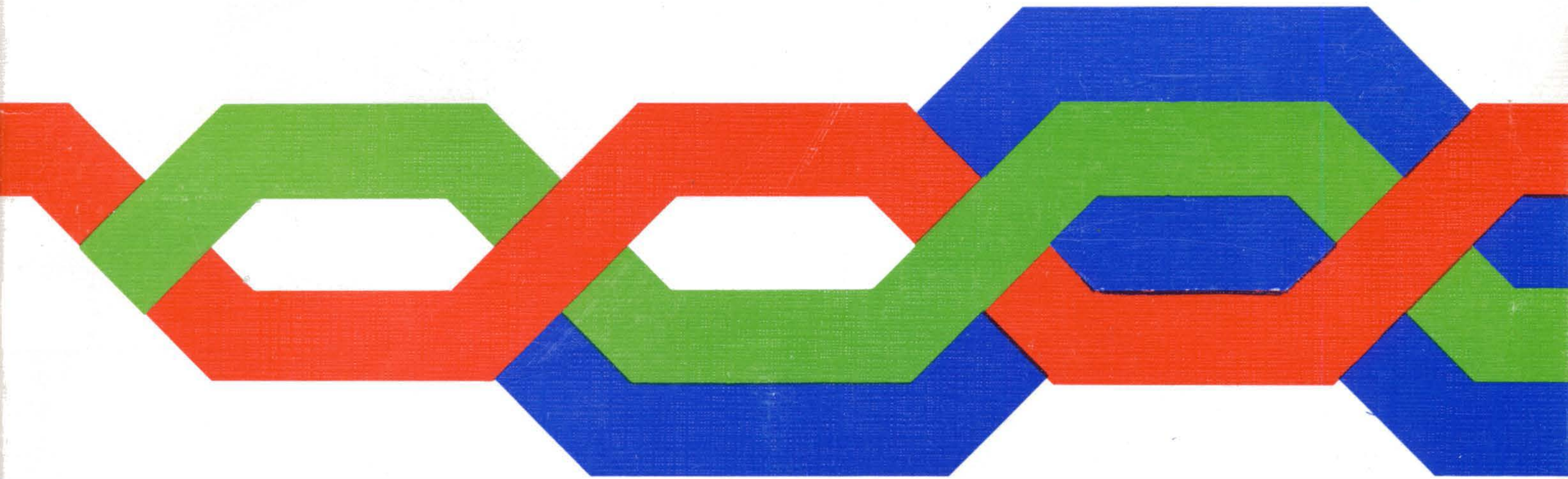
Post Office Telecommunications

Maintenance News

Issue 1 Spring 1973



Contents

Produced for SvD by THQ Internal Communication Unit

Introducing Maintenance News:

A letter from the editor

Maintenance News is a news and views magazine for all telecommunications plant maintenance staff. Published by THQ, it will appear three times a year.

We have a wide readership to serve, and to maintain a proper balance of interest we aim to include in every issue something for each of the main divisions of staff: external; subscribers' apparatus and line; exchange; and transmission. We cannot publish items about telegraph customers' apparatus maintenance, because they fall within the territory of the magazine *Punch Up;* another restriction is the need to avoid covering the same ground as *External Plant News*. Both these illustrious predecessors of ours will continue to go to the staff already receiving them.

We shall interpret *'News'* widely as meaning anything likely to interest maintenance staff. We shall be dealing in particular with new maintenance methods being tried or introduced so that you get to hear about them early, together with the reasons behind them. New solutions to problems on the plant in maintenance will also be included.

Maintenance News is 'official' in the sense that its contents must not be disclosed to the public. But it is not a substitute for instructions and action should not be taken on any item unless it clearly recommends you to do so, or refers you to TIs. Our main purpose is to enlighten and inform, perhaps even to entertain, but the views of contributors remain their own.

Readers' letters will be welcome as will news and views from Regions and Area EPCs, so long as this is not at the expense of local publications. Regional members are, in any case, being invited to serve on the Editorial Board to help keep *Maintenance News* on the right lines.

The address for contributions, whether letters to the Editor or material for articles, is:

The Editor
Maintenance News
Room 3018 Tenter House
Moorfields
LONDON EC2Y 9TH

A letter from the Director, Service Department

Dear Colleagues

Maintenance, these days, is much more than 'keeping the system going'. It is a live, on-going activity requiring the people engaged in it to keep up to date over a wide field of increasingly diverse equipment and technology. Maintenance techniques and maintenance organisation, and the resultant effect on running costs, are playing a critical part in decisions for the future.

In an operation of this kind, with so many people involved at various levels, and despite our comprehensive volumes of instructions, there is a real need for a flow of perhaps less inhibited communication to supplement the formal line. We hope that *Maintenance News* will fill the bill.

To be really effective the flow must be two-way. We must share our problems and experiences, and recount those of our solutions – maybe minor triumphs in the face of odds – where we think this will help others. Maintenance situations are repeating themselves all over the country, and contributors need not feel that their seeds of wisdom will fall on stony ground. So we hope for plenty of material from our colleagues in Regions and Areas. The THQ Maintenance Division for their part will do their best to explain the technical and policy reasons for what we are doing, and to follow up queries from the field.

As a regular reader of the current news magazines in this field, I am sure that this new venture has the potential to be interesting, entertaining, and useful, and I wish it and those responsible every success.

Yours sincerely
C R DANCEY

A letter from the Head of Maintenance Division (DDE/SVD)

Dear Colleagues

For some time past we have considered the practicability and advisability of producing a THQ maintenance magazine, and have been somewhat inhibited by the existence of excellent Regional publications on the subject. Was there a place for such a magazine and what should be its contents if its purpose were to supplement without duplication the existing coverage of maintenance topics? These were the questions to be asked and answered before proceeding with publication.

We think there is a place for this journal and that we can ensure that duplication of information is avoided. This belief has been strengthened by the encouragement of our field colleagues who have expressed their support for the idea of *Maintenance News.* Time and endeavour will prove if we are successful in our aim of supplementing local bulletins in an interesting and helpful manner.

You are the experts in communications engineering and have had some measurable success by using your expertise in providing an efficient communications system for the use of the public. We should also be able to demonstrate our ability to communicate with each other and I hope that the pages of *Maintenance News* will be used widely for an interchange of views and opinions on all aspects of maintenance.

Yours sincerely
T J REES

Local line insulation routining

Regular routining of the local underground cable network can detect defects before they cause service interruptions and Areas which practise it have achieved significant reductions in fault rate. Not immediately, because staff clearing insulation faults detected by the routiner diverts effort from service-affecting faults, but the eventual improvement in the standard of the network pays dividends. This article is meant to encourage other Areas in the use of Local Line Insulation Routiners (LLIRs).

There are three versions of LLIR. First, the original rack-mounted LLIR developed by the LTR which can be programmed for automatic routining of up to 10 exchanges, each of up to 10 000 lines. Second the trolley-mounted version, tester TRT88, which can routine only one exchange or unit of up to 10 000 lines and has to be manually switched to routine other exchanges. Third, the tester TRT239 which is the TRT88 modified for automatic routining of up to 10 exchanges. This article refers to both testers TRT88 and TRT239.

All LLIRs can perform the following tests on subscribers' lines:
battery contact (testing A and B legs bunched);
low insulation to earth (A and B legs bunched);
low insulation wire-to-wire (loop test).

The routiners can be calibrated to carry out the tests to insulation resistance standards of 0.25MΩ, 0.5MΩ, 1.0MΩ or 2.0MΩ. They gain access to subscribers' lines via test selectors and are run at night to avoid monopolising the test selector and having to pass over too many busy lines. They can detect NU tone and busy conditions and so step over spare and busy lines. Line faults cause the subscribers' numbers to be punched on a calibrated chart roll, the punching mechanism being a fault recorder no 2.

The history of LLIRs has not run altogether smoothly. In the early days exchange maintenance officers frequently found disconcertingly long lengths of paper roll on the exchange floor in the mornings, not due to drop-offs in calibrating the routiners or to overnight disasters in manholes, but to early morning dew on the insulators at overhead DPs.

Later the MTR produced a modification which, by operation of a key, programmed the LLIR to test for battery contacts only. Cutting out the earth and loop tests prevented the LLIR detecting low insulation on the overhead portions of subscribers' circuits and effectively made it an underground cable routiner. This modification cuts out the 40V calibrating battery when the key is operated so that the testing standard is 5/9 of the calibration value.

Detecting and clearing battery contact

faults only can lead to a very worthwhile improvement in the standard of network maintenance. Unfortunately, many Areas with networks in a poor state found that LLIR testing detected too many faults, and had to abandon it to concentrate on clearing Class A service-affecting faults.

