INTRODUCTION

Rigidity is one of the most important considerations in machine tool design. Vibrations and 'elastic deflection errors' are related to this factor. In the present discussion, the author has dealt with the 'elastic deflection errors' only.

A rigid construction reduces the deflection magnitudes in the different machine tool units, that they undergo in time of machining due to the various forces developed. This helps in providing higher dimensional and form accuracies on the machined components. But the designer, in the absence of sufficient scientific investigations in this direction, has to rely mostly on his previous experience and knowledge of the working of similar models. Some research workers in this field have made valuable contributions, but the work done so far is not adequate to meet the requirements of the machine tool industry. This work is presented here in the hope that it might make an humble contribution to the advancement of knowledge in this field.

The work presents a new approach to the problem of 'elastic deflection errors'. While the basic approach is applicable to all the different types of machine tools, the present volume deals with the different cases of 'turning on lathe' and 'facing on lathe'.

The work starts with a basic theoretical analysis of the effect of rigidity in general on machining accuracy ~~in general.~~ In order to apply these general equations to specific cases of turning and facing on lathe, first a study of each set up is made as to how the various forces act and vary in time of machining. Then the rigidity characteristics of the different units, giving rise to elastic deflection errors, are found out in a special way. Experiments have been carried out for the purpose.

Theoretical analyses are then made with the help of the above information, making use of the general analysis. Equations have been formed, based on which theoretical deflection-error curves have been drawn for a few cases. Then taking some practical magnitudes of rigidities and machining forces, etc., deflection-errors have been calculated for some cases. On the basis of these analyses, some suggestions have been made to the designers and users of machine tools for higher machining efficiency.

In the end, a general method of carrying out 'performance tests for deflection-errors', in different machining operations on different machines, is given. The test-results for one case of 'turning on centres' are explained with the help of theoretical analyses.

The work opens out a field for further research, which, it is hoped, when explored, will be useful to the industry. The present discussion is limited to 'lathe' only; but the 'method of investigation', which has been used here, has great potentialities. For example, machining setups on other machine tools could be similarly investigated. This approach should prove a useful means for evolving standards for 'Rigidity Testing of Machine Tools'. This is a big problem in itself, requiring the joint effort of a large number of workers in the field.

A very promising opening appears to be in development of radically new designs of machine tools, making effective use of 'negative rigidity'. The author has already made some progress in that direction and hopes that it will lead to less massive and more efficient machine tools. A brief discussion on a new design-idea of 'effective rigidity controlled machine-tools' has been given in the Appendix (p. 144).