TRANSPORT and ROAD
RESEARCH LABORATORY

Department of the Environment

TRRL REPORT LR 465

EXPERIENCE WITH THE FISCHER AND PORTER VEHICLE-COUNTER UNDER TROPICAL CONDITIONS

by

D.H. Blackmore and J.D.G.F. Howe

Overseas Unit
Transport and Road Research Laboratory
Crowthorne, Berkshire
1972

CONTENTS

EXPERIENCE WITH THE FISCHER AND PORTER VEHICLE-COUNTER UNDER TROPICAL CONDITIONS

ABSTRACT

This Report describes operating and maintenance experience with the Fischer and Porter punched-tape counter under tropical conditions. It is based on the results of a two-year study by staff from the Laboratory of 25 counter installations in Kenya.

The Report describes the special installation procedures required for earth and gravel roads. An analysis is given of the life of detector tubes and batteries and of the causes of counter breakdowns. The need for an underground method of detecting vehicles is clearly indicated by the difficulties experienced with conventional surface-laid pneumatic-tube detectors. The problems to be overcome in developing a viable system are discussed.

1. INTRODUCTION

The Fischer and Porter vehicle-counter is one which automatically records the flow of traffic. The operation and maintenance of the counter in the United Kingdom has been described elsewhere[1]. This Report provides additional material based on experience gained when the same counter was used under tropical and sub-tropical conditions.

In March 1968, the Tropical Section of the Transport and Road Research Laboratory installed 25 Fischer and Porter counters on rural roads in Kenya for a two-year study of the magnitude and causes of variations in traffic flow. The counters were located on roads with earth, gravel, bitumen and concrete surfaces. Climatic conditions at the sites ranged from virtually waterless semi-desert to temperate highlands with an annual rainfall in excess of 1500 mm. Only those aspects of counter performance peculiar to conditions in Kenya are described here as Reference 1 provides a comprehensive description of general operating principles.

2. INSTALLATION

2.1 Special procedures for earth and gravel roads

2.1.1 Site drainage

When a site is chosen on an earth or gravel road, areas susceptible to flooding should be avoided. Sometimes the detector may be placed on the concrete approaches to a bridge, but when this is not possible the exact position of the tube should be chosen during, or soon after, a time of rain, when unsuitable parts of the road will be evident.

2.1.2 Laying rubber detector tubes

If the rubber detector tube is laid directly onto an earth road the tube will rapidly sink into the surface especially if the soil becomes wet. To prevent this and to provide the detector with some protection against the abrasive action of grit and stones it is best if a "mat" is laid across the road surface. In Kenya a length of four-ply canvas belting, about 100 mm (4 in) wide, similar to that used in machine shops for transmitting power between pulleys, was laid across the full width of the road. The detector tube, fitted with clips and end-fixings, was stretched on the canvas and special soft-iron nails about 250 mm or 300 mm (10 in or 12 in) long were driven through the clips and belting into the road surface beneath. Where the surface was particularly stony or compacted, standard wire nails 150 mm (6 in) long proved adequate for this purpose. Plate 1 shows a detector tube installed on an earth road. Fixings, clips, canvas belting and nails suitable for use on a variety of road surfaces are shown in Plate 2, and working drawings, to enable the more essential components to be manufactured locally, are given in Figs 1-3.

2.1.3 Laying rubber detector tubes on uneven road surfaces

On many earth roads and some bituminous roads where the surface is wavy or ridged it is necessary to adopt an irregular spacing of the clips and to arrange them so that they are secured in the hollows in the surface. If this is not done the gaps formed between the detector and the road surface can be a hazard to pedestrians and animals, and unnecessary wear will be caused by the vibration of the stretched rubber after the passage of each vehicle.

2.1.4 Re-use of old detector tube fixings

Occasionally it is possible to re-thread a new length of tube through the fixings which are still securely nailed to the road surface after a cut tube has been withdrawn. This is recommended only for earth roads where the traffic flow is low and the canvas belting and the intermediate fixings are in good condition and much unnecessary work would be caused by lifting and relaying the canvas and clips.

2.2 General installation considerations

2.2.1 Choice of site

It is not uncommon for both children and adults to amuse themselves by stamping on the detector tube. This practice is very difficult to detect, and at sites where the flow is low causes significant errors in the results. The site must therefore be kept as far away as possible from market centres, schools, and other population concentrations to minimise the risk of interference. At the time a counter is initially installed, it is worthwhile enlisting the help of local government officials, or persons in respected public positions such as schoolmasters, so that the purpose of the count can be made known throughout the area.

Experience in East Africa has shown that the only really satisfactory way to prevent interference is to appoint a locally respected elder and pay him a small monthly fee for policing the site. He can also be asked to keep a daily diary of local weather conditions and events such as market days and political or social gatherings. As the causes of variations in daily traffic flow in developing countries are at present not generally known, such a diary can be invaluable for the evaluation and correction of results.