Another problem was the laborious operation of analysing the punched charts to obtain cabinet, pillar and DP particulars for each line. Some Areas made the mistake of attempting to clear all faults between LLIR runs. It is much better to group them in cabinet and DP areas and look for coincidence patterns. Tackling the worst coincidences concentrates effort on the worst joints and individual isolated faults can be left for later.

The MTR more recently have produced a further modification for 'dual standard' testing with LLIR, by testing for battery contacts at 0.25MΩ and earths at 50KΩ during the same test run. This lower standard for earth testing eliminates the majority of bogus overhead faults. The use of the dual standard technique requires an identification digit to indicate which test the line has failed. The analysis of the chart roll is more laborious because of the need to separate battery and earth faults.

In THQ we are tackling the problem of chart analysis by running computer-analysis trials in Sheffield, Leicester, Cardiff and Aldershot RSC areas. The computer holds two record files, one relating subscribers' numbers to DP numbers, and the other, DP numbers to cabinet and pillar numbers. The fault recorder no 2 in the LLIR is replaced by an interface (similar to one developed by NWTR) and a reperforator no 5E producing output in 5-hole telegraph codes suitable for telex input to the computer. LLIR routines are carried out weekly and on receipt of data by telex the computer gives a same day printout of the five cabinets having the most faults in each RSC area. The complete analysis is returned next day, the printout also giving the number of faults in each cabinet area for the previous seven weeks. This allows the build-up of black spots to be seen and should prove very useful.

The computer can recognise fault identification digits, and we propose to introduce dual-standard LLIR testing during the field trial to assess the advantages of testing for the different types of fault.

To assess the improvement in the network through using LLIR we are collecting the following information during the trial:
reported underground faults;
maintenance and renewal costs;
action taken as a result of computer printouts;
rainfall figures (this to determine whether the MTR may be right in asserting that continuous use of LLIRs can eventually make the network independent of weather conditions).

To sum up, LLIR has an important part to play in external plant maintenance by monitoring the network to detect incipient faults. Areas which have used it little or not at all would be well advised to take the plunge and run LLIR regularly, weekly if possible. In the short term you will find more faults since things must get worse before they get better. Ultimately the standard of your network will be much improved and your customer complaints will fall.

Sv 5.1.1 (01-432 1374)

Letters to the editor

Dear Sir

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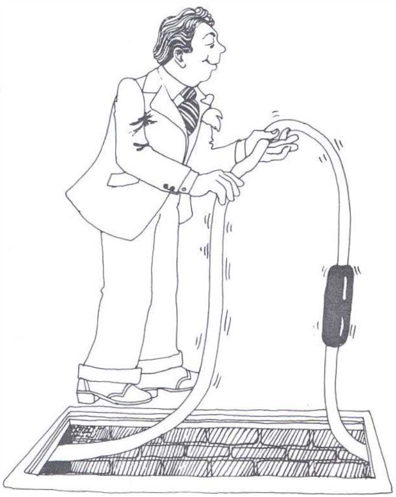
Yours faithfully
Spurius Larteius

We are a young publication and the above is the only letter we have received so far. Would future correspondents please write in English – Editor.

Pulse testing in the local line network

For some seven years now, pulse echo test sets have been used by Area precision test officers for locating faults in the MU, CJ and local cable network. Because of the limited availability of the equipment, and the high underground fault incidence on the local line plant (some 25 times that of the MU/CJ network), no great use has been made of this faulting method for dealing with the day-to-day faults in the local network. However, with the continuing need for overall improvement in local line serviceability and maintenance performance ratings, consideration is now being given to achieving these improvements by extending the use of pulse testers to faultsmen-jointers. Field trials in the more compact LTR director exchange areas have shown encouraging results but as a further means of determining the success of the technique in widespread rural areas, and to assess the overall scope for it nationally, other Regions have been asked to carry out experimental trials.



To the uninitiated faultsman, whose expertise is generally limited to d.c. faulting methods, the first reactions may well be that pulse testing techniques are beyond his understanding and will involve the use of highly complicated equipment and operating procedures. It is hoped therefore that the following explanation of pulse testing principles, together with the knowledge that LTR faultsmen are already quite adept at using the equipment, will help lessen these fears.

As a simple comparison, consider a beam of light projected down a darkened corridor. Any objects in the path of the beam will partially or completely reflect the beam, the degree of reflection being dependent on the size of the object and its reflecting properties. This is the basic principle of pulse testing, the difference being that a short duration voltage pulse is transmitted down the cable pair. As it travels along the line any impedance irregularities, such as cable faults, will reflect all or part of the pulse energy back to the sending end where it is displayed on a cathode ray tube (CRT). To obtain a steady and complete display of the cable pair under test it is necessary to apply the pulse several hundred times a second, each pulse being allowed sufficient time to travel the full length of line and back before the next pulse is applied. The CRT is uniformly scaled and calibration facilities on the instruments enable the display to represent specific periods of time, for example, 10, 100 or 200 microseconds. By measuring the time interval between the sent and reflected pulse the distance to the fault reflection can be calculated. The speed at which a pulse travels over a cable pair will vary according to the conductor size and its insulating material, but for general application on local line cables it has been found that 100 metres a microsecond is a suitable factor for converting the measured time into distance: for example, 10.4 microseconds is equivalent to 1040 metres.

Each cable pair tested will exhibit minor reflections which are due to small irregularities in the cable make-up, but in general the reflections due to service-affecting faults will be more discernible because of their greater magnitude. The reflected pulses are displayed in the form of a hump, this being in a positive or upwards direction for conductor faults (disconnections, high-resistance joints) and in a negative or downwards direction for insulation faults (short circuits, earth or contact). As the measuring technique is so different from normal d.c. methods some initial difficulty may be experienced with the interpretation of the pulse display. However, as with other new instruments, a few days practice will soon familiarise the operator with the equipment controls and the meaningfulness of the display. A useful approach to help pick out the fault reflection is to inspect the larger reflections and select the one most consistent with the reported d.c. fault symptoms: for instance, a short circuit gives a negative hump.

Pulse test sets are versatile instruments and have several other facilities provided which enable the more difficult or obscure faults to be identified. Briefly the main facilities are:

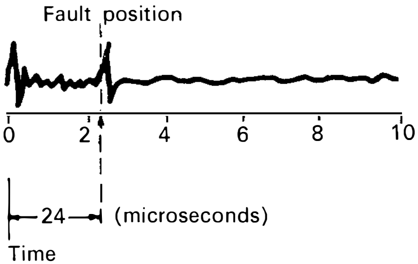
(a) a means of comparing a 'good' pair to the 'bad' pair under test on the same display, whereby differences between the pairs can be observed and assist in identifying the fault;

(b) the facility to locate split or rectified split pairs, by sending the pulse out on one pair and receiving it back on the other;

(c) the provision of a delay network, by which it is possible to inspect a long line in shorter sections throughout its entire length. This facility allows closer inspection of the display and greater measuring accuracy. For example if the display is calibrated to represent 10 microseconds and the delay switch is set at zero the first 1000 metres of cable is on view. Operating the delay switch one position will insert a delay network such that the section of cable 1000-2000 metres is observable. Successive delay steps of 1000 metres every step can be inserted until the entire line has been examined. When using the instrument in this manner the measured time to the fault is obtained by adding the time indicated on the display to the delay switch setting.

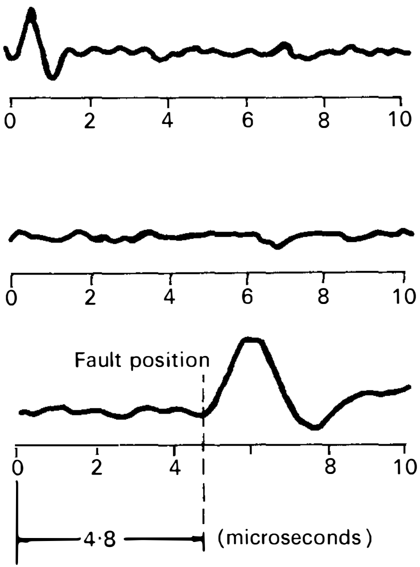
The operational aspects of pulse testing have yet to be decided but, from experience gained to date, its application would appear to fall into two categories: firstly, in the larger concentrated exchange areas, such as in London or Birmingham, where the equipment is most likely to be provided on an exchange basis and all tests are made from the MDF; and secondly, in the more widespread rural exchange areas where best results will probably be obtained using mobile instruments for testing from flexibility points and the subscriber's end of the circuit.

