

HARDENING and TEMPERING

Beginner's Workshop

GEOMETER discusses the merits of various metals and their uses

ABILITY to cut metals and resistance to wear are characteristics of certain steels which it is often essential to exploit, either for cutting tools or special components.

Making a choice, one is guided by the following in regard to the three main groups of steels: (1) mild steels will not harden of themselves, but require case-hardening; (2) carbon steels will harden in water and temper to colour, and may be used for a variety of tools and components; (3) alloy steels require special heat treatment appropriate to their composition and purpose, otherwise they may not prove satisfactory-though properly treated they may be superior to carbon steels.

Mild steel saws and files easily and, heated to red and quenched in water, remains soft. Carbon steel is more difficult to saw and harder to file than mild steel, and heating to red and quenching in water hardens it, while reheating and slow cooling softens it, so it can again be sawn and filed. Alloy steel may be as hard as, or harder than, carbon steel to saw and file., and heated to red and cooled, even in air or oil, may become as hard as carbon steel cooled in water, while reheating and slow cooling may prove ineffective for softening.

Thus, an unknown bar may be sawn, filed, and have pieces cut off for testing the effect of heating and various methods of cooling to ascertain its suitability for a purpose.

Heating and quenching

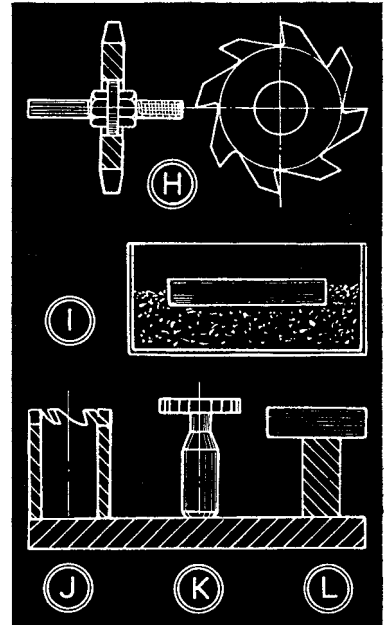
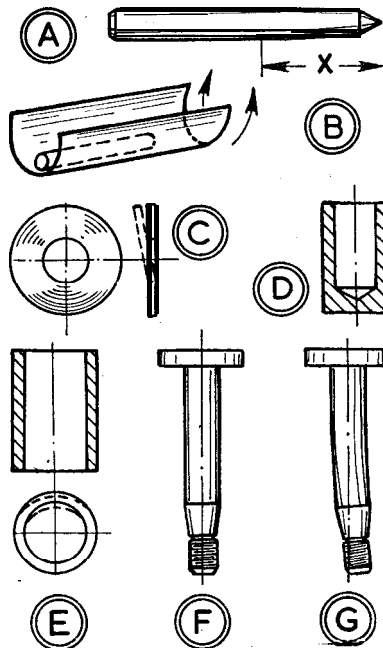
When obtaining steel for hardening and tempering, however, the choice should be cast steel or silver-steel-both carbon steels, the latter of better quality and in ground rods and round bars, and different-sized square and flat sections. Rods and round bars in particular are very accurate to size, and for many purposes can be used as bought, while cast steel generally requires turning.

Hardening temperatures vary between 1,380 and 1,520 deg. F. (750 to 825 deg. C.), which is covered by a cherry red colour of the steel. This is more than a dull red? but less than a very bright red verging into orange. Quenching water temperature is gener-

ally that of a room, that is, between 50 and 80 deg. F.

Any convenient means of heating can be employed-a blowlamp or fire and, depending on the type of tool or component and the hardening required, heating can be local or complete. A centre punch **A**, for example, made from silver steel rod, need only be heated in the length "X" towards the point, leaving the shank and end soft. Alternatively, as for another tool or component, it could be wholly heated and hardened. Heating should in any case be uniform on the portion where hardening is required, and the tool or component twisted and turned in the flame, using pliers or a wire wrapped round; or heated completely on a bed of cinders in a brick hearth or metal container.

When parts are small, or a flame is fierce, overheating of thin sections or cutting edges may result. Holding and rolling in a sheet metal guard **B** then affords protection and even heating. To avoid distortion in quenching, a flat object like a washer **C** should be plunged edgewise in the



water and a hollow component **D** with the blank end down to avoid trapping steam. A sleeve **E** is also best quenched vertically, as is a shaft **F** or bending may result-as **G**. Large parts should be raised and lowered and moved about in the water until cold.

Tempering

Colour range for tempering is light straw for fine tools to dark brown for shock tools like chisels-seen when reheating after polishing with emery cloth, at which colours the tools are quenched in water. The cutting edge should be the correct colour, though the shank of the tool may be soft.

For uniform tempering from the centre, a circular cutter **H** can be fitted with a tight washer and stud-heated each end in a flame. A tin of sand **Z** on a stove provides for overall tempering; and a soft body or shank and tempered teeth can be achieved, **J** and **K**, on a hot plate (electric or over a stove) while certain tools can be conveniently laid on a block **L** for the heat to rise. **EI**