CHAPTER I

INTRODUCTION

The subject of explosive forming of metals has evoked a great interest in the industry as well as in the research laboratory because of its very attractive features. Large components which are beyond the capabilities of the conventional processes can be formed by this explosive forming technique economically. Intricate shapes and materials of low formability can be worked fairly easily. The aerospace industries were probably the first ones to employ this technique successfully, but the range of user industries now has considerably widened. The scope and the capability of the method has grown enormously side by side and itts becoming increasingly urgent to understand the mechanics of the process well.

The energy released by the detonation of chemical explosives is used for the forming of metals. The energy release occurs in a few microseconds and this energy is imparted as kinetic energy to the work piece, which is clamped adequately. The workpiece absorbs the kinetic energy as it is brought to standstill and results in an useful deformation. Since high speeds of motion are involved in the process, inertia forces play an important role. Yet another complication due to the high speed of deformation is the factor of high strain rate. Material properties are known to be sensitive to strain rate of deformation and so also its impact on the formability.

Energy sources other than explosives, like a bank of high voltage capacitors which can store electrical energy and quickly release it, have been employed in cases where the requirement of energy is small. Explosives, however, have remained the only source of energy for large applications, primarily because of their economic advantages.

The energy of the explosive may be directly transmitted to the workpiece to be formed, with comparatively small losses, if the explosive is in contact with the workpiece. However, in most successful applications of the explosive forming technique, the energy is transmitted to the workpiece through the medium of either air or water.

In the underwater firing of the explosives, roughly fifty percent of the total energy is released as a spherically expanding shock wave energy, and only a small portion of this, equal to the solid angle subtended by the charge on the workpiece, can be utilized for the metal forming. Marginal increase in the utilization of the shock wave energy can be obtained by placing proper reflectors close to the charge directed towards the workpiece. The remaining energy released by the explosive is associated with the motion of a gas bubble formed due to the detonation. Recently it has been possible to utilize some of this energy associated with the bubble motion for the purpose of metal forming. By creating proper conditions during the collapse of the bubble, the collapse is made asymmetrical. Such an asymmetrical collapse results in the formation of a fluid jet which pierces the bubble and strikes the object to be deformed. The resulting nature of the deformation is basically different from that of the shock wave deformation. For example, metallic diaphragms have been formed to round shapes by this bubble collapse, as compared to the conical shapes which are obtained in forming with the shock waves. The process of involution of the bubble and the formation of the fluid jet is similar to that which occurs in the cavitation damage of hydraulic machinery.

The current interest in the subject is centered around the analytical investigations of the behaviour of diaphragms, rings, and shells etc. under the dynamic loading and the practical methods of forming different shapes, with or without dies. Trial-and-error methods employed for explosive forming of various components are being progressively replaced by methods based on the theoretical analysis. Efforts are being madeto make the process safer and usable under ordinary shop conditions. Studies are in progress on the behaviour of the materials at high strain rates of deformation as well as on the effects of high velocity deformation on the metal properties like corrosion, fatigue etc.