# INTRODUCTION

The application of solutions and melts of macromolecular materials in almost all branches of industries requires a very carfeul investigation of the mechanical properties of these materials . The last half of the present century has seen an immense development of highly sophisticated theories which describe the non-linear (non-Newtonian) behaviors of such types of materials. Some of these theories are based on microscopic models [2,3], where special types of statistics, termed conformation statistics [4] , are employed in order to determine the macroscopic mechanical properties .Other theories are based on phenomenological equations of state [5] . In the present work , the constitutive equation based on the retarded motion approximation up to the fluid of grade two is used .

All non-linear theories of constitutive equation , whether macroscopic or microscopic , result in the specification of a set of parameters which characterize the properties of the fluid under consideration . The fluid of grade two is characterized by three parameters ; namely the coefficient of viscosity , $\mu$ , and the two elastic constants $\alpha_1$ and $\alpha_2$ which are related to the two normal stress differences $(S_{22}-S_{11})$, $(S_{11}-S_{33})$ . The determination of these

material parameters is done using proper devices , known as rheometers and the branch which is concerned with such measurements is termed rheometry .

In general , the rheometer is based on the solution of a specific boundary value problem which allow a number of experimental measurements sufficient to determine a specific set of material parameters . The conventional rheometers based on the realization of either steady or periodic viscometric flow are not capable to determine the non-Newtonian properties of fluids . For this reason ,one of the major purposes of rheology is to investigate further types of flow other than viscometric flow , which allows the determination of some of the non-Newtonian properties of fluids.

It is worthy to mention that about 25 years ago [6] the force and the torque acting on a sphere which undergoes simultaneous rotational and translational creeping motion in a fluid delivers nearly complete characterization of an incompressible fluid,at least up to third order .However ,the practical realization of a corresponding device has never been carried out .

About 20 years ago Walters et al [7] designed special device consisting of two eccentric cylinders where both