In lightly trafficked rural areas and remote districts it is very convenient to install the equipment near a Local Authority Depot or a camp of the Ministry of Works or Public Works so that the counter can be supervised by government employees. In this way the task can be simplified by sharing it among a number of people and reports of damage to the detector tube or of malfunctioning of the counter can be relayed to the maintenance team with minimum delay.

Finally, when all the more important points in choosing a site have been considered, it is an advantage if the counter can be placed where a convenient tree, telephone pole, road sign or stout fence-post stands on the verge. If the counter cannot be chained and padlocked to one of these objects it will be necessary to drive in a stout metal stake for the purpose. Plate 3 shows one in use in Kenya.

2.2.2 Laying detector tubes across footpaths

It is essential to avoid laying the detector tube across a footpath and in urban areas where footpaths are usually paved it will be necessary for the rubber tube to be carried under the surface inside a metal pipe, specially laid for the purpose. Where a footpath is not paved it is usually possible to cut the soil with a sharp spade and conceal the tube just below ground level.

3. MAINTENANCE

The routine maintenance of a traffic counter poses particular problems in many developing countries. Usually, shortages of technical staff permit only one repair base and the distances to be covered are large. These circumstances underline the need for on-the-spot counter supervision because visits by skilled maintenance staff will necessarily be relatively infrequent. In Kenya, where each of the four maintenance circuits was in excess of 1600 kilometers, each counter was visited approximately once a month. The interval between visits was chosen because it was found to be the most practical with the staff and transport available, but the optimum period would probably have been about half this.

When an internal counter fault occurred soon after a maintenance visit a whole month of results was lost and, despite site supervision, even detector-tube damage that was not immediately obvious often went unreported for several days.

An approximate indication of the 'life' of the more vulnerable and critical components are given in the following sections.

3.1 Detector-tube life

Experience in the United Kingdom has shown that, apart from vandalism and accidental damage, two main factors control tube life. They are the level of traffic flow and the ageing effects caused by the atmosphere and sunlight. At the high levels of traffic flow, of the order of 30,000 veh/day, found on motorways and trunk routes, tubes rarely last for more than a few weeks and they are replaced as the need arises. On roads with lower levels of flow, of the order of 1000 veh/day, it is usual to adopt a preventive form of maintenance and replace tubes at regular intervals of not greater than about six months.

In Kenya, the differences in road surfaces were expected to be an additional factor affecting tube life and, to provide information about this, detector tubes were left in service until failure occurred.

Table 1 gives figures of detector-tube life on different road surfaces.

Table 1

Detector-tube life on different road surfaces

	Tube life		
	Earth roads	Concrete roads	Bitumen roads
Number of sites	15	2	20
Average No. of days in use	258	147	134
No. of vehicles counted	19,000	17,000	114,000

At two sites on earth roads where the average daily flows were 25 and 40 vehicles, both tubes were still in use after more than 600 days' service. The site having the most frequent tube replacement was also on an earth road in a crop-farming area, where farm implements such as harrows and ploughs were moved from field to field across the detector tube; the average tube life was 48 days although the flow of vehicles was only 25 per day.

It will be seen from Table 1 that, in general, tubes lasted nearly twice as long on earth surfaces, mainly because the flows were lower on this type or road, but partly because the canvas belting protected the rubber from much of the abrasive action of the road surface.

Up to a point, tube life increases as flows decrease, but eventually the ageing effect of the atmosphere causes a deterioration in the rubber and makes tube-replacement necessary even at sites with very low traffic flows. For this reason it is recommended that tubes are replaced after about six months' use even though they may show little or no apparent wear.

The only replacement of the canvas belting in a group of 14 sites on earth roads occurred after 12 months at a site where the average flow as just over 150 vehicles per day. At the end of this 12-month period, several other canvas strips at sites with lower average daily flows were beginning to show signs of wear.

3.2 Battery life

In the United Kingdom it is customary to change the 7½-volt battery used in the Fischer and Porter counter after it has been in use for a year, irrespective of the amount of traffic it has counted. Although it was intended to follow this practice in Kenya, shipping delays made it necessary to keep some batteries in use for 16 months. At the end of this time none had failed, but when an unused battery which had been in store for 12 months was fitted as a replacement it gave only another six weeks' service before becoming flat.

Generally, the age of a battery is the best indication of when it should be replaced, but a regular monthly voltage test shows whether it is approaching the end of its useful life. A voltage of 7.0 or less indicates that the battery should be replaced immediately.

In many developing countries the 7½-volt Fencer battery is unobtainable and special arrangements have to be made for a regular supply. An annual delivery should be sufficient and, if this is made by airfreight, the batteries should arrive in fresh condition and give a full twelve months' service.

3.3 Use of chemical insecticides

Early in the Kenya experiment 6 weeks' traffic flow records were lost at one site because an insect had entered the counter, presumably during a routine inspection visit, and become lodged between the diaphragm contacts. As this type of problem seemed likely to recur under tropical conditions, all counters were treated with a chemical insecticide. A standard Shell Vapona strip was cut into rectangular pieces, approximately 50 mm x 10 mm, and a piece was put in each counter; no further problems with insects were experienced. The manufacturer recommends changing the chemical strip after about 3 months' use.