The first method is already used by the LTR on the following basis. Fault complaints received by the RSC are initially diagnosed by d.c. line testing and if considered to be in the underground plant the details are passed to the test set operator for location from the exchange MDF. The operator determines the dist-



A typical display given by a disconnection fault with the instrument switched to 100 microsecond range.

Time to fault 24 microseconds
Distance = 24 × 100 = 2,400 metres.



Delay switch setting
'O'
(cable section 0-1,000 metres)

'10' microseconds
(cable section 1,000-2,000 metres)

'20' microseconds
(cable section 2,000-3,000 metres)

The display given by the same fault but with the instrument switched to a 10 microsecond range and observed in cable sections of 1,000 metres.

Time to fault = delay switch setting + reading on trace
= 20 + 4·8 = 24·8 microseconds
Distance = 24·8 × 100 = 2,480 metres

ances to the faults and then by referring to the exchange cable records converts each fault position to an 'address'. This information is passed back to the RSC for distribution to faultsmen-jointers to deal with, as they become available. Since the majority of underground faults occur at cabinets and in the cables beyond, all pulse times to cabinets in an exchange area are predetermined from the MDF and recorded for future reference. Fault positions with respect to cabinets can then be readily determined. The pre-testing of cabinet pulse times, which are determined by applying simulated faults (short circuit and open circuit) on spare pairs at the cabinet, also serves a very useful purpose in the preliminary field training of the test set operator.

It has been shown that to utilise the inherent accuracy of the pulse test set it should be used at the MDF. Different distances from test positions to the MDF for various subscribers' lines may otherwise affect the accuracy of fault location. Further, because testing of the few underground faults per day should only take an hour or two it seems better to give it to a field technician as part of his duty, rather than require a visit from an RCO whose RSC may be remote from the exchange. The trials should evolve the best practice.

Pulse testing has a number of advantages over existing d.c. faulting methods. It does not require co-operation or test conditions to be applied at the remote ends of the pair under test; it avoids the need to convert conductor resistance measurements to distance; and in many instances, for example with low earth faults, it dispenses with the need for running out an overground wire when no good pairs are available in the cable. Pulse testing is not claimed to be more than 70 per cent successful but nevertheless it can be a quick and accurate method of locating a considerable proportion of the day-to-day service-affecting line faults, thus ensuring an improvement in out-of-service times and a reduction in plant disturbance.

Sv 5.1.1 (01-432 1373)

A new method of monitoring cable pressures

A continuous search is being made for better methods of locating leaks in pressurised cables. Tracing such leaks at present is often a long and tedious task.

In the trunk and junction network cable pressure leaks are usually heralded by the operation of a contactor near the leak. Contactors, installed in cable joints, are spaced out along each cable typically, on coaxial cables, at 4Km intervals. They are normally set to operate at 2lbs per square inch below the normal static pressure of 9lbs per square inch. On operation, a local earth is connected to one wire of an alarm pair.

The alarm condition is received at a terminal station identifying the position of the operated contactor. It is then necessary to carry out a series of cable pressure readings in the vicinity of this contactor to prepare a pressure gradient graph. This indicates the approximate position of the leak, which is finally located by leak detecting solution or more sophisticated methods such as by the use of tracer gas equipment.

The taking of pressure readings is very time consuming, involving the removal of jointing chamber covers and often pumping out water.

In conjunction with THQ/TD8, active steps are being taken to explore the possibility of replacing the on/off contactors by transducers spaced at closer intervals along cables. The transducers would convert pressure levels over the whole range of 0-9lbs per square inch into electrical signals and, with suitable telemetry, transmit the information to a reception centre. Here, under fault conditions, pressure gradient graphs could be prepared, possibly automatically, from the data received. Faultsmen could thus be directed, at the outset, to a position close to the leak.

Ideally the transducers should be fitted in every joint, so cost is a prime consideration. In addition they need to be extremely reliable in operation over very long periods.

Types of transducer so far investigated have included the potentiometric type used in the aircraft industry. This is an aneroid capsule mechanically coupled to a sliding contact on a potentiometer giving a variable resistance output. One promising development of this type uses a silicon beam coated on both sides with silicon oxide. The beam is coupled to the aneroid capsule in place of the potentiometer. Any resulting bending of the beam causes one surface to increase in resistance and the other to decrease.

A variation of this type of transducer dispenses with the aneroid capsule and measures pressures directly from a thin silicon disc. Other types range from those giving variable inductance or capacitance outputs, to those making use of the piezo-electric effect and to pressure sensitive transistors.

Several of the types mentioned are now being evaluated for their suitability for PO purposes and it is hoped that a trial installation will take place in a new cable during 1973.

Sv 5.2.2 (01-432 1306)

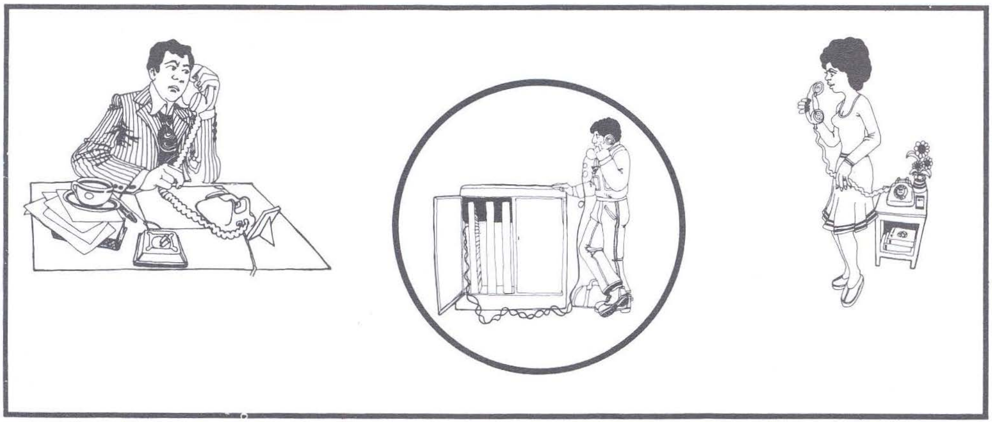
Don't cut 'em off

Our customers in general use normal facilities for fault reporting when they have trouble with their telephones. If they go to the extent of telephoning or writing to the Area Office, Region or THQ this usually means that they feel they have not had, or will not get, satisfaction by following the normal channels. They are also by this stage, dissatisfied with the service they are getting from the PO.

If, following close on such a complaint, a customer finds his phone out of order yet again – even though this time it is due to us making a special overhaul – attitudes towards the PO can deteriorate further.

If you are investigating a written or oral complaint, or a form A1053 has been issued, and you need to cut off service for more than 5 minutes, ring the customer first. Tell him what you intend to do and why, and if necessary arrange a mutually convenient time to do the work (TI E1 A0082 refers).

Sv. 5.1.3. (01-432 1386)



No access cards

Frequently no access cards A108 (M) returned to RSCs contain no indication of the customer who returned it because the telephone number space was not completed. The result, a missed appointment and a dissatisfied customer.

Of course, it's largely his own fault for not completing the card properly, but we can avoid this happening.

Always write the telephone number in the space provided on the right hand portion of the card before leaving it at customer's premises.

Sv. 5.1.3. (01-432 1386)

Battery contact testing on 56 type test desks

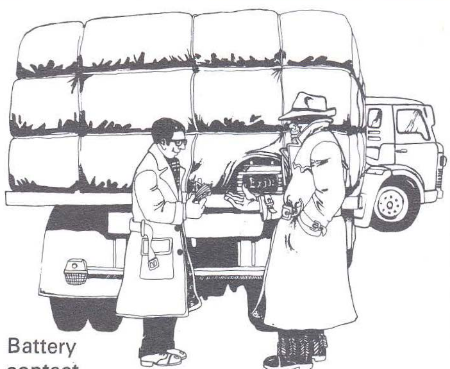
It was a rule of thumb when using the pre-46 type test desk with the edge-on scale meter that a deflection of more than a few divisions was accepted as a fault which was given out to the faultsman to clear. This was quite a sound rule since readings of 4·5V and 8·3V on the 80V scale indicated battery contact faults of 2 MΩ and 1 MΩ resistance respectively.

The 56 type test desk meter, however, is much more sensitive and 2 MΩ and 1 MΩ battery contacts produce deflections of 16·6V and 25V.

For battery contacts of 250 kΩ and 50 kΩ, deflections are 22V and 40V on the pre-46 type meter, but on the 56 type meter 40V and 47·5V. Application of the old rule of thumb when using a 56 type test desk will therefore result in faultsmen being sent out on faults unnecessarily.

