

THE USE AND DEVELOPMENT OF CANE TRACKING EQUIPMENT

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Abstract

Increased milling capacity, more complex carrier systems, coupled with the move from rail to road transport and hence smaller consignment size, have required constant modification and updating of existing cane tracking units. A brief history is provided of past developments and description given of design and operation of the present day instrument. Future possible developments are considered.

Introduction

A cane tracking device is required to provide demarcation and identification of each individual consignment of cane throughout its travel along the carrier system to the sampling point which is at or near the first mill.

Cane tracking in its earliest mechanised form was achieved by gearing a wheel to the cane carrier drive shaft, and using the proportional rotation to operate signal lights at appropriate times, thus indicating the beginning and end of a cane consignment at the first mill. Increased milling capacity involving more complex carrier systems, coupled with the move from rail to road transport and hence smaller consignments, have demanded improved cane tracking techniques.

The original electronic cane tracker was developed at the Jaagbaan Mill. Further development led to an improved modular type, which simplified the location and repair of faults.

The present generation of cane trackers incorporate the latest type of integrated circuit on plug-in printed boards. This provides a compact, flexible, and more reliable instrument system.

Principle of operation

The carrier system is represented by a system of lights on a display panel, each light representing the length of travel of the carrier corresponding to half a revolution of the carrier head shaft. The cane consignment is referenced and identified by electro-mechanical counters, at both the input and output points on the panel. Two push buttons are provided at each input to initiate the beginning and end of each consignment. At the sampling point an output counter and stop/start indicator lights are provided. A bell also provides audible warning of the beginning and end of each consignment.

Description of components

The cane tracker consists of six basic parts. (See Figure 1.)

The functions of each being:

- (1) Pulse generators. These are switches which are activated by two cams attached to the head shaft of the carrier and set 180° apart.
- (2) Main display panel. This panel contains a lamp representation of the carrier system, together with control buttons and counters. The control panel is operated by the Sample Controller stationed at a convenient point in the cane yard.
- (3) Slave display. This is a replica of the main display but without control buttons and is mounted in the laboratory thus permitting remote surveillance by senior personnel.
- (4) Sample point box. This box duplicates the output section of the cane tracker for the sample point attendant. It includes circuits which activate the audible and visual