3.4 Site inspection procedure

The inspection procedure and the inspection report form used were generally as described in RRL Report No. 9, but at low-flow sites it was necessary for the inspection staff to run their own vehicle back and forth across the detector to study the counter in operation. About 25 crossings of the tube, at different speeds and at various distances from the verge, was considered a reasonable check. The number of extra vehicles registered on the counter during the check were noted to enable a correction to be made to the day's total. For this purpose a separate box was included on the inspection report used in Kenya.

3.5 Operating temperatures in the counters

At eight sites counters were equipped with maximum and minimum thermometers, and temperatures were recorded at each monthly visit. The highest and lowest temperatures observed during an eighteen-month period were 47°C (117°F) and 1½°C (35°F). The reliability of counters was found to be independent of the temperature experienced at individual sites.

3.6 Causes of loss of records

During a 26-month operation period flow records for 773 days or parts of a day were lost at the 25 sites.

Fig. 4 shows that during the first twelve months of this time the number of days lost from all causes remained fairly constant at about 1.2 days per month per site.

It can also be seen that, during the first seven months, counter faults accounted for most days lost whereas tube failures accounted for relatively few. From the seventh month onwards, tube failures contributed increasingly to the loss of records, but the percentage of days lost due to counter faults remained unchanged.

In addition to tube and counter faults, flat batteries accounted for a loss of 93 days' records and a mislaid roll of data tape was responsible for a further 30 days lost.

3.6.1 Counter breakdowns

The breakdowns of counters accounted for about 32 per cent of the total days lost in the first twelve months.

Counter failures on eight occasions were caused by fatigue in the leaf springs of the punch-motor switch and, to compensate for the reduction in the spring tensions, the switch assemblies were moved a little closer to their operating cams.

Faulty clocks caused breakdowns on eight occasions. Three of the clocks proved impossible to regulate and were overhauled by a watchmaker; in another five clocks the electric motor, which winds the clock spring, stalled because the brushes were not making proper contact with the armature. This fault was cured by cleaning the armature and bedding-in the brushes.

Other electrical and mechanical causes of failure were broken or loose wires on three occasions and the complete breakdown of the gear trains of two punch-motors.

Counters were damaged by vehicles on four occasions.

4. FUTURE DEVELOPMENTS

Generally, the surface-laid rubber tube proved to be a satisfactory method of vehicle detection, although at certain sites where the proportion of pedestrians was high in relation to other road users the tube was often interfered with by passers-by. Additional hazards to be detector tube were agricultural implements and roads graders which were relatively common in the case of earth- and gravel-surfaced roads.

For these reasons underground methods of detection offer obvious advantages. In addition, most underground devices record 'vehicles' and the usual manual correction counts, which enable 'axles' counted by a pneumatic detector to be converted to 'vehicles', are not required.

Two types of underground detector can be supplied by the manufacturer for use with the Fischer and Porter counter. Both work on the electrical inductance principle[2]. The TACDET is for use with mains supply and is not generally of interest to rural developing countries. The TOPDET is designed to operate with a 7½-volt dry-cell battery identical with, but additional to, that which normally powers the counter. As far as it is known the TOPDET has not yet been used on earth and gravel roads.

The effect of the depth of loop immersion on detection accuracy is of particular concern, because a minimum of 300 mm below the surface would seem necessary to provide a margin of safety against grader operations. Similarly, the effect of loop size on detector accuracy is important because some earth and gravel roads reach effective widths of 15 m or more.

The suitability of a Topdet battery operated detector for use with a large deeply buried loop is currently being assessed at the Transport and Road Research Laboratory.

5. ACKNOWLEDGEMENTS

The field work was carried out by the staff of the Ministry of Works, Government of Kenya, as part of a joint project with the Transport and Road Research Laboratory.

6. REFERENCES

1. BLACKMORE, D.H. Operation and Maintenance of the Fischer and Porter punched-tape counter, *Ministry of Transport, RRL Report* No 9: Harmondsworth, 1966 (Road Research Laboratory).

2. HEAD, J R. The operation of the inductive loop vehicle detector. *Traffic Engineering and Control,* **12**(3), July 1970, 135-139.