As a general rule when using a 56 type meter for testing for battery contacts, deflections above 17V can be regarded as suspect but whether it is worth giving them all out as faults will depend on the general state of the local line plant and the availability of faultsmen. The aim should be to maintain the line plant to such a standard that all deflections above 25V are given attention.

Sv5.1.3. (01-432 1387)



Testing for CSH or loop

It does not seem to be generally appreciated that by using the private control facility on the test desk test access circuit (AT 4829) it is possible to tell whether a line is CSH or looped.

This is true provided that the test selector (AT 3837) has been modified in accordance with works specification TE 7932. After operating the hold key, challenging the line, and then operating the private control key, the line can be tested. Full CB conditions are received in the case of a CSH, 25V battery each leg for a short circuit and 7V battery A leg, 43V battery B leg for a 1000Ω loop.

It is possible to use this method in conjunction with knowledge of line plant resistance values to determine whether it is a subscriber's loop or a line fault giving the busy condition. However the main objective is to tell whether the busy condition is due to a CSH or a loop (i.e. inside or outside the exchange).

Sv5.1.3. (01-432 1387)

Test junctions with high capacity on 56 type desks

With the extension of test access from local exchanges to RSCs some test junctions tend to have large capacities. Because of the sensitivity of the 56 type meter on the ohms scale, a deflection of more than full scale is often encountered. This makes it difficult to reach a definite conclusion as to whether the bell capacitor is across the line or not.

A method of overcoming this is to use the 'Ohms ÷ 10' key which results in a smaller capacity kick. This becomes easily recognisable after a few tests over similar junctions and lines.

Sv5.1.3. (01-432 1387)

Insulation damage to wire jumper 6000 series

The insulation of jumper wire in the 6000 series is prone to excessive wear at points where new jumpers being run in rub against those already there. This particularly occurs at the jumper rings on the line side of the MDF, which is the side from which jumpers are normally fed in. The trouble is most prevalent on large MDF's.

Until jumper wires with improved insulation can be developed it is important to try to prevent wires being pulled in from rubbing on the jumpers already in place. One way that this can be done is by using a simple double hook in the shape of a letter S with one of the hooks bent at 90° to the other (see fig 1).

It can be made up locally out of $\frac{5}{16}$" mild steel rod, 14" long. The length of the complete hook is 6"; the open hook is $2\frac{1}{4}$" deep by $1\frac{1}{4}$" wide; and the other hook is $2\frac{1}{4}$" deep by $1\frac{1}{4}$" wide and is nearly closed at the end.

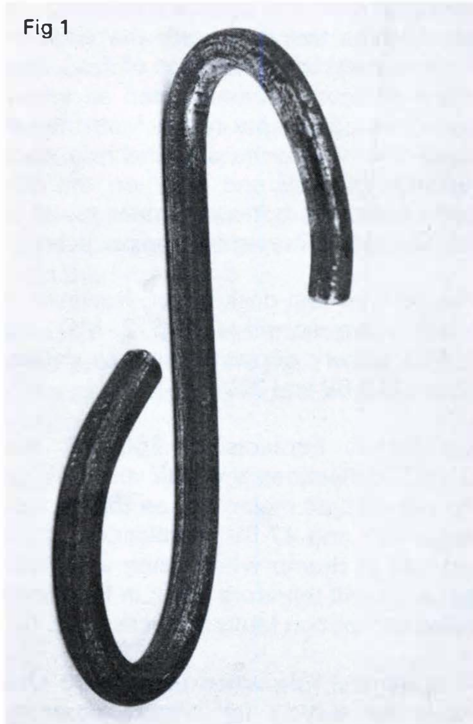


Fig 1

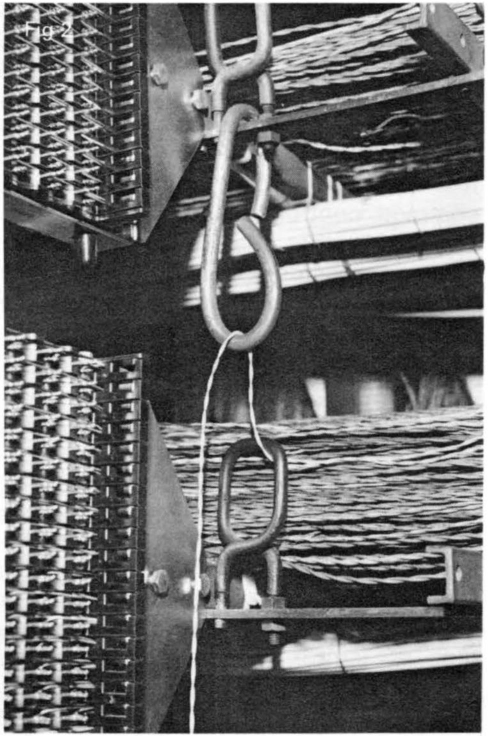


Fig 2

On the older type of MDF the double hook should be used wherever this insulation wear appears to exist. The open end should be used to hang the hook on the horizontal bar next to the jumper ring above the fuse mounting being terminated (see fig 2). During the pulling in process, the jumper should be fed from the swift through the closed hook and then down and through the jumper ring (see fig 2). This ensures that the wire as it is pulled in rubs on the top of the ring, which should be free of other jumper wires. Once the wire has been pulled in it should be removed from the hook before terminating the wire.

Difficulty should not normally be experienced on rack type MDF's. If however it is noticed that damage to jumpers is occurring, the jumper should be fed initially from the jumper reel through the ring immediately above the block to be terminated, and then pulled along the frame in the normal way. (This is ring C in fig 2 of TI A6 D1101). The jumper fed through ring C should then be cut and removed before being passed back through one of the normal rings and terminated on the block. Where the use of ring C is not possible, the special hook can be used instead – the open hook being used to hang it above the block on the horizontal bar holding ring C.

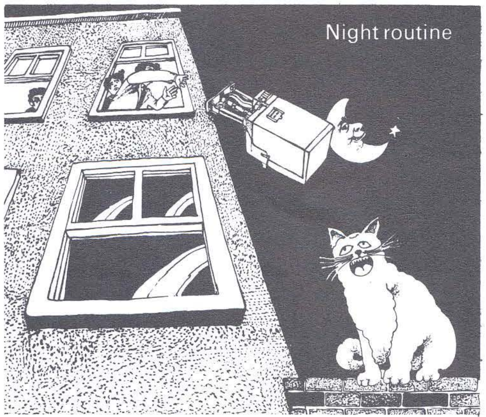
Sv5.1.3. (01-432 1386)

Night routining – background to a breakthrough

By now there can be few maintenance engineers in Strowger exchanges who have not made contact with night routining techniques – apart, that is, from those fortunate enough to operate in the compact surroundings of UAXs and SAXs where automatic routiners are as yet unknown. Of the 9200 routiners installed in director, non-director and trunk exchanges, some 75 per cent are now connected to fault recorders no. 1B and are thus able to operate without supervision by staff. By 1974 the remainder will also have this facility.

Why have we gone to the considerable expense of implementing such a vast program, involving not only the large scale provision of fault recorders but also major modifications to existing routiners to allow their operation to be controlled by fault recorders? To find the answer we must get down to fundamentals, including the basic characteristics of Strowger itself.

We all know Strowger to be a system whereby a path is set up between calling and called parties one selection stage at a time, step-by-step – either directly in accordance with the dialled information in non-director working, or indirectly in director working and STD calls. The points to be noted are that a previously disengaged selector is taken into use at each stage of routing the call towards its



destination, and that each selector is an entity in itself since it contains its own control circuits. In such a system it is not practicable to cushion a caller from the effects of selecting a faulty path – only systems like TXE and TXK which use fast switching circuits and sophisticated common control techniques allow this. Thus it is that the quality of service offered to customers using the Strowger system is very much influenced by the number of faulty paths existing in the switching network at any instant.

It is well known that faults occur at random and that the rate at which predictable-type faults occur can be controlled to some extent by routine preventive measures. However, we cannot insure against chance-type faults such as breakage of mechanical parts or 'HR' relay contacts; and it is just this type of fault that creates havoc with service because we get no advance warning of impending trouble. Therefore service-affecting faults tend to remain in the network until their presence is indicated either by customer complaints of difficulties on certain routings (something we wish to avoid) or by maintenance tests. If these tests are carried out at regular intervals the average number of faults developing during each interval tends to stay at a level, called the 'standing fault level', which we can control by altering the frequency of testing. It can be shown that the number of calls failing due to defects in the switching plant is directly related to the standing fault level.