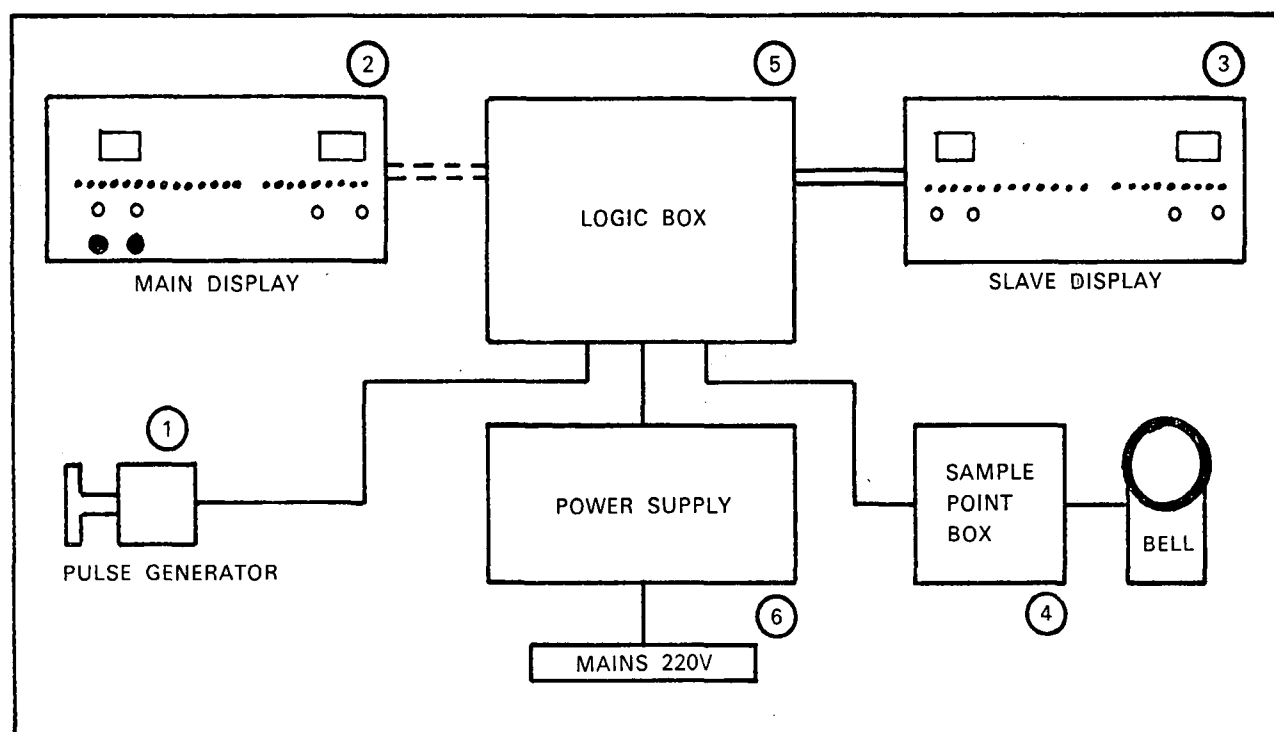


FIGURE 1

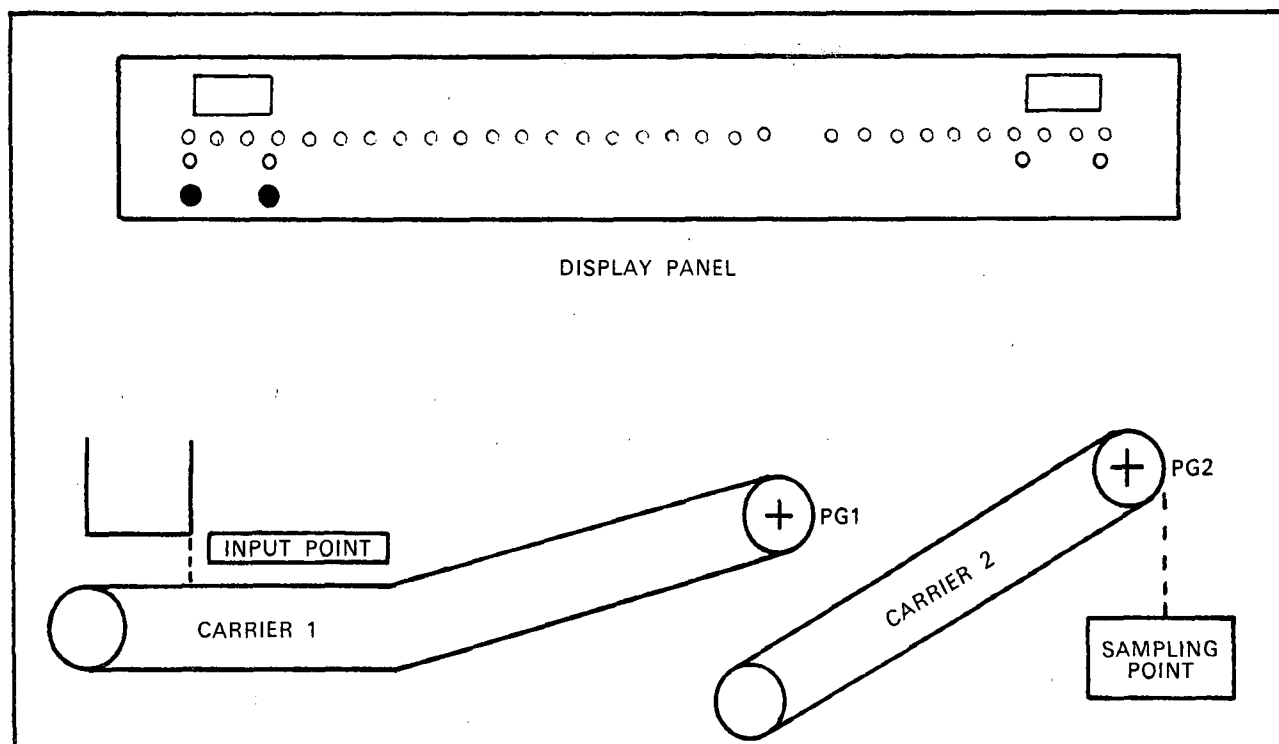


FIGURE 2 A Carrier System with Equivalent Display Representation.

alarms, and an interlock which suspends the operation of the sampling gate during the non-sampling period between consignments, i.e. to allow for admixtures of cane.

