the ends of the secondary (Fig. 11) using a six-volt soldering iron transformer. Do this *after* the panel has been finished, so the exact length of the long lead can be determined by fitting. Solder one lug to the bent end of start of winding, as close as possible to coil, taking care to clean off insulation well. To this lug, bolt one end of the lug-equipped heavy jumper of #1 flexible cable. Place a short piece of large sleeving over the long lead before attaching the lug.

The panel (Fig. 13) is made of a piece of .125 in. steel plate, attached in a vertical position with two side brackets to a  $\frac{3}{4}$  in. plywood base. Two clamp-type electrodes are used on the panel (Fig. 14). The right hand one is insulated and is fixed (Fig. 15), while the other is not insulated and is made to slide about .063 in., by slightly slotting the bolt holes (Fig. 16). The bolts of the sliding member are equipped with short steel sleeves, which are cut about .002 longer than the thickness of the panel. The slotted holes are made a close but free fit for these sleeves. In this way, it is possible to tighten the nuts at the back of the panel and yet allow the piece to slide freely. A coiled spring is fitted to keep this part back against the stop on the front of the panel (Fig. 16), which is placed in position so as to limit the sliding motion to about .063 in.

The main operating lever (Fig. 18A) is at-

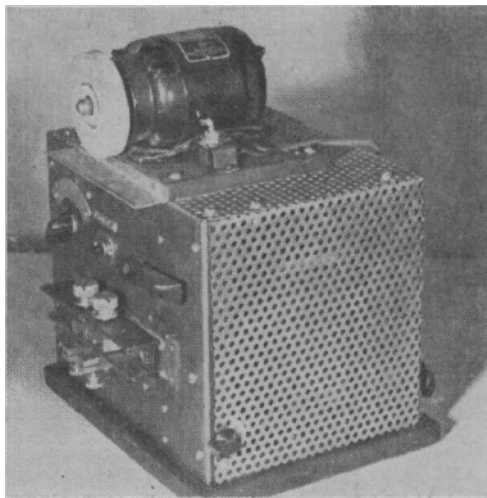
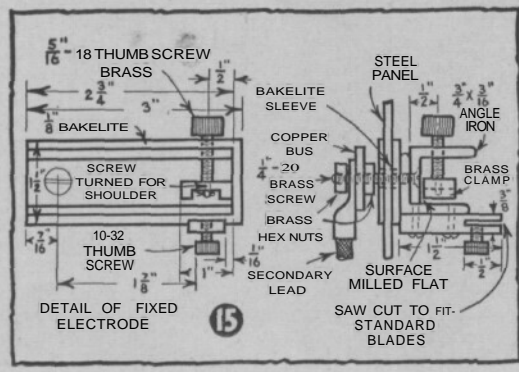
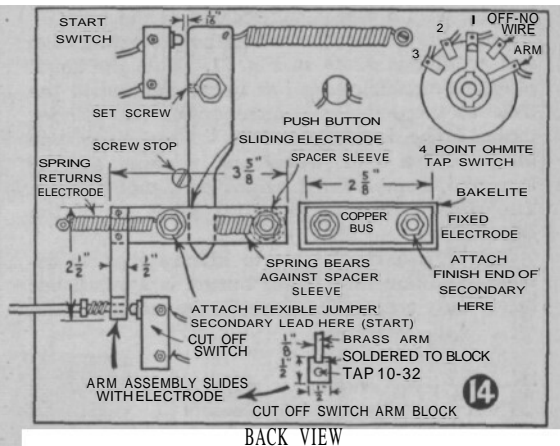
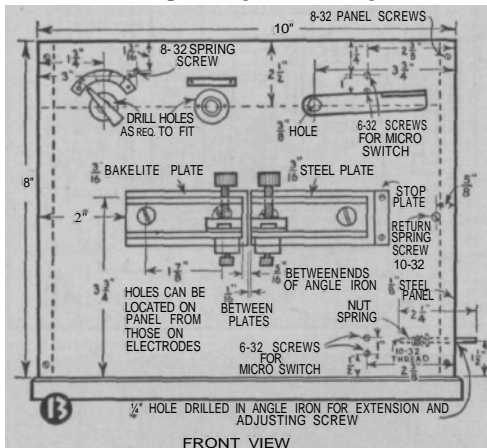


Fig. 12. A right side view shows the adjusting knob, which regulates the timing of the weld.

tached to a .375 in. x 24 cap screw (Fig. 18B) which is used as a shaft through the panel. On the back side a vertical lever (Fig. 18C) is secured to the shaft so it will be moved by the first one. A short but quite heavy compression spring is secured to the lever with a single screw in the center which bears against a steel spacer sleeve on one of the bolts (Fig. 14). This spring causes the compression of the ends of the blade after heat has melted the steel. Another coiled spring (Fig. 14) is used at the top of the lever to return it to its original position.

