THE

Telecommunication Journal OF AUSTRALIA

THIS ISSUE INCLUDES

- PITT EXCHANGE CUT-OVER
- PORTABLE TRT
- QUALITY CONTROL
- FINAL ROUTE TRAFFIC SUPERVISION
- BELLENDEN-KER TV PROJECT

Vol. 24, No. 3

1974

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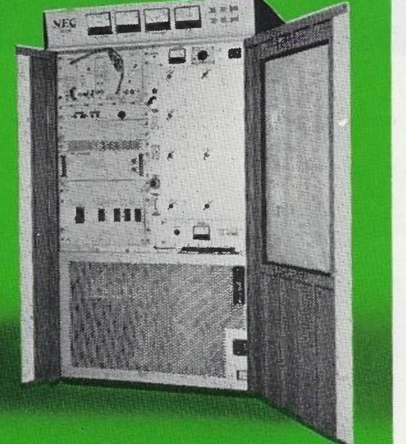

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THE TELECOMMUNICATION JOURNAL OF AUSTRALIA

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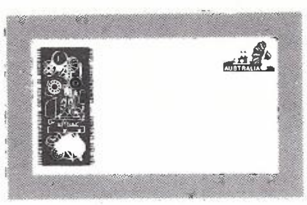

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1974 – Pitt Exchange, The Scene of Major Telephone Cut-overs in the Heart of Sydney

R. G. McCARTHY, B.E.

Features of the Pitt Street, telephone exchange building and of the various types of telecommunication equipment accommodated in this building are included in this survey of the historic major intensive effort needed to successfully cut over Sydney's inner city business areas to crossbar equipment.

INTRODUCTION

1974 is the year of major cutovers in Sydney's newest and largest telephone complex in the Pitt Street Telephone Exchange Building, on which, by 1975, some $27 million will have been spent.

The Pitt building consists of 18 floors designed to house a major local telephone exchange for subscribers in the inner-City area, a major automatic trunk exchange for Sydney's growing demand, and a manual trunk exchange with 230 operators positions (initially) to switch National and International trunk traffic. By 1980 the equipment installed in the building is expected to have reached maximum capacity.

THE SUBSCRIBERS LOCAL EXCHANGE

On the 14th June this year the Australian Post Office undertook the largest single telephone exchange cutover yet attempted in Australia. Some 11,500 lines of subscribers equipment serving subscribers numbers starting with '28' and some '25' codes were replaced within a few hours by 14,000 lines of equipment in the Pitt Street Building. Before cutover these subscribers were connected to the 53 years old "City North" telephone exchange located on an adjacent block at the rear of the new building. Because this is the heart of the business area of Sydney, the average calling rate of these subscribers is among the highest in Australia. The equipment necessary to serve these lines is approximately three times that needed to serve the same number of lines in a suburban area, and occupies three floors of the new building.

The cutover introduced 14,000 lines of crossbar employing 1000 outlet group selector and Reg. LP register equipment at a cost of about $5 million. Some of this equipment is shown in Fig. 1. The external plant costs for the 70,000 cable pairs from some 48 cables that radiate into the network from the new building and associated tunnels account for a further $4 million.

Approximately one third of the total cable pairs provided to interconnect Sydney's telephone exchanges in the twelve months up to June 1974 terminate at Pitt. These terminate on a main distribution frame (MDF) which is two storeys high and 31 meters long (see Fig. 2). The first storey terminates the subscribers' cables and the second junction cables. This frame will eventually replace the smaller frame in the City North buildings. 42,000 cable pairs have been provided to interconnect the frames in these two buildings to allow the old subscribers and junction lines to be progressively transferred to the new MDF.

The installation of the crossbar equipment was carried out by Plessey Telecommunications Pty. Ltd. under contract to the APO. This task took about two years to complete, during which time 1800 racks of equipment on the 3 floors were installed (Fig. 3). This included 1/6th of the total consumption of crossbar switch racks from one year's Australian construction programme.

A realistic target for the cutover was needed to allow directory preparation and subscribers advices to be realeased well in advance. Despite industrial problems, equipment shortages and continual slippages to associated projects such as cable tunnel excavations in the city area, it was decided to have the cutover coincide with the 1974 White Page Directory issue and to introduce controls to ensure this target was achieved.

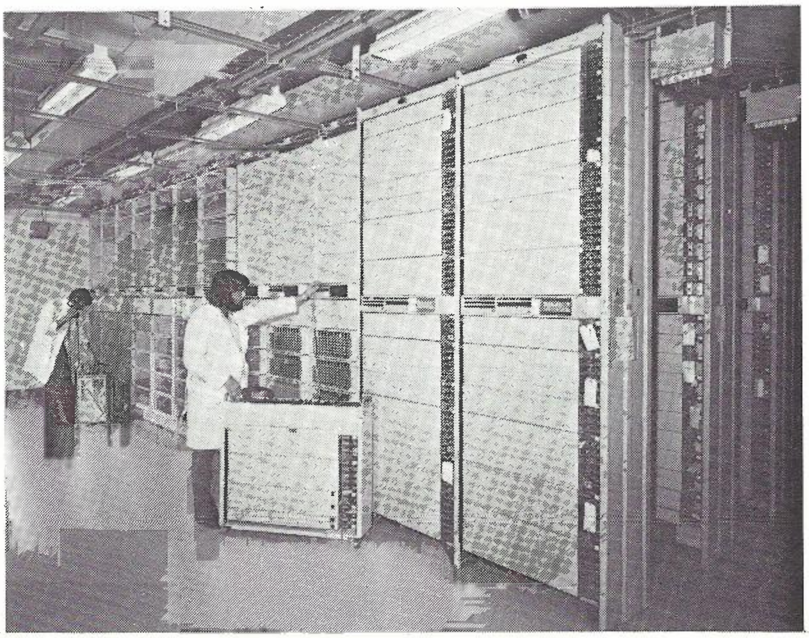


Fig. 1.—View of Half-suite – ARF Equipment Room – 5th Floor.