It is agreed policy that the call failure rate shall be radically improved by 1975, which implies that the standing fault level must be reduced. This requirement can be met by shortening the interval between successive cycles of functional tests, and our ultimate aim in this direction is that all items of exchange plant connected to automatic routiners shall be tested each day. Such an ambitious testing programme would be out of the question if we were to continue to operate routiners in the traditional way, that is under manual supervision during the hours of normal duty. This is because the *rate* of testing (in terms of selectors per hour) is very much lower than the theoretical capability of the routiner, due to selectors being busy carrying normal day traffic; so to minimize the risk of encountering busy equipment we must change our period of testing to the quiet night hours, though without requiring maintenance staff to work a night rota.

Such a requirement was foreseen when the RT 1000 type of routiner was developed in the early '50s. The solution was to arrange for the identity of a faulty item of plant and the fault symptom information to be printed out by a fault recording machine associated with the routiner, so that staff coming on duty in the morning would find a complete record of faults discovered by the routiner during the night. Apart from maximizing the rate of testing, this system of routining at night had the twin advantages of indicating faulty plant that should be taken out of service before the onset of the morning busy period, and of allowing maintenance staff to attend to these faults and to carry out their other tasks without constant interruptions from routiner alarms.

Once it was agreed that the philosophy of night routining was the right approach to the problem of improving the serviceability of Strowger plant, it remained to provide the necessary facilities to all routiners at large. This has necessarily been a long job – designers had to work up modifications to some 35 different routiner test unit circuits, PO Factories had to lay down production lines for out-and-return modifications to 4500 access control panels, and Area works groups had to put the on-site work into their programs.

So when *your* routiner has been modified and connected to the fault recorder, get familiar with the night routining operational procedure described in TI E6 R5005. You will find that having once broken through the initial work bulge that more frequent routining will inevitably bring, the new pattern of work is much more logical and you will have the added satisfaction of providing your customers with the standard of service they've always wanted but seldom got. You *know* it makes sense!

Sv6.1.4. (01-432 1354)

Seeking out the rogue switch

We are shortly holding trials of a scheme to be known as 'Routining At Night with Centralised History' (RANCH) in a number of Telephone Areas, the first of these being Manchester South. All Strowger director, non-director and trunk exchanges that have been equipped with automatic routiners and fault recorders will be involved in the trial.

With the introduction of night routining (see article on page 16 in this issue) we can ensure that equipment with proven faults is serviced or at least removed from the network before customer service is seriously affected.

Why then do we need the RANCH Scheme?

Night routining also brings to light equipment which later proves to be 'FNF', yet some equipment is known to be excessively fault prone. RANCH is designed to identify these items and bring them to the notice of exchange staff so that extra maintenance attention can be given to them. Otherwise these 'rogue' switches remain a liability affecting customer service and taking up precious time through needing frequent attention.

The rather academic selector fault history card scheme is one way of finding the rogue switch but it is not as successful as it might be. First, engineers under pressure give priority to engineering work with the result that the clerical work associated with the equipment fault cards is often overlooked. And second, the AEE, with his many other duties, does not always find time to go down to the exchange floor to maintain oversight of the scheme. A replacement scheme is therefore needed and we think RANCH is it.

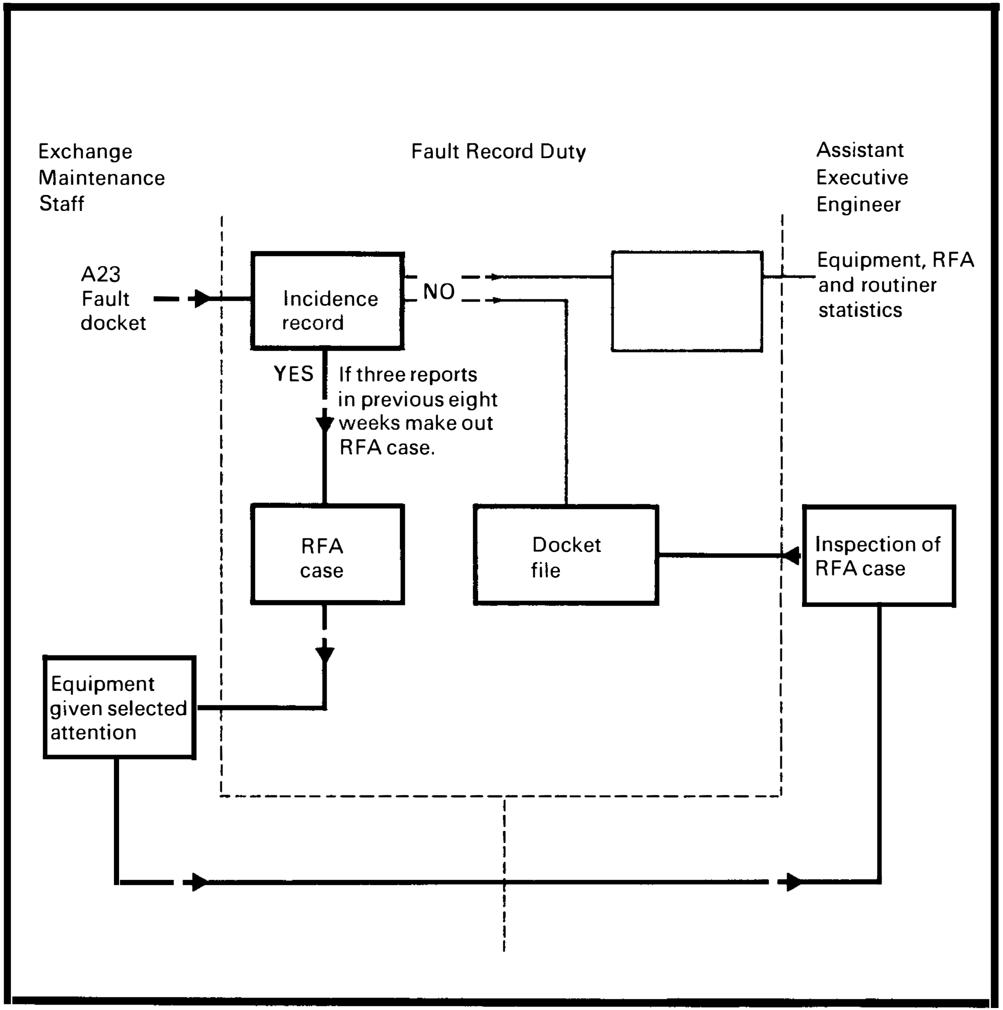
The need is for a scheme which will cater for: a fault record to be kept by a clerical duty so that fault prone items of equipment can be identified and brought to the attention of the maintenance officer concerned for action; information concerning fault prone items to be given to the AEE.

The RANCH scheme is designed to satisfy these requirements by setting up centralised fault record duties (FRDs) using clerical staff. Where practicable, the duties will be performed by the person giving day-to-day clerical assistance to the exchange AEE, and the work done in the regular accommodation provided. Alternatively, the duty may be set up at a central point to deal with the work on behalf of several AEEs.

Normal routine control procedures are unaffected by the scheme and faults detected in any way are corrected as they arise. Routiner A23 dockets, apart from those such as 'Busy' and 'Test Line Busy' are forwarded to the FRD on a daily basis and the information entered on a fault record sheet. The FRD then checks to see if there have been three or more faults or FNFs in eight weeks on the switch, in which case a Recurrent Fault Action (RFA) docket is made out. This, together with details of the faults giving rise to the case, is forwarded to the maintenance officer responsible for the equipment.

The maintenance officer decides on the course of action to be taken and after dealing with the case and entering details of any faults found, and any remedial action taken, returns the case through the AEE to the FRD for filing.

If a previous RFA case has occurred within the last eight week period for the equipment item concerned, then this becomes a



Repeat RFA (RRFA) case. The FRD forwards an RRFA docket together with all the relevant fault dockets direct to the AEE who discusses the case with the maintenance officer concerned before deciding on the action to be taken, which usually means a full investigation. On completion, the case is returned from the maintenance officer again through the AEE to the FRD for filing.

The FRD also prepares summaries of RFA cases, and a routiner symptom fault analysis, before forwarding these to the AEE. These assist in the direction of special maintenance effort to particular sections of equipment and routiners.

The RANCH scheme is directed towards faults detected by automatic routiners and no fault record is kept of faults detected by other methods. RANCH however makes provision for limited preventive maintenance to be given to the equipment concerned on each occasion that a faulty item is detected.

The diagram shows a simplified flow chart of the working of the RANCH scheme. The trial has the support of COPOU and is registered with the Experimental Changes of Practice Committee as field trial no. M430.