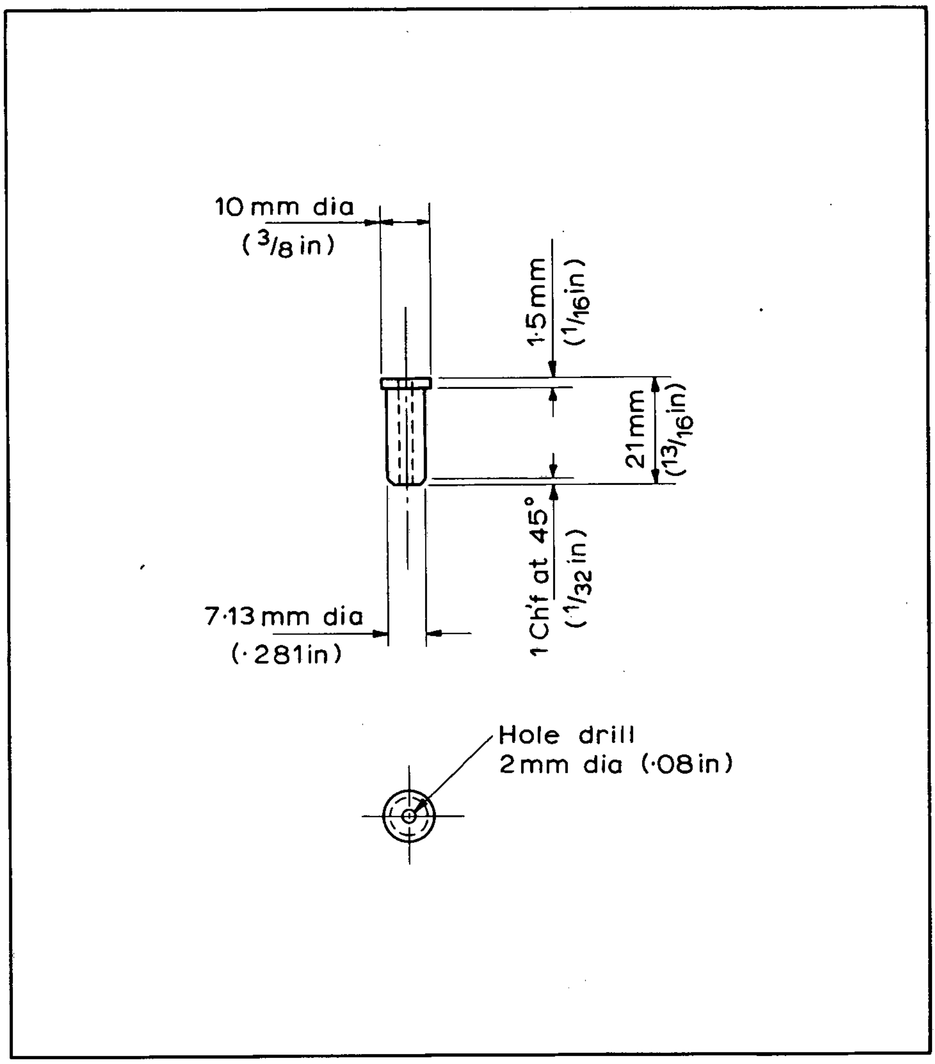


Fig. 1. TERMINATION PLUG

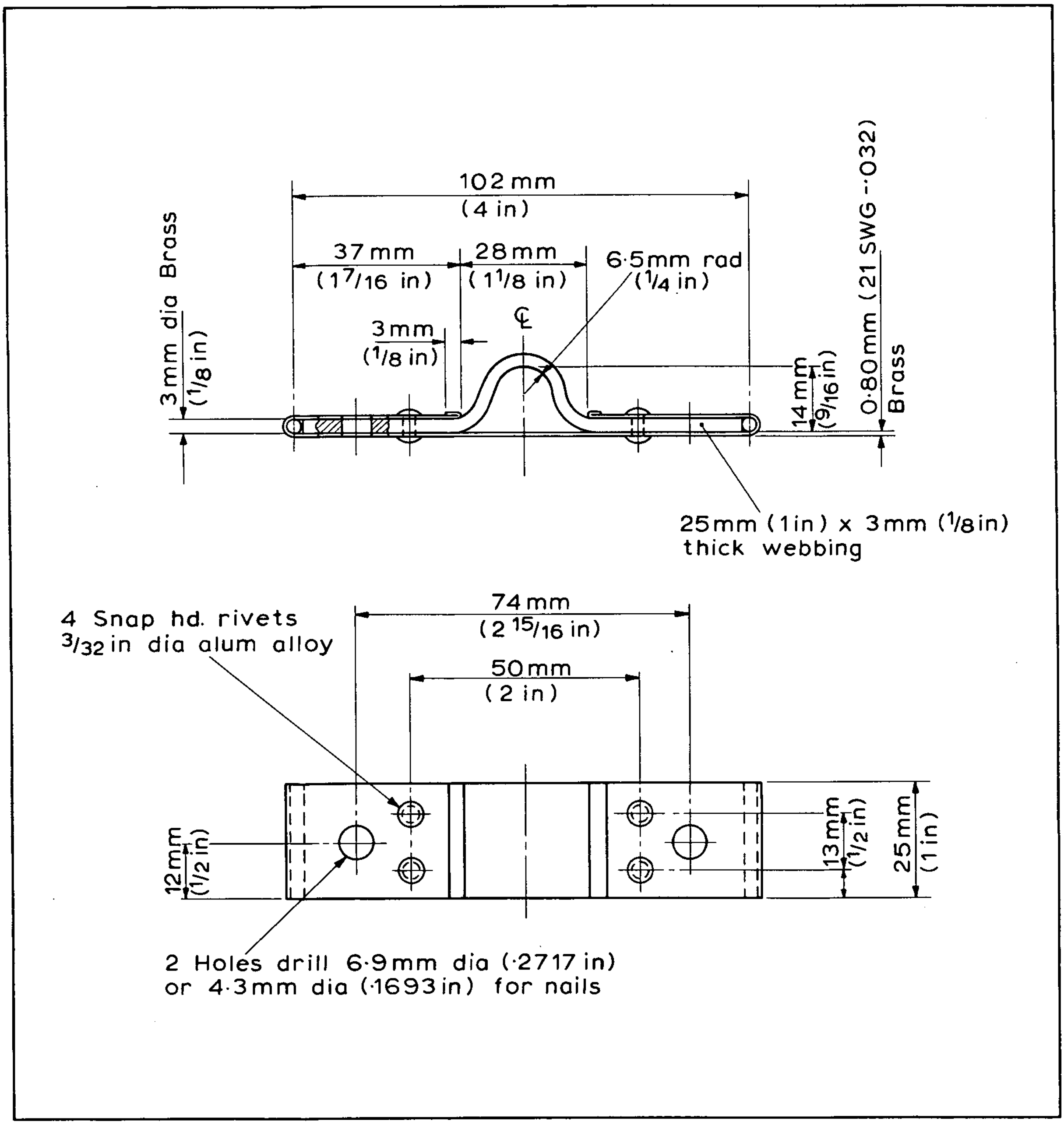


