SYNOPSIS

This thesis consists of five chapters. In chapter I, the problem of initial stress has been analysed. The limitations of the existing theories of isotropic elasticity gave rise to the need for an altogether new approach to the problem. Consequently hypo-elasticity, a new theory of elastic response based on time rates, was proposed in 1955 by Truesdell[14]. Details of its formulation are given here to show that the theory is dynamically sound. Its main features have also been described. The relations of hypo-elasticity to other theories of elasticity and plasticity have been shown. That this new theory in some cases predicts yield without assuming an yield condition indicates its strength and potential relevance. Later in this chapter, we have described fluent bodies recently introduced by Walter Noll[18] as a special type of 'hygrosteric materials'. The diagram to show various special cases, especially hypo-elastic bodies is also attached.

In chapter II, we have discussed the problem of 'hypo-elastic flexure' for hypo-elastic materials of grade zero. The exact solution of the constitutive equations, consistent with the equations of mass and motion and the boundary conditions, has been obtained

without assuming any particular form of the stress-strain relation. When compared with those obtained by Seth[34] after assuming the linear stress-strain relation and with those obtained by Ericksen[35] after using the strain energy function, our results happen to be similar to theirs. In hypo-elasticity no particular form of the stress-strain relation is assumed. It is rather the outcome of definite assumptions regarding the motion. It depends on the manner in which the stress is applied in time.

In chapter III, the following problems have been discussed:

    (i)   Solid rotating shaft,

    (ii) Hollow rotating shaft,

    (iii) Spherical shell.

Here also the results happen to be similar to those obtained by Seth[23].

In chapter IV, a few applications of hypo-elasticity to plasticity have been given in the following cases:

    (i)   Rotating shaft,

    (ii) Combined tension and torsion of a cylindrical tube,

    (iii) Pure shear.

The comparison of the results with those of theories of finite strain and plasticity becomes quite interesting.

In chapter V, the comparison of hypo-elastic bodies with fluent ones has been drawn. Taking linear fluent material as defined by Noll[18], we have solved the problem of steady flow past a fixed sphere.

In the end, we have given a few suggestions for further work on the subject in addition to the concluding remarks.