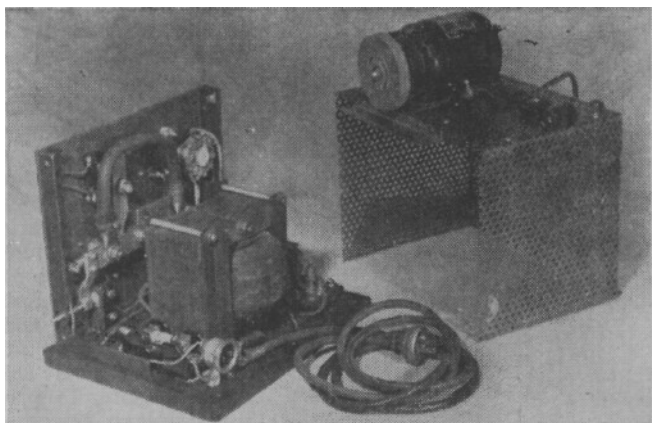
A Micro Switch has been placed so that movement of the inside lever will compress its plunger. These switches have three terminals with one common so that they may be connected either as normally open or normally closed switches. This one should be a normally open switch. Another switch is placed in a lower



position with an arm attached to the copper bus bar and an adjusting screw bearing against its plunger. This one is a normally closed switch. The switches are connected in series and connect the line to the coil of the relay (Fig. 19). In operation, pressing down on the lever causes the top switch to close and, since the lower one is already closed, a current flows through the relay coil. The relay contacts close and send a heavy current of low voltage to the welder electrode clamps. With the ends of the blade preventing the sliding electrode from moving, current flows until the steel has become plastic, then, with the sliding of the movable electrode, the lower switch contacts are opened, which re-





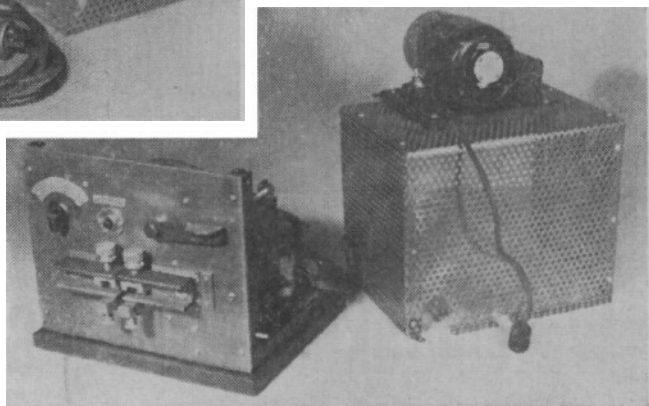


**Fig. 21. A view of the completed job, with the protecting cage removed. The small receptacle at the lower left supplies the grinder motor.**

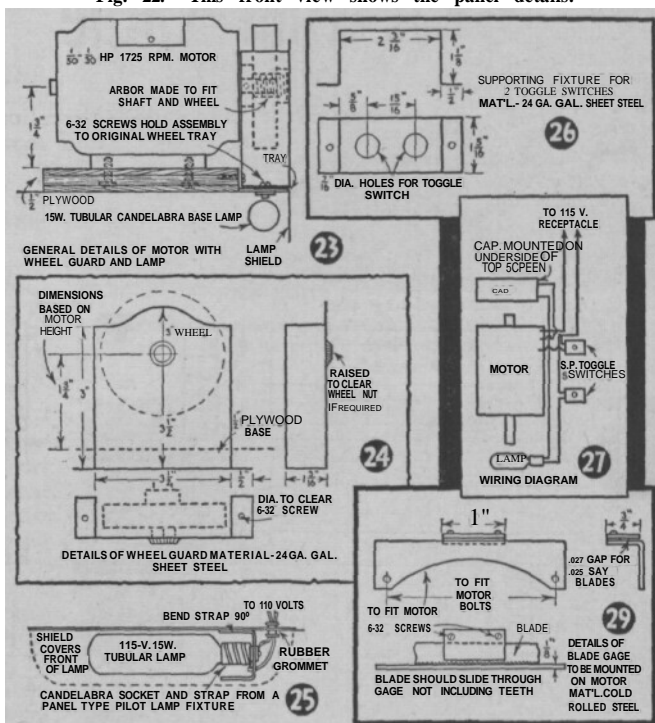
The welder can be dressed up further and at the same time made more convenient to use by enclosing the grinding wheel for better safety and adding a light over the electrodes, so better vision is assured for placing the ends of blades (Fig. 23). A third addition is a gage placed on the front end of the motor, to test the welded joint for thickness after grinding.

The wheel guard (Fig. 24) is made from heavy galvanized sheet steel, bent up as shown and attached to the tray under the wheel with two 6-32 screws. To the underside of the tray is attached a candelabra base socket to take a 15 watt 115 volt tubular lamp (Fig. 25). The socket was taken from a panel type pilot lamp fixture and consists of a screw shell attached to a metal strap, bent to fit as shown. Two small screws and nuts hold the socket to the tray, through drilled holes in the strip and the tray. Wires soldered to the terminals of the socket are carried to the wiring at the side of the motor where the single toggle switch is replaced with two switches on a new wider support (Fig. 26). Thus a switch is provided for the motor and another for the lamp. The lamp wires are spliced to one side of the 115 volt line and one terminal of the new switch. A short jumper connects the other side of the switch to the other side of the line. The wiring diagram shows these connections in detail (Fig. 27).

The next step is to make a front shield for the lamp, and some of the same galvanized steel is used. In Fig. 28 this shield is shown removed to get a view of the lamp assembly. To the tabs on



**Fig. 22. This front view shows the panel details.**



a spacer of .027 between. Since standard blades are .025 in thickness, this allows .002 clearance. All blades after grinding should be able to pass through this gage (Fig. 1A.).