DEVELOPMENT AND TESTING OF A SYSTEM FOR MONITORING FIELD OPERATIONAL CHARACTERISTICS OF A TRACTOR DRAUGHT CONTROL SYSTEM WITH A FIELD MOUNTED IMPLEMENT

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1. INTRODUCTION

The conventional draught control system, as fitted to modern tractors, consists of a negative feed back control system that adjusts the working depth of mounted or semi mounted soil engaging implements in an attempt to regulate the draught requirements of the implement.

The system has become important in agricultural production because it increases the efficiency of tractor operations in two ways. Firstly, by controlling the draught requirements of an implement the draught control system allows tractor engine efficiency to be optimised. Secondly, by transferring some of the weight of the implement onto the rear wheels of the tractor, wheel slip is reduced and controlled. This latter function, more than any other, was responsible for the major change in the design concept of tractors, permitting smaller, lighter tractors to do the same work as their heavier predecessors, pulling trailed implements.

The control system has lead to the ability of relatively light weight tractors being able to maintain a high work rate (in terms of area cultivated in a given time) with acceptable working depth fluctuations, and without undue energy loss through wheel slip.

No direct comparisons of the performance of different draught control systems operating under field conditions have been reported in the literature as there appear to be no methods for making such comparisons. When comparisons of any performance aspects between different control systems or implements have been reported, these have been restricted to noting performance variability in given soil types, (Dwyer *et al.* (1), Crolla *et al.* (2)) or have ignored random soil force variations (Dwyer (3)). Because of the heterogenous nature of natural soils no two systems could be compared under exactly the same soil force pattern. In addition to this, soil characteristics may vary with time and moisture content. This prevents accurate comparison of different systems from data collected at time intervals large enough to allow soil conditions to change.

One possibile method of overcoming these problems would be to repeatedly simulate a standard set of field conditions. It is not unreasonable to imagine the development of a simulator which could, under laboratory conditions, repeatedly reproduce forces characteristic of typical field work, and apply them to the tractor under test. Thus "standardisation" of "soil conditions" would be achieved in that each draught control system under test would be subjected to the same simulated level of soil variability.

For such a proposed simulator to be realistic, the input signals would have to be at least representative of field conditions, albeit that they would be arbitrarily chosen. The collection of such data from the field during typical tractor and implement operation is therefore considered to be an important prerequisite to consideration of the design and operation of a simulator. Furthermore, this collected data must be able to be retrieved in a manner which would lend itself to application as the input signals to the simulator.

The project described herein therefore had the following objectives.

(1) The design of apparatus capable of accurate measurement of the relevant data under field conditions.

(2) The recording and storage of field data in a form that could be retrieved, filtered if necessary, and used as input signals for such a proposed simulator.

(3) Comparison of the effects of travel speed, field topography, and soil physical conditions on the operation of any selected draught control system, as activated by a particular tractor and implement combination.

The project did not attempt to design a simulator. Rather, some suggestions are put forward on this aspect, based on observations of the collection procedure and nature of the field data.