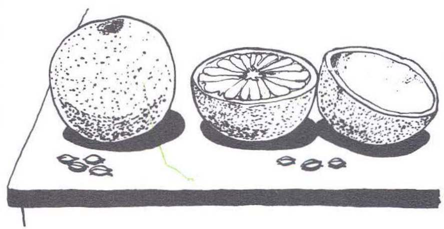
Sv6.1.4. (01-432 1352)

Plant improvement plans – PIP 5, PIP 6 and PIP 7

Plant Improvement Plans (PIPs) are generally short or medium term actions to obtain a better performance from telecommunications plant. The need sometimes becomes evident from analysis of fault returns, analysis of customer complaints and analysis of network performance statistics. Often the adoption of a national plan stems from an idea applied and found successful in an Area or Region.

Maintenance staff rightly expect existing routines to help control the performance of equipment, enabling us to provide a satisfactory service at a reasonable cost. When improvement of standards becomes necessary, despite the additional activity involved by introducing PIPs, these do enable an impassive look to be taken at our activities and achievements, at the same time pointing to equipment or sections of plant impeding progress.

PIPs 5, 6 and 7 are the outcome of a long look at the STD service which involves men and equipment in some 6,000 exchanges, 60 Telephone Areas and 10 Regions. PIPs apply the principle of getting your own house in order before blaming the distant end for failures, and have been shown to pay dividends in terms of improving service. Each plan deals with a particular section of plant. The following paragraphs outline the main objectives of PIPs 5, 6 and 7.



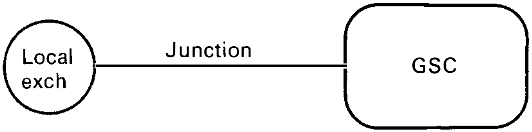
PIPs 5, 6 and 7

PIP 5

This plan is aimed at improving the performance of the STD traffic path, line circuit to GSC. Losses due to engaged plant (PE) and plant defects (PD) in this section of plant are not apparent from Telephone Service Observation (TSO) STD results since these measurements are taken at the GSC, and failures prior to this sampling point are not seen. The customer is affected by them however and benefits from any improvement.

The plan calls for the quality of service to be measured by passing 200 test calls a week during the five working day busy periods and recording the results. If failures are worse than 2 or 4 per cent (PE plus PD), from ND and D exchanges respectively, the equipment involved is inspected for certain defects and, if necessary, subjected to a hold-and-trace test call run. After corrective action has been taken a further measurement is made to verify the effectiveness of the

PIP 5



Items checked:
1. O level 1st code or O level 1st selector
2. Local register (DIR)
3. Junction hunter (DIR)
4. Outgoing MOJ relay set (R/S)
5. Outgoing junction
6. Incoming MOJ or register access R/S
7. Register and translator
8. Switching and test no. in GSC

operation. If losses are again seen to be excessive the faulting exercise is repeated. The plan is applied regularly in Director areas and at local discretion in Non-director areas, where often the condition of this section of plant is monitored by normal test call sending programmes. Basic equipment improvements as well as tester improvements have resulted from experience in applying PIP 5.

PIP 6

PIP 6 has been introduced to maintain the maximum possible number of trunk circuits in service during the normal business day. The aim is to identify circuits which test busy but are not carrying revenue-earning traffic, and faulty circuits which can have traffic presented to them resulting in call failures.

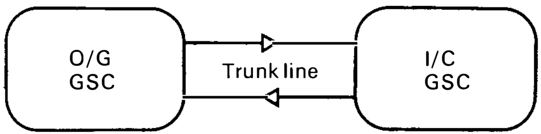
This is achieved by operating the trunk and junction routiners in a step-over-conversation mode, after 9am each day. Each circuit which tests busy is automatically checked to verify if a Called Subscriber Answer (CSA) condition exists on the 2-wire line. If the CSA condition exists the circuit is assumed to be in revenue-earning use and the routiner releases the circuit and continues testing. If a circuit tests busy but the CSA condition is not present the routiner will time out in the normal way and operate a prompt alarm. The circuit is then checked by the trunk maintenance control centre (TMCC) staff to verify whether it is busied for engineering reasons. If there is no engineering reason for busying, action is taken to restore the circuit to service. Circuits which test faulty give a prompt alarm and are dealt with by TMCC staff under the trunk fault reporting procedure.

Each centre operating PIP 6 is required to maintain a record of the number of circuits tested, the number of circuits faulty, the number of circuits busied for engineering reasons and the number of circuits busied for use as part-time private circuits. These results are forwarded to the Regional network co-ordination centre (RNCC) where a trunk outage index for each centre is calculated as follows:

Trunk outage index =

$$\frac{\text{no. of ccts testing faulty} + \text{no. of ccts busied for engineering reasons}}{\text{no. of ccts tested} - \text{no. of ccts busied as part time private ccts}} \times 100\%$$

PIP 6



Items checked:
1. Outgoing signalling relay set
2. Trunk line
3. Incoming signalling relay set
4. Switching and trunk test no. in GSC

Similarly the RNCC produces Area and Regional indices in the same manner. The results are forwarded to the national network co-ordination centre where a national trunk outage index is compiled.

Application of the plan has 'recovered' the equivalent of 700 trunks for traffic use, a figure which increases as the network expands. A target of 99.5 per cent serviceability is considered possible.

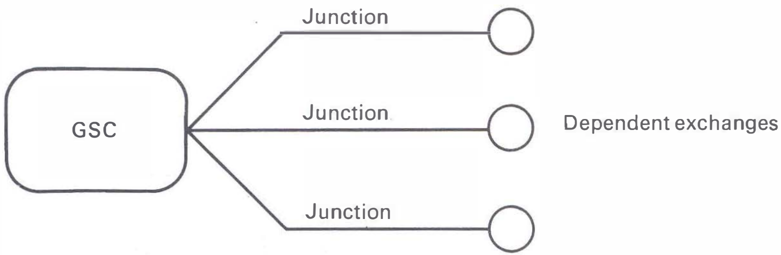
PIP 7

This plan is similar in the method of application to PIP 5 but in this case the plant at the incoming end of a trunk call is involved – GSC to local exchange multiple. In this plan the quality of service is measured from incoming trunk first selectors to test numbers in the local dependent exchanges and corrective action is taken when the PE plus PD loss is seen to be worse than 3 per cent.

Both customers, and the TSO (STD) results of other GSCs, benefit from any improvements made in this section of the network. The need for test call sending over the trunk network to isolate such failures should, as a result, be reduced.

Sv6.2.3. (01-432 1364)

PIP 7



Items checked:
1. Switching in GSC
2. Outgoing R/S in GSC
3. Outgoing junction
4. Incoming switches and test no. in dependent exchange

Now for an interruption

Many readers will realise that

A 10 .' ?43-(28)) :£- @3 - .3"- @3 %49.)35534' 59 %8 @743' ?75 8,5£3 3=3,5 9% 5£3 43:38=3 .3"- @3 ,95 ?38, @ '33, ?6 5£3 9034-594 28)) ,3::3"85-53 - 4303-5 54-,'.8"89, 2£8:£ 8' 3/03,'8=3 %94 5£3 :7'59.34 -' 23)) -' 8,:9,=3,83,5 .

What happened to that teleprinter message? It was interrupted for just ten milliseconds – a letter shift being converted to a figure shift – so that the paragraph became an unintelligible jumble of figures, full-stops and symbols. It can be sorted out with the help of a teleprinter code card, but mangling of intelligence is infuriating if you are in a hurry, as our customers normally are. They will tolerate the occasional printing of an incorrect character but if this happens frequently or results in a meaningless message they will rightly complain. They don't complain all that often but of course we do not wish them to have to tolerate any avoidable interruptions.

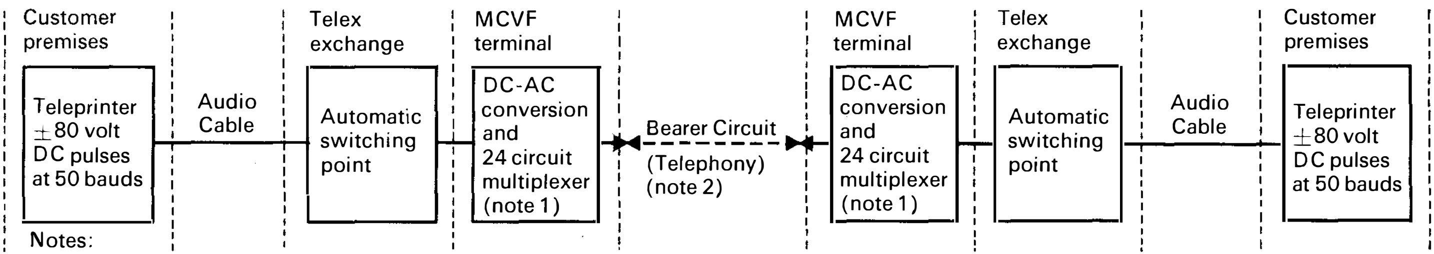
Our problem is to investigate short duration interruptions – of say less than 300 milliseconds – on telegraph circuits or MCVF systems. Message mutilation of the type mentioned above is caused by such interruptions, as are many less spectacular errors we never hear about.