Fig. 2. INTERMEDIATE CLIP

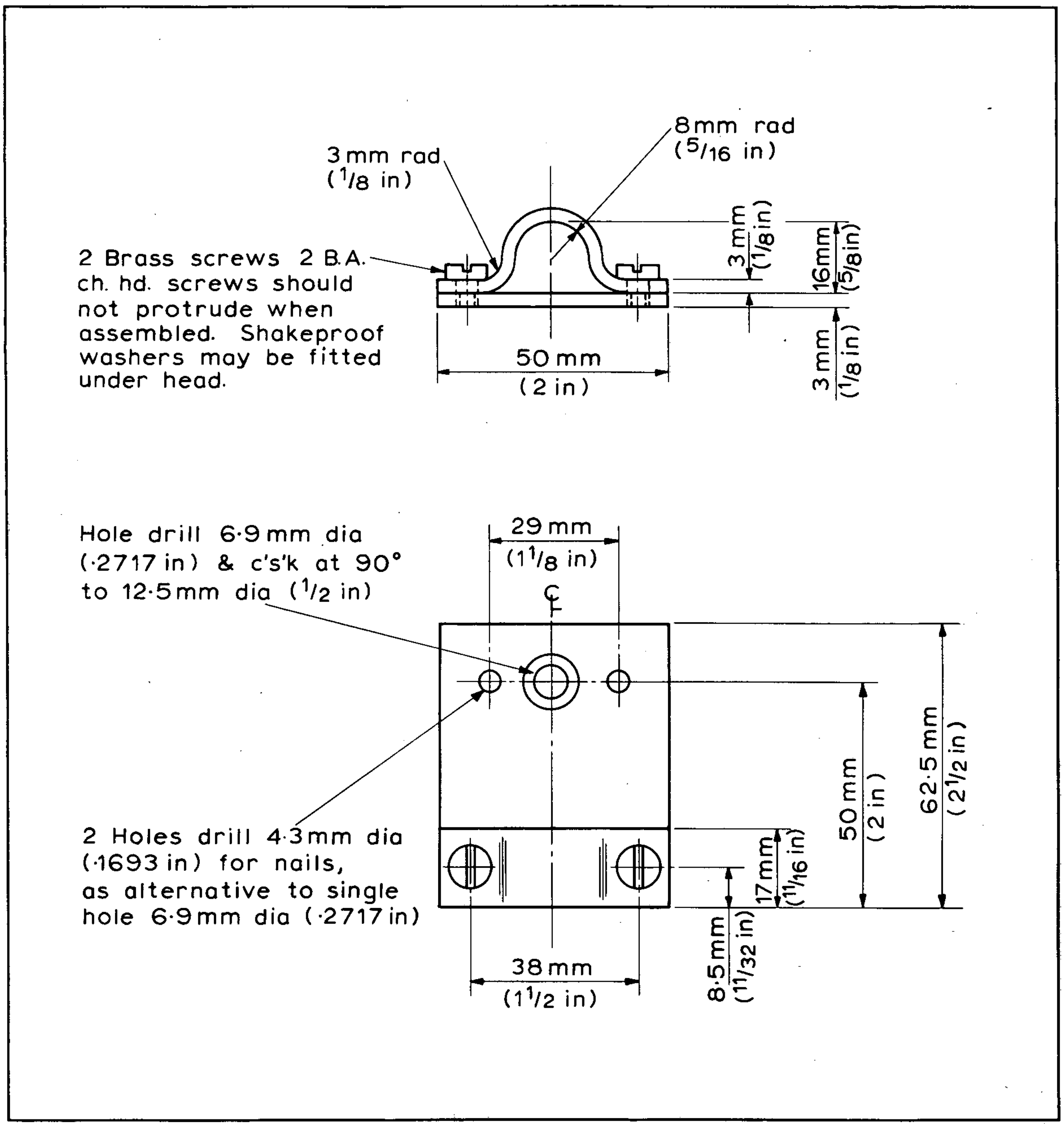


Fig. 3. END FIXING

