CHAPTER I

INTRODUCTION

When studying any metal cutting process, measurement of the cutting forces involved is of prime importance since these determine the horsepower required of the machine tool.

Thus when changes are made in tool angles, tool material, workpiece material, speed, feed, depth of cut or any other cutting parameter, the effect on cutting force is usually required.

A variety of machine tool dynamometers have been developed to measure forces on cutting tools, such as grinding dynamometers, milling dynamometers, shaping dynamometers and lathe dynamometers.

In general, unless some feed-back mechanism is used, a force measurement actually involves the measurement of a deflection with a suitable calibration between the force and the deflection it produces.

In most dynamometers the force is applied to some sort of spring and the deflection thus produced is measured. Since the dynamometer must be stiff, very small deflections are involved.

Among the devices that have been used to measure such small deflections are dial indicators, hydraulic cylinders with a pressure gauge, pneumatic and optical systems.

Also electrical transducers for example, piezoelectric crystals, differential transformers, magnetic strain gauges and wire resistance strain gauges.

The mechanical gauge is simple and has often been used, but suffers from the fact that it gives a visual reading only.

All the electrical transducers require high-quality amplifiers except the wire resistance strain gauge, which can be used with a simple bridge.

Thus the present work includes the the design and construction of a compact, sensitive, two component lathe dynamometer having high natural frequency and negligible cross-coupling, using wire resistance strain gauges.

The completed dynamometer is used for tests relating the parameters of feed, speed, depth of cut and cutting ratio.

REVIEW OF PREVIOUS WORK

Ever since machine tools have been used, it has been necessary to measure the cutting forces involved, since from the point of view of horsepower and tool-wear, it is obviously desirable to adjust the various cutting parameters to give minimum cutting force.

Design requirements for a tool dynamometer are serve. Maximum stiffness is essential to avoid interference with normal cutting, which means that very sensitive measuring elements must be employed. Usually two or more force components are to be measured simultaneously and it is essential that cross-sensitivity be kept to a very small value. Presence of cutting fluids make waterproofing very desirable.

Many types of measuring element have been employed, including dial indicators, piezoelectric and electromagnetic transducers and optical devices, but the most reliable has proved to be the electrical resistance strain gauge. Furthermore, it used, with appropriate electronic instrumentation, for dynamic measurements of force against time.

Thus the problem for the two-component case reduces to the design of a cantilever which while having high stiffness, will have high enough stresses due to bending at the outer surface to give adequate signals from the strain gauges. Also to attach a tool-holder to this cantilever while still keeping the natural frequency of the system at a value. Finally to enclose the whole instrument as necessary to avoid damage under normal workshop use.