Melting down metals and pouring them into molds to set in the shape of the mold is one of the earliest of man’s technological advances. Today this ‘founding’ process is one of the major manufacturing techniques in industry, and basically it has changed little from those somewhat primitive operations of several hundred years ago.

Strictly speaking foundry practice relates to any melting and pouring operation be it metallic or otherwise, but today the term is generally used to describe those industrial activities where component parts of various shapes, sizes and composition are made by the pouring of molten metal into molds. Mold designs have become very sophisticated to permit the casting of precisely dimensioned parts in clusters to achieve high production rates through multiple casting methods. Foundry work also involves single castings weighing several tons, but in all cases the basic process is similar.

However, in providing human operators with a distasteful environment, foundry operations are among the most offensive activities, with noise, noxious fumes, splashing from molten metal and heavy moving machinery all affecting personal safety, health and the quality of life of all concerned. Yet the foundry industry ranks sixth in the USA on the basis of value added to the raw material by the operations performed on it. Dependent upon it are automobiles, farm machinery, mining, and equipment of all forms.

The casting process

In common with many other industries the need to improve the profitability of foundry operations is now imperative to combat competition, and if this is to be done without further impairing the working conditions for human operators, automation of some kind is essential. This does not represent a new departure on the part of management since the industry has always made use of specialized equipment such as manipulators to lighten the task of the operators.

The work of a foundry is not limited simply to melting down the metal, pouring it into a mold and then extracting the casting from the mold when it has solidified. The complete foundry operation extends
to the removal of any unwanted parts of the casting (such as risers, gates and sprues — see Chapter 10 on die casting), and then finishing the part to specified dimensions, usually by a grinding process. Much of what goes on in a foundry requires eyesight, judgement and decision-making based on long experience. These qualities are not readily replaced by automation although much has been achieved with manipulators guided by human operators who use their skills at a more remote point, away from the dangers and unpleasantness while the machine provides the muscle power needed to move a heavy casting.

But even with these aids the foundry is not an attractive place to work, and there is a dearth of good operators in the industry. This has resulted in serious attempts to bring the robot into this workplace with a good deal of success, but there is little doubt that these are early days and the penetration by robots is still to come, as it surely will.

The process of casting involves four main steps; heating the metal until it is molten, pouring it into a mold, removing the charge of metal from the mold when it has cooled sufficiently and finally cleaning up and finishing the part by removing unwanted flash, oxidation products and excess metal. Whether the casting weighs four ounces or four tons, the procedure is the same; only the way in which the operations are carried out differs.

Over the past decade quite significant advances have been made in the technology of casting. Modern electric furnaces are cleaner and permit closer temperature control over the charge of metal. Mechanization of various sorts has been introduced along the molding lines — it should be noted that a single ladle charge may be sufficient to make several castings, requiring the ladle to be moved along a line of molds. Also automation has been applied to the pouring of the metal and subsequent operations.

Molds are generally made of sand. The mold, in two parts which mate together leaving an entry hole for the metallic charge plus some orifices to allow air to escape, is often made under high pressure, so that the sand is very tightly compacted. Very often the surfaces of the mold which are to be in contact with the molten metal are sprayed with a ‘die ease’ compound, typically a graphite-kerosene mixture. This may be baked on to the surface by raising the surface temperature to about 500 degrees. The use of such a spray is very important in intricate, shaped areas, the purpose being to insure that the cooled casting comes cleanly away from the mold.

When the metal is poured into the mold, good foundry practice requires that the charge flows cleanly into the sprue and that the flow-rate is such that the sprue never overflows. Furthermore, for a good homogeneous casting, the level of molten metal in the sprue should be constant throughout the pouring operation. This is not easy to achieve, especially with very heavy ladles. In some castings,