HARDENING AND TEMPERING TOOLS.

In the case of cutting, shearing, stamping, drawing, and similar tools that have to be hardened to enable them to deal with sheet metals, it is necessary to exercise special care in heating them to the required temperature before they are plunged into the water bath for cooling. The careful and uniform heating applies to all hardening, more or less, but it is of particular importance in the case of expensive dies or punches. The principal point is to watch that the tool be heated as gradually as possible, and too much stress cannot be placed upon the importance of care in hardening. It is not unusual to see a blacksmith or a toolmaker place a large die into a fire, heat one side red-hot, whilst the other side is nearly cold, he will next turn the die round and heat that side which was cold, whilst that which was red-hot will get nearly cold again. There are now special gas stoves that may be used, and properly constructed muffles may also be erected and fed by the application of fine slack, which will do useful work in heating tools for hardening. Where neither of these are handy it is possible to heat a tool properly in a breeze fire, providng that the fire is large enough for the purpose, but it is useless trying to heat tools uniformly in a small fire. First blow up a fairly large fire, then introduce the die, and, covering the die with red-hot breeze, blow the fire very gently until the die

has a thorough gentle soaking. The greatest trouble with which the toolmaker has to contend in hardening his tools is the risk of their splitting, cracking, or warping. The cause of these troubles is generally the cooling and contraction of the various portions of the tool at different rates. To avoid this cracking and warping it is important that the tool be uniformly heated and as uniformly cooled as possible. In the case of dies, all screw, dowel, or gauge-pin holes in them should be filled with clay during the process of hardening. When quenching the tool plunge it straight down into the water, holding it stationary for a minute or so, then move it slowly about, keeping it perpendicular all the time. Do not use any of the so-called special hardening mixtures or fluids, as they are practically worthless for tools. Use a plentiful supply of fresh clean water and brine, or rain water and brine, then, when you meet with a brand or steel that cannot be hardened by heating to a cherry-red and quenching in cold clean water, treat it as useless for tools and at once dispense with it. Tools such as drawing or extending dies, where the hole is required to be perfectly hard for its whole depth or length, the cooling of the central portion of the die may be assisted by directing a powerful jet of water through the hole in the die. An ordinary cutting-out bed or die is usually quenched by being plunged into a tank filled with clean water and the die held under the water until it is quite cold, when it may be removed, have its face cleaned or ground bright. It may then be tempered by being placed upon a flat piece of red-hot iron.

Very large dies may be heated for tempering either in a muffle or over a breeze fire. In all cases the slower

and more uniformly the change of color appears the more reliable will be the results from the tools. In tools for turning, planing, and shaping, chipping chisels, drills, and many varieties of cutting-out punches, where it is not necessary to have the tool hardened for the whole of its length, the hardening may be readily done at one heating. The following explanation of hardening and tempering a chipping chisel will serve to illustrate how this is accomplished:

The chisel, Fig. 198, being held by its head H in a pair of tongs, is placed into the fire for about one-third its length A B, and carefully heated to a cherry-red, care being taken that the extreme end E of the chisel

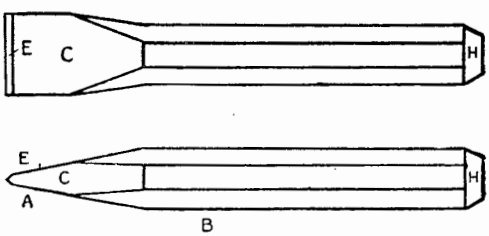

Fig. 198.

does not become overheated. If the chisel is very thin the end E should be cooled by dipping it into water once or twice during the time that the chisel is being heated. After it has been heated to the required temperature it is dipped into the water for a portion of its length, according to the size of the chisel this may vary from ¾ to 1½ inches, and held in the water until cold, then remove the chisel, and brighten the hardened portion C by rubbing with a piece of stone or emery cloth. The heat will now travel from the unquenched portion

to the quenched portion. The change of color is watched as it travels along from B to A, until the required color appears at the cutting end E, when the chisel is again plunged into the water bath, this time the whole of it will be quenched. This method can be applied to any tools to be hardened at their ends only, but it must be understood that the nature of the work to be operated upon may necessitate the tool being brough down in temperature to a totally different color. For instance, turning tools, dark straw or yellow color, 450 degrees temperature, cutting-out punches for sheet steel, very dark straw or yellow, 490 degrees temperature; cold chisel for chipping cast iron, dark purple color, 550 degrees temperature.

It should be noted that when chisels, drills, or turning tools are being forged, it is advisable to hammer them until the steel has become quite cold, as this hammering gives toughness and fineness of texture, it may then be re-heated for the purpose of hardening. Taps and reamers are sometimes covered with a mixture of Castile soap and lampblack, to preserve their cutting edges, and to prevent them being burnt whilst being heated for hardening. This class of tools may also be heated in a wrought-iron pipe filled with charcoal dust, the ends being plugged with clay. This method generally results in the taps or reamers being heated uniformly, and they are afterwards dipped into water in a vertical position, and held there until cold.

Circular milling cutters may be covered with Castile soap and lampblack with advantage, and the hole of the cutter plugged up with clay, this preserves the center, which is not usually required to be hard. The tools are generally slightly warmed before the mix-

ture of Castile soap and lampblack is applied, and a circular cutter should be plunged into the water bath edgeways. The tempering of a tap or reamer is usually done by introducing it into a cast-iron or wrought-iron collar, which has been made red-hot, the tool is held in a pair of tongs, and passed along the center of the hole. At the same time it assists matters if the tool is rotated whilst being moved along, as the continual change of position prevents one portion becoming hotter than another, and results in a more even temper. Taps, reamers, milling cutters, and similar tools are generally tempered to a light brown color, and quenched in oil.

Small punches from 1/16 to ½ inch diameter, and dies from ¼ to 1 inch diameter, are best heated in a wrought-iron pipe about 12 inches long and 2 inches in diameter, with one end closed. This may be done by welding a wrought-iron plug in one end of the pipe. The small punches or dies are placed in the pipe, which is, in turn, thrust into the breeze fire. This method gives much better results than can be obtained when the flame of a fire is allowed to come in contact with such small tools. When the punches or beds, as the case may be, are sufficiently heated the pipe is removed from the fire, and the tools tipped into a bucket of clean water containing a handful of common salt. Tools hardened in this manner will be found to be quite clean, and ready for tempering. This may be readily done by placing the tools upon a wrought-iron plate, say 12 inches square by ⅛ inch thick, heated over a gas stove, the small round punches should be rolled over the hot plate until the required color appears, while small dies are best placed endways on the plate.