sodium dichromate solution for 5 to 10 minutes at room temperatures. This solution is made by dissolving 0.1 gallon of sulphuric (66°Bé.) and 1.1 pounds sodium dichromate in 1 gallon of water. For unscaled monel, use 1 gallon of water, 1.5 gallons of sulphuric acid (66°Bé.), 2.2 gallons of nitric acid (38°Bé.), cool, and add 0.2 pound sodium chloride.

Welding.—Monel metal welds readily by gas or electric method. Monel rods should be used. Welding tip should be one size larger than for steel. An electric welding flux has been specially developed. Monel metal rods make a machinable weld on cast iron. Monel metal is easily soldered and brazed; clear surfaces are necessary.

Drawing and Punching.—Reduction of diameter and depth of draw are about as for steel, but corners of dies should have a larger radius to prevent tearing. Metal is "sticky" and tends to adhere to soft dies. The diameter of the first cup is usually about two-thirds that of the blank. Reduction of 30 per cent in gage may be had in one draw with slight reduction in diameter. Clearances are usually greater than for steel; runs 0.010 to 0.015 inch on metal from 0.1021 to 0.078 inch. Greater power required than with steel. Proper adjustment of pressure plate and blank holder prevents wrinkling. Anneal at 1400 degrees between draws. Punches are designed about 75 per cent stronger than for steel, with same clearance angles.

Spinning.—Owing to toughness, monel metal is harder to spin than copper, brass, steel, or silver and requires more frequent annealing. Spinning tools should be brass, bronze, wood, or tool steel, not soft steel. Lubricate with tallow. No change necessary from ordinary speed of lathe.

Nichrome

Nichrome is a trade name for a specific mixture of nickel and chromium. It retains strength at high heats and resists continued or repeated exposure to heat, as in annealing and carburizing boxes; it also resists nitric, hydrochloric, and sulphuric acids. Its properties are:

Tensile strength	64,000 pounds
Elongation in 2 inches	3½ per cent
Reduction in area	2 per cent
Melting point	2500°F.
Specific gravity	8.06
Weight per cubic inch (cast)	0.29 pound
Brinell hardness	157–187
Rockwell hardness	B-83–94
Scleroscope hardness	30

Nichrome welds readily by arc or flame. Preheating is necessary and the weld surface must be clean. Flux is needed in flame welding, but not in arc. Nichrome cannot be cut successfully with a torch, because it does not oxidize readily; a hack or cold saw is better and cheaper.

Nichrome castings can be machined readily with any good high-speed cutting steel at a speed of about 18 feet per minute. Because of the toughness of the alloy, the tools must be ground with special angles. These particular angles have been worked out, and Fig. 16 shows how tools should be ground for machining and threading Nichrome and Cimet castings.

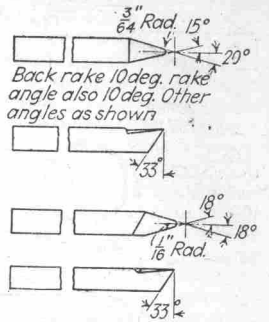

FIG. 16.—Tools for Nichrome

Machining Aluminum and Its Alloys

Successful machining of aluminum and its alloys requires different tools than for steel and free-cutting brass. The tools should have appreciably more side and top rake than the tools for cutting steel; they should have very keen edges supplemented by hand stoning with an oilstone and used with suitable cutting compounds.

Except for aluminum alloys high in silicon content, carbon steel and high-speed steel tools may be used satisfactorily. Carbon steel tools may generally be maintained with a keener cutting edge. Cemented tungsten carbide tools are necessary for machining the high-silicon alloys, notably "Lo-Ex" No. 132 piston alloy. Carbide tools are also superior to carbon and high-speed steel tools in production because keen edges are maintained over long periods without regrinding. Diamond tools are often used for boring holes where a fine, accurate finish is desirable, such as piston pin holes.

Cutting Speeds.—Aluminum can be machined best by using high speeds and fine to medium feeds. Surface speeds from 500 to 800 feet per minute are possible under some conditions with ordinary carbon steel tools, and appreciably higher speeds with high-speed steel and carbide tools. The feed may vary from ¼ inch for roughing cuts to a few thousandths for finishing cuts. An increase in the amount of metal removed from the stock can often be obtained to better advantage by increasing the speed rather than the feed. The work should be cooled before calipering and finishing to size.

Cutting Lubricants.—For many purposes a soluble cutting oil is good. Ordinary carbon oil or kerosene will often serve but works better when mixed with lard oil, usually in equal parts. For heavy cuts and slow feeds, such as in roughing work or tapping, pure lard oil is good. Cutting compounds of paraffin oil are unsatisfactory. For milling, sawing, and drilling, the soluble cutting oils are satisfactory and more economical than kerosene or kerosene and lard oil lubricants.

Lathe Tools.—Using the round-nosed tool, Fig. 17, the tool should be set to have proper clearance and not curl the chip more than necessary. Before finishing with the tool, its edge should be whetstoned. Set the tool considerably higher on the work than when machining brass or steel, preferably on a diameter of the work, making an angle of 45 degrees with the horizontal. The tool shown