There was a time when long duration interruptions were a formidable problem. Consider the possible routing for a customer-to-customer teleprinter circuit shown in figure 1. Without a doubt the worst source of interruptions is the bearer circuit, which is a 300-3,400 Hz telephone channel routed over an audio, carrier or coaxial line system.

In the early days of multi-channel telegraph systems, bearer circuits were routed over audio and later over 24-circuit systems. Then as the demand for circuits increased because of telex growth the use of the HF network (coaxial systems) had to be considered. Between 1961 and 1963 the incidence of long duration interruptions (greater than 300 milliseconds) on bearer circuits routed over the HF network was compared with the incidence on audio bearer circuits: the HF network was declared unsuitable for multi-channel telegraphy. The challenge was taken up by the introduction of Plant Improvement Plan no. 1 (PIP 1), which set out the causes of interruptions and how to avoid them; it also explained how to interpret the pen-recorder charts used to monitor HF systems. As a result the HF network was much improved, for telephony as well as telegraphy, and is now widely used for the routing of MCVF telegraphy systems.

Long duration interruptions can, generally speaking, be dealt with fairly readily but not enough is yet known about short duration ones. They can be due to things such as high resistance connections anywhere on the circuit; to MCVF equipment; to the coaxial system or associated multiplexing and frequency generating equipment; or to any of the power supplies. Possible causes of faults might be overloading of a coaxial system in the busy period due to badly aligned supergroups, or the occasional sticking

Fig 1



Notes:
1. This equipment is designed for bothway circuits, with DC-AC and AC-DC conversion.
2. The bearer circuit is a telephony circuit routed over audio, carrier or coaxial equipment.

of a mercury-wetted relay in MCVF channel equipment.

Do all such faults get reported and how many are cleared FNF or RWT? To answer such questions, Sv6 have begun an investigation into short duration interruptions on MCVF telegraph systems. A start has been made using an interruption counter 173B with an associated pen-recording dB meter, on a system with a bad fault history. The technique used is to monitor the system as well as a channel of the same system at the receive terminal and compare the number of interruptions recorded. The purpose of the pen-recorder is to indicate the time of day the interruptions occur.

You may think this is not the best way to deal with the problem. Or perhaps you even know the answer already, for there is much expertise in the field. How about letting us have your comments or suggestions? We should be very interested in them. To cope with the problem on new equipment, it is proposed to provide pilot frequencies on all MCVF systems with facilities for pen-recording dB meters and interruption counters.

Sv6.4.2 (01-432 1316)

Revised fault recording procedures for transmission equipment

Since the introduction of transistorised transmission equipment there has been a considerable improvement in the reliability and performance of the HF transmission network. Transistor equipment currently outnumbers valved equipment by approximately five to one and, of course, this ratio is increasing at a significant rate as older equipment is recovered and the network continues to grow. With its inherent reliability transistorised equipment is about 10 times better than its valve counterpart.

Current procedures for recording faults and the method of maintaining surveillance of the network have remained basically unchanged for 20 years. It has become increasingly obvious that these should be critically examined to determine what changes are necessary, in keeping with current trends.

THQ have discussed the subject with a number of Regional Service Divisions over the past few months and draft TIs are being produced. The object has been to reduce the number of records and returns without sacrificing information essential for network maintenance both at local and headquarters levels. This aim can be met by providing:

(a) controlling stations with fault record facilities to ensure prompt clearance and restoration of service;

(b) local management with information from which the performance of equipment and circuits under their control can be judged, and maintenance effort directed to the best advantage;

(c) RHQs and THQ with information about the incidence, causes and treatment of faults so that improvements in organisation and facilities can be made where necessary;

(d) THQ with early warning of specific equipment weaknesses so that these can be rectified by changes of components or equipment design.

The proposed revision of records should satisfy all these requirements and also produce a saving of both engineering and clerical effort.

In the revised procedure the use of the primary fault docket (A62) will be discontinued except for a few special cases. The station fault register (A880) will then become the primary fault record, and the only record for most transmission faults. The A880 will be modified to provide more information on faults in addition to its existing use for progressing faults. The A62 will continue to be used for faults on special circuits, such as programme circuits, and will be modified to suit the new procedure. It may also be used as a temporary fault docket in large stations with shift working to simplify the handing over of outstanding faults from one rota-duty to the next.

The fault history of each wideband circuit (group, supergroup and hypergroup) is recorded at present on individual forms (A63) which, together with other cards detailing line-up information, make up a complete dossier. Under the revised procedure the A63 will become redundant and be replaced with a Visual Display Index (VDI). This will be either wall mounted or free standing in the maintenance control area of the station. A VDI entry will be made for all controlled wideband circuits listed in alphabetical and numerical sequence, and a date reference will be made on the VDI strip against the relevant wideband circuit for each fault. It will therefore be easy for maintenance and supervising officers to see at a glance the wideband circuits which have a high fault liability.

These changes in fault recording should satisfactorily fulfil the requirements of both (a) and (b) but with (c), however, it is not easy for management to determine the efficiency of transmission maintenance. The manhours per maintenance work unit is no guide to the quality of maintenance being achieved since it is unrelated to the loss of service which may result from faults. The present A70 fault summary was introduced many years ago to give an indication of the loss of service by summarising the number of faults on controlled groups supergroups, 24-cct carrier links, and so on, for each Area/Region, together with a summary of the interval of time before fault location commenced and the out of service time attributable to repeater stations. A considerable effort was required to compile this record and it has now largely fallen into disuse. Now that the majority of the HF network is routed on coaxial and radio systems, and with the considerable improvement in the reliability of the terminal translating equipments, most down-time is due to faults in higher order hypergroups and broadband plant. Full particulars of these faults are now recorded and summarised by the network coordination centres organisation so that this information has to a large extent replaced the A70 summary. Under the revised fault recording procedure it is proposed to make this record redundant.

Finally, provision (d): THQ requires information on equipment faults and fault rates so that corrective action can be taken at the earliest opportunity. Comprehensive returns for all equipment faults are at present called for from each Area/Region at six-monthly intervals. In future, THQ will only require this information for 62 type equipment since the causes of faults and fault rates on earlier equipment are now well known. Should any unforeseen trouble develop on earlier equipment it will be brought to THQ's attention by use of the A646 procedure.

Sv6.2.1 (01-432 1371)

Transmission reference and analysis console

In large repeater stations, equipped with 500 or more terminating HF groups, the group fail alarm condition from the group AGC amplifier has been used to give an individual lamp indication of a group failure on a centralized display panel. By the use of simple logic circuits higher order plant failures on supergroups and hypergroups can also be indicated. In addition, by selection of groups having separate routings except for a common but remote routing, it is possible for the station to monitor a remote system. The information available from the display panel enables maintenance staff to quickly appreciate the status of the plant and initiate action to clear failures.

