

trol panels involving high voltage (more than 550 volts) should be completely enclosed. Doors should have locks and contacts wired in the control circuit to short circuit the capacitors when door or panel is opened. A manually operated switch will serve as an additional safety measure, assuring complete discharge of the capacitors.

- 4 Back doors of machines and panels should be kept locked or interlocked to prevent tampering.
- 5 A fused safety switch or circuit breaker should be located conveniently near the welding machine so that power supply circuits may be opened before a man services the machine and its controls.
- 6 The point-of-operation hazard should be eliminated by suitable guards. Enclosure guards, gate guards, two-hand controls, and similar standard guards as designed for punch press operations are applicable.
- 7 A flash welding machine should have a shield or hood to control flash and fumes, and a ventilating system to carry off the metallic dust and oil fumes.
- 8 Where flying sparks are not confined, the operators and nearby persons should be protected by shields of safety glass or other transparent material.
- 9 Foot switches, air or electrical, should be guarded to prevent accidental operation.

Arc Welding and Cutting

Arc welding is a process for joining metals by heating with an electric arc or arcs with or without the application of pressure and with or without the use of filler metal. The process includes shielded welding which uses gas or a solid flux to blanket the weld. Arc welding is used to fabricate nearly all types of carbon or alloy steels, the common nonferrous metals, and is indispensable in the repair and reclamation of metallic machine parts.

Arc cutting is used only for rough cuts or for scrapping because of the unevenness of the cut obtained. It has been used for underwater cutting in salvaging operations. Oxy-

arc or arc-oxygen cutting is used for finer cutting and is especially useful for cutting metals that do not oxidize readily.

For arc welding or cutting, two welding leads, the electrode lead and the work lead, are required from the source of current supply. Usually, one lead is connected to the work and the other to the electrode holder. The work lead (cable) is the most satisfactory means of providing the return (ground) circuit to the welding machine (Fig 31-6), but in some cases operating conditions may require the use of a grounded steel structure.

Power supply

Either AC or DC may be used for arc welding or cutting of any kind, including carbon arc cutting and cutting with heavily coated electrodes. With small diameter electrodes used on thin sheets for manual arc welding, current values vary from 10 to 50 amp. For most manual welding, because the welder must withstand the heat, current values should not exceed 500 or 600 amp.

Automatic machine arc welding may use current values up to 200 amp or even higher on special applications. Such operations employ AC only for more than 500 to 600 amp because with AC "arc blow" (swerving of the arc path caused by magnetic forces) is almost completely absent. Arc blow is especially detrimental when higher current values are used.

Converters

Commercial AC and DC power supplies are not suitable for arc welding. Consequently, to convert commercial power for arc welding, a rectifier must be used for DC welding, and a transformer for AC welding. A motor generator may also be used to produce alternating or direct current.

Since these welding converters are subject to abuse and are given little expert attention as compared to ordinary electrical equipment, they should be well protected, both mechanically and electrically. Often the machines are moved about, so convenient primary power receptacles should be provided about the shop or construction operation. Plugs and receptacles should meet the requirements of Underwriters' Laboratories, Inc.

AC transformers for welding are usually