- (5) Logic box. This box contains most of the electronic circuit elements, including the shift generators, transfer networks, shift registers, input/output boards and interface relays. It is usually mounted in the laboratory to take advantage of the cleaner environment.
- (6) Power supply. This unit converts mains 220 volts A.C. into stable D.C. voltages of 12, and 24 volts. The 12 volts are used to operate the logic circuitry while the 24 volts are used to illuminate the display lamps.

Carrier representation

Each cane tracking instrument is fabricated to suit a specific cane carrier configuration. The design of a display to represent the simple carrier system shown in Figure 2, is outlined below.

A carrier system with equivalent display representation

Assume the headshaft sprocket of carrier No. 1 has ten teeth at a pitch of 150 mm. For one revolution of the headshaft, the carrier will move through a distance of 1 500 mm. If the carrier is 15 000 mm in length then 10 revolutions would account for one carrier length travel. If 2 lamps are made to represent one headshaft revolution, then the main carrier is represented by 20 lamps.

Similarly, if carrier No. 2 is 5 000 mm in length and has a headshaft sprocket of 10 teeth at a pitch of 100 mm, then one revolution would equal 1 000 mm carrier travel. Thus five revolutions would be one carrier length. Again, if 2 lamps are to represent one revolution, then the carrier would be represented by 10 lamps.

Method of operation

As the head of a consignment passes the input start point, the start button is pressed. This illuminates the green input indicator lamp, and the input counter will increase by one digit. The lights indicating the cane consignments on the first carrier, will advance by one, for each half revolution of the

headshaft. This corresponds to the movement of the cane along the carrier. Upon transfer to carrier 2, the lamps will advance in sympathy with the pulses from the second pulse generator.

As the head of the consignment reaches the cane sampling point, a delay timer is activated. This is to allow sufficient time for the cane to pass through the sampling and sub-sampling equipment.

After the required delay, a green output indicator lamp comes on, and the output counter increases by one digit. The digits displayed on the output counter will be the same as that indicated when the particular consignment was initially introduced on the display panel. At the sampling point the sub-sampler commences its operation.

When the end of a consignment passes the input point, the stop button is pressed, and this extinguishes the green input indicator lamp. Thereafter the lamps on the display will extinguish in sympathy with the end of the consignment, as it moves along the carriers.

When the end of the consignment reaches the sampling point the delay timer is again activated to allow for the passage of the cane through the sampling and sub-sampling equipment. Thereafter the red output indicator lamp illuminates and the bell rings to indicate the end of sampling.

Early electronic developments

The early electronic cane tracker consisted of logic modules using germanium semi-conductors (Fig. 3), but these proved unreliable at ambient temperatures above 30°C. A further disadvantage was that all the modules were permanently "wired in", making repairs difficult. The whole system was also bulky.

Second generation

This generation of electronic trackers used silicon semi-conductors which are compact, and temperature stable up to 70°C. Constructional improvements included the use of plug-in modules into standard chassis, affording greater manufacturing and modification flexibility. The plug-in modules also facilitated easier fault diagnosis and repair. Increased mill through-puts demanded a higher resolution of tracking along

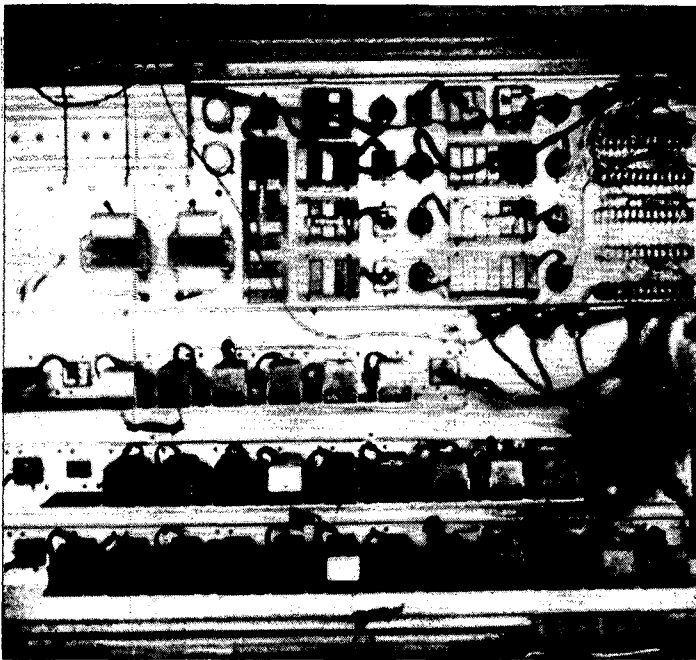


FIGURE 3 Germanium Blocks and Power Supply of an early cane tracker.

the carriers, which was achieved by pulse outputs twice per revolution of the carrier drive-shaft; this, however, increased the amount of electronics and cables required for the main and slave displays.