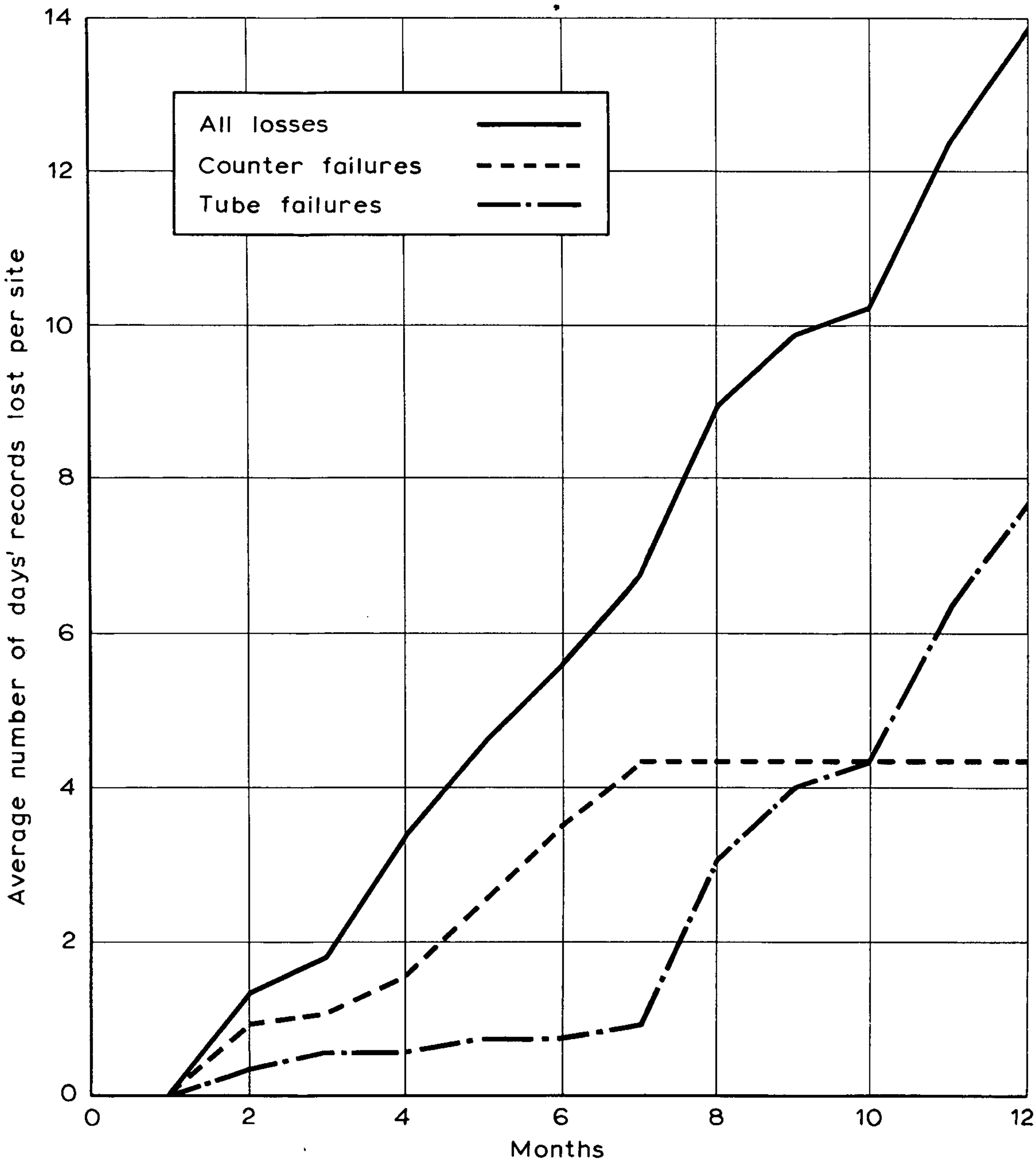


Fig. 4. CAUSES OF LOSS OF RECORDS DURING THE FIRST TWELVE