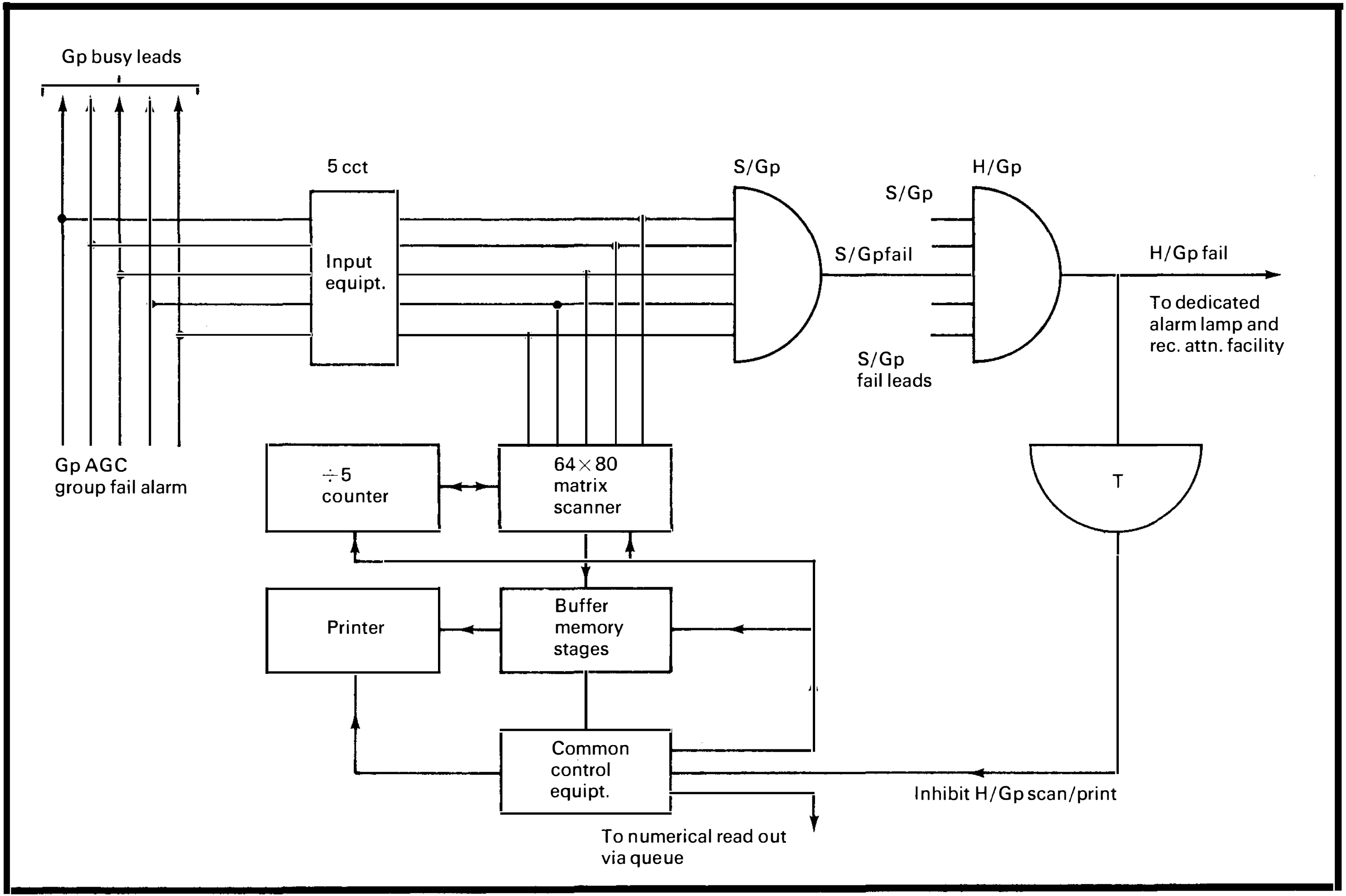
With the growth of the HF network it is not uncommon at the present time for repeater stations to be equipped with terminal groups in excess of 1000. In these cases with an individual lamp indication for each group, supergroup *etc* the display panel and associated apparatus becomes quite large.

Birmingham Area staff, in collaboration with P&S Department, are developing a scanning technique for group continuity surveillance. The group-fail alarm leads are concentrated on a 64×80 matrix, giving a total capacity of 5,120 groups, which are scanned approximately every 15 seconds. The data from the scanner is processed to give a printout. In the event of a group or supergroup failure the printout of the circuit designation is in red and includes the time of the incident: for example, for a supergroup failure – 09.00 SG106; or for a group failure – 09.10 1272.

The printout starts when any input changes state (fails or clears). A group/supergroup fault clearance is in the same format but printed in black. In the event of a hypergroup failure the printer is inhibited to prevent superfluous information being printed. In these cases an illuminated hypergroup button flashes red, accompanied by an audible alarm, with the designation of the hypergroup showing in the window of the button. When the button is depressed (rec attn), the lamp glows continuously red and the audible alarm ceases. On clearance of the fault the lamp flashes again and the audible alarm restarts. Acknowledgement of clear, by depressing the button, restores the alarm circuit to 'clear state'.

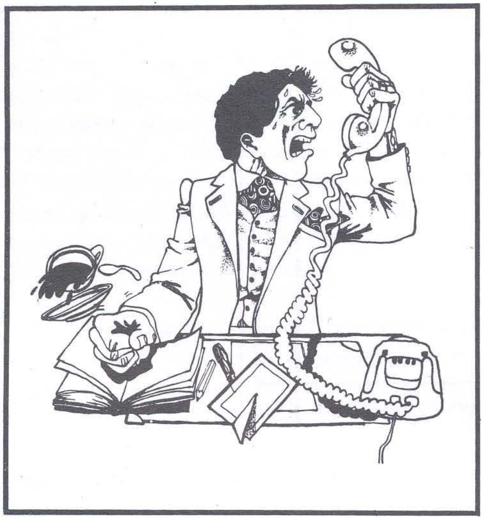
The console provides for 64 hypergroup indicators. Alarms from local regulated line section terminals are also extended to the console on a separate group of lamp button units. A route fail analysis facility is provided by a further group of lamps with easily changeable designation strips. These give an indication of remote system failures, the inputs for these lamps being programmed from selected inputs at the supergroup/hypergroup stage.

Sv6.2.1 (01-432 1368)


Gp busy leads
5 cct
Input equipt.
S/Gp
S/Gp
H/Gp
S/Gpfail
H/Gp fail
To dedicated alarm lamp and rec. attn. facility
S/Gp fail leads
Gp AGC group fail alarm
÷5 counter
64 × 80 matrix scanner
T
Printer
Buffer memory stages
Common control equipt.
Inhibit H/Gp scan/print
To numerical read out via queue

Tell us what you think of TIs

You may not believe this, in view of the weight of paper in your TI files – or the weight sent you for filing – but the purpose of changing to the TI system was to restrict information more effectively than before. The twelve TI Divisions, A to M, correspond to the main functions of Area staff and make it plain where in THQ the authority and responsibility lie for deciding what information should go into the TI files of particular field staff. Thus, in the Maintenance Division of THQ Service Department we are responsible for the contents of the files of all inland telecommunications plant maintenance staff, and control what goes into them. The purpose of controlling information is to restrict it as far as is reasonable to what is essential for the user, which is the long-term aim of the TI system. To begin to achieve it means rewriting probably something like 10 per cent of existing TIs and taking a very critical look at distribution.



It may be quite satisfactory to have voluminous sets of detailed instructions in files in Area offices (types 5 and 4 files), in AEEs' and Inspectors' dens (type 3 files) and at staff assembly points and attended exchanges and other such premises (Type 2 files). In most such locations there is usually someone with time to do the filing and someone with expertise to keep a watch on the list of new and amended TIs and bring new and changed information to the attention of those needing it. Or so we in THQ like to think.

In maintenance, however, some TIs are needed for reference at the work face remote from supervision and it is highly undesirable for the type 1 files the system provides for such situations to be voluminous. The travelling man (or party) has to do the filing and watch out for new and changed information, and if there is over-distribution of TIs neither gets done. Poor service can result, not to mention the frustration of the authors, who have sweated to get their urgent information into TIs, only to have it ignored.

Type 1 files, then, are the big problem, but not a new one. Some field managements, more particularly in external and subs app maintenance, remembering what things were like in the days of EIs, have decided against getting type 1 files for some of their mobile staff. This may be justified where supervision is good enough to ensure that TIs are followed and the long-term performance of the plant remains satisfactory; but in THQ we cannot bank on this in every situation.

Some over-distribution may occur with a system designed to reach basic duties because it cannot possibly cover all variations in the field. Recipients are not expected to file TIs they are never likely to need, but even to sort out the surplus can be something of a chore. One alternative would be for supervising officers to specify individual TIs to be included in the files of travelling staff. This would reflect the way Section files for static staff are compiled; but this in itself would introduce another chore in up-dating the file records every time a relevant new TI was issued, and might well bust the THQ computer looking after the registered files. On balance, retention of the basic duty system is the simplest. Incidentally, if you are inundated with TIs it is always worth checking that you haven't asked for too many basic duties in your file. This is quite a common cause of over-distribution.

The TI system places responsibility for the contents of type 1 inland maintenance files firmly on us in Maintenance Division; and we can, if need be, write E Division TIs specially for them and restrict distribution as we see fit. But it would help to know what you think about the problem. Accepting that most people have been trained at least in the rudiments of their craft and that newcomers learn more by experience and from supervision than by reading instructions, we must ask ourselves whether only TIs of the following kinds should be included in type 1 files: memory aids for procedures learnt on training courses; complex testing and adjusting sequences; tables of figures, for instance those needed in fault location; bulletin TIs (Special Maintenance Information TIs).

What do you think? If you've done your own comb-out we would be interested in a list of the TIs you thought worth keeping, but be sure to tell us also your file number or your basic duties. Or you could let us have your general views in a letter to the Editor. If some Area managements have arrived at solutions for particular cases which could be recommended nationally, we should be pleased to hear about them.

Sv5.1.4 (01-432 1380)

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