Further development

Initially the electronic cane trackers were manufactured by a local electronics firm but in view of the constant need for modification and improvement, it became evident that the



FIGURE 4 Prototype Integrated Circuit Cane Tracker with twice the resolution of the existing unit.

design and manufacture within the precinct of the Central Board would be more convenient.

This led to the development and manufacture by the Central Board Instrument Service Centre of a prototype integrated circuit (IC) system (Fig. 4) that:

- (a) requires less maintenance;
- (b) is more reliable;
- (c) is compact and portable.

(a) Reduced maintenance

Reduction in maintenance was achieved by:

- (1) replacing all mimic display filament lamps with light emitting diodes. These have no filaments but emit light from a semi-conductor junction, making them extremely robust and giving them a virtual indefinite life. The power consumption per lamp was reduced from 1 200 mW to 51 mW;
- (2) transistors, which are normally very reliable in themselves, gave way to integrated circuits, which are more compact and more dependable; all connections are encapsulated within epoxy chips;
- (3) epoxy encapsulated reed relays are used wherever possible, in place of electro-mechanical relays which require maintenance due to ingressing dirt and moisture in the hostile environment of a sugar mill.

(b) System reliability

In order to maintain continuity of operation it is essential to lessen the need to call in experts to attend to faults. The instrument system as shown in Fig. 1 had certain shortcomings.

- (1) The main display in the cane tracking station was connected to the logic box in the laboratory with a multi-core cable containing up to 250 wires. These cables run through the mill buildings and along the cane carriers, and are thus prone to accidental damage.
- (2) Fault conditions can occur within the logic box which cannot be rectified by local staff.

It was recognised that the cost of manufacturing two separate self-contained prototype IC trackers would amount to no more than the cost of a single "generation 2 type" unit. Thus, to achieve a more dependable system the single fixed logic

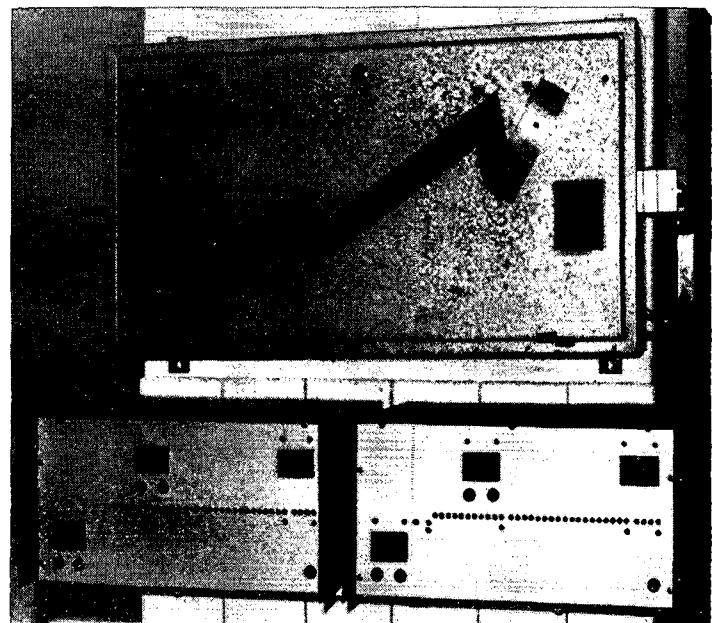


FIGURE 5 Two identical instruments as used at Umzimkulu.

box in the laboratory was replaced by two identical, fully portable, instruments connected with a small cable containing approximately 10 wires.

One instrument is located at the sample control station, and the other in the laboratory. In the event of a fault with the unit in the sample control station, the laboratory unit may be substituted without disruption to sampling.

Damage to any cable, all of which contain only a few wires, can readily be repaired by the local staff.

The Central Board IC system is compact, easy to install, and readily removable if necessary.

Future developments

The Central Board Instrument Service Centre is at present investigating the use of electronic counters (as seen on electronic calculators) to replace the existing electro-mechanical type. The electronic counters are expected to be more reliable, maintenance free and comparable in cost.

Future Central Board cane trackers may use the newer Cos-Mos electronic technology and the carrier display panels may use liquid crystals. Both operate with a very low power consumption and this may enable the complete system to be independent of mains power supply.