MONTHS OF OPERATING

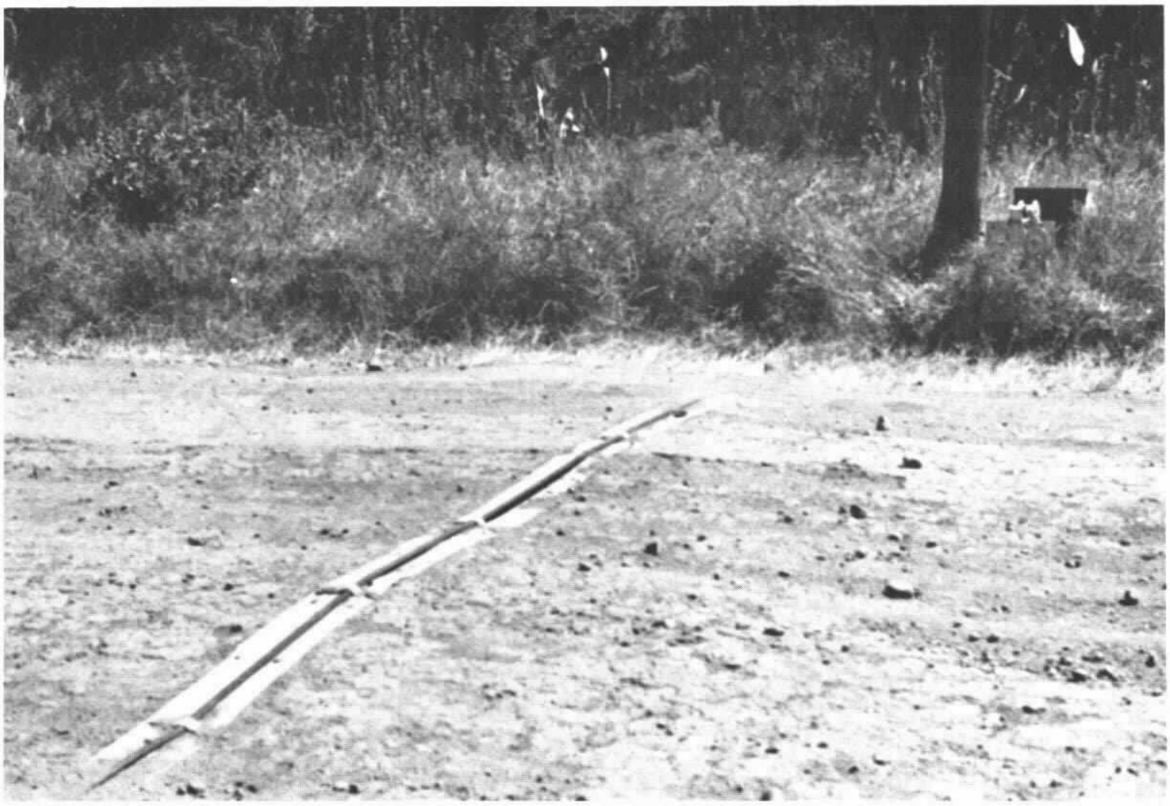
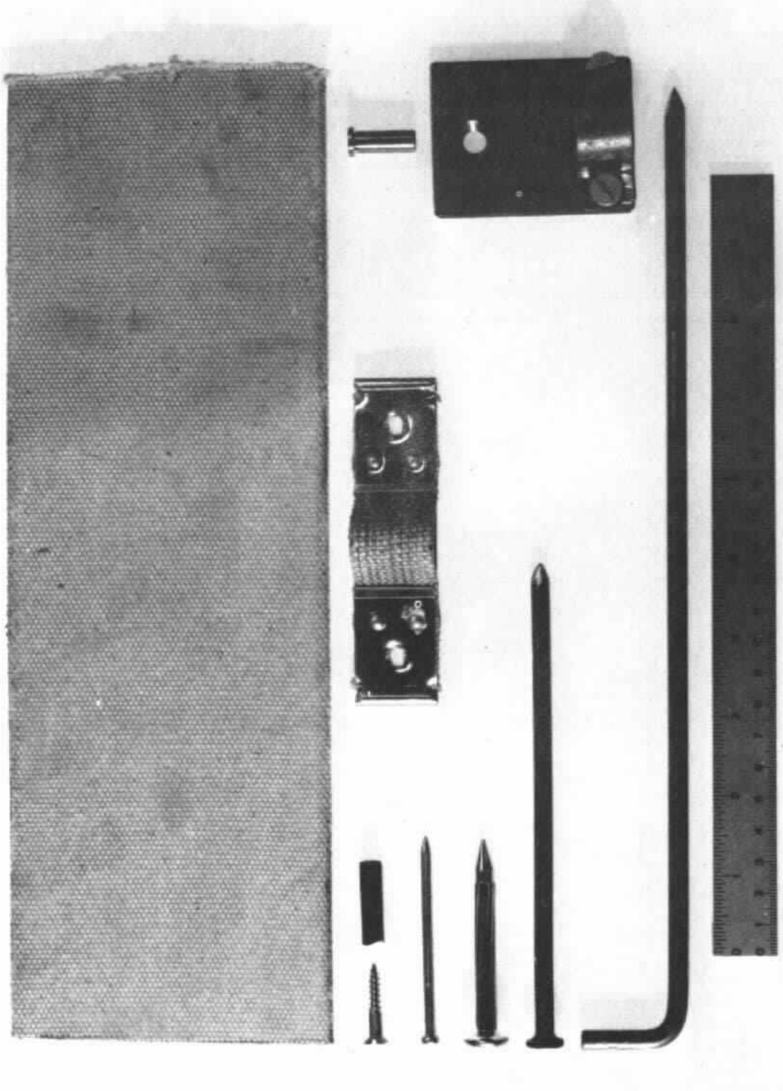


PLATE 1

Detector tube installed on an earth road



Neg No B4075/70

PLATE 2

Nails and fixings for detector tubes

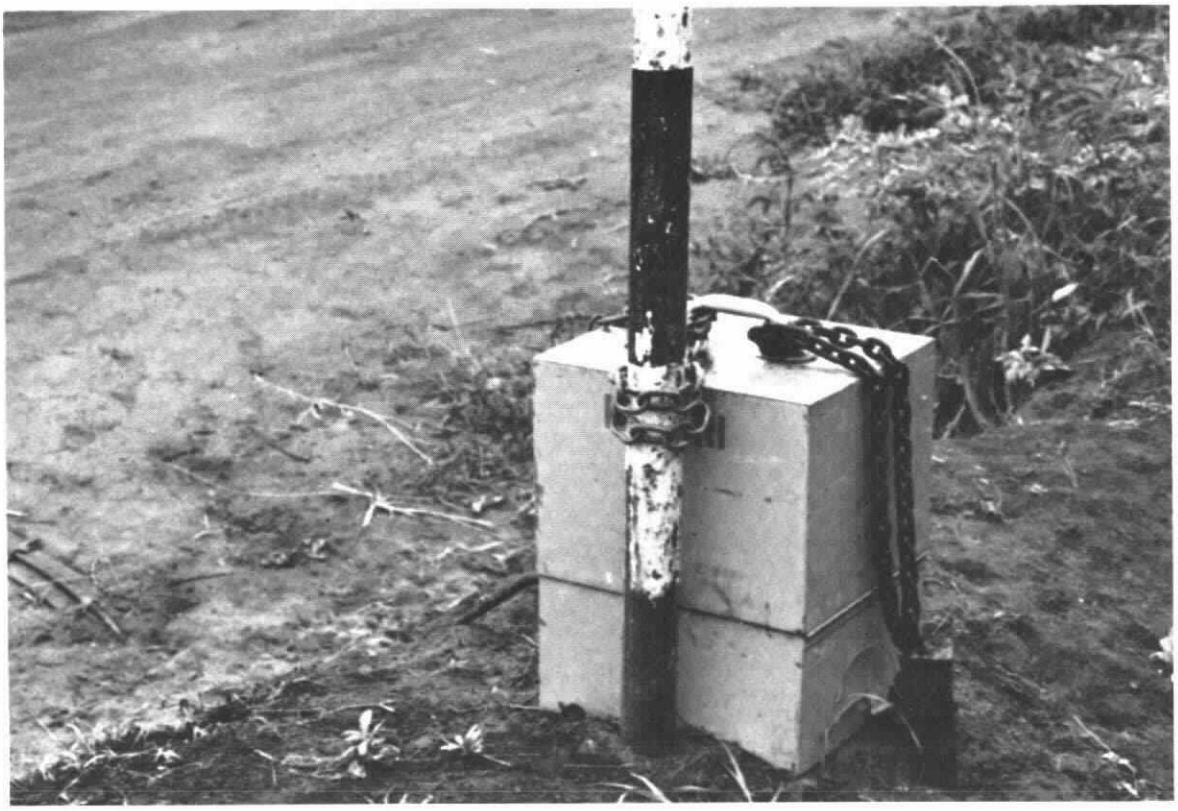


PLATE 3

Counter secured to direction sign and iron stake

(813) Dd891796 3,750 7/72 H P Ltd., So'ton G1915
PRINTED IN ENGLAND

ABSTRACT

Experience with the Fischer and Porter vehicle-counter under tropical conditions: D H BLACKMORE and J D G F HOWE: Department of the Environment, TRRL Report LR 465: Crowthorne, 1972 (Transport and Road Research Laboratory). This Report describes operating and maintenance experience with the Fischer and Porter punched-tape counter under tropical conditions. It is based on the results of a two-year study by staff from the Laboratory of 25 counter installations in Kenya.

The Report describes the special installation procedures required for earth and gravel roads. An analysis is given of the life of detector tubes and batteries and of the causes of counter breakdowns. The need for an underground method of detecting vehicles is clearly indicated by the difficulties experienced with conventional surface-laid pneumatic-tube detectors. The problems to be overcome in developing a viable system are discussed.

ABSTRACT

Experience with the Fischer and Porter vehicle-counter under tropical conditions: D H BLACKMORE and J D G F HOWE: Department of the Environment, TRRL Report LR 465: Crowthorne, 1972 (Transport and Road Research Laboratory). This Report describes operating and maintenance experience with the Fischer and Porter punched-tape counter under tropical conditions. It is based on the results of a two-year study by staff from the Laboratory of 25 counter installations in Kenya.

The Report describes the special installation procedures required for earth and gravel roads. An analysis is given of the life of detector tubes and batteries and of the causes of counter breakdowns. The need for an underground method of detecting vehicles is clearly indicated by the difficulties experienced with conventional surface-laid pneumatic-tube detectors. The problems to be overcome in developing a viable system are discussed.