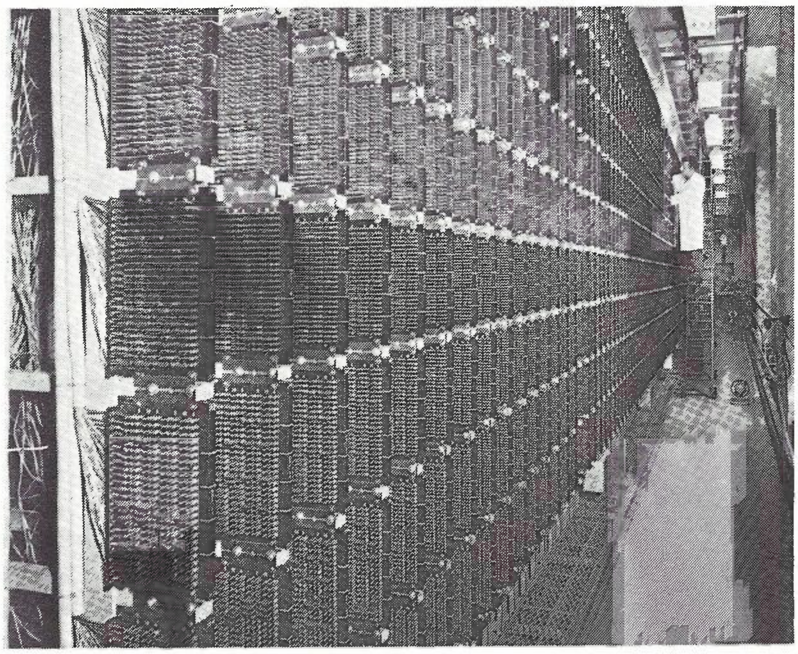


Fig. 2 — View of Equipment Side of Main Distributing Frame (MDF) — 2nd Floor

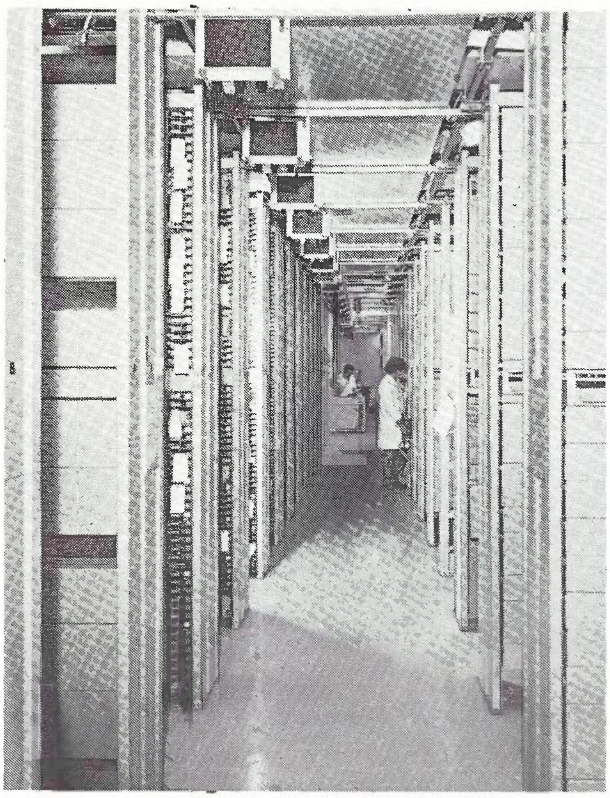


Fig. 3.—View Down Central Equipment Aisle – ARF Equipment Room – 5th Floor.

To the subscribers involved the cutover meant new telephone numbers, starting with 233, 232 and some 231 codes, and improved service with new facilities such as STD. As almost half of the lines involved in the cutover were connected to subscribers' private automatic exchanges or switchboards, the cutover preparations required officers of the Telecommunications Division to determine the necessary alterations to switchboard designation strips and the engraved key caps associated with some substation equipment. Key cap replacements were provided by Post Office technicians, and Service Advisors made brief visits to all subscribers prior to cutover and provided temporary re-designations where necessary. As night switching facilities and special telephone attachments were numerous in the types of businesses involved in the cutover, consultation with subscribers concerning these services was necessary. Modifications were carried out on some types of private automatic branch exchange (PABX) to ensure compatibility with the new crossbar equipment.

The activities at cutover on 14th June were planned to ensure efficient deployment of staff who were given defined tasks and a clear understanding of the order of action. The equipment cables on the City North MDF were cut away by 20 men, 10 on platforms above the rest, whilst the Pitt Exchange was connected by inserting MDF cables at the switching equipment racks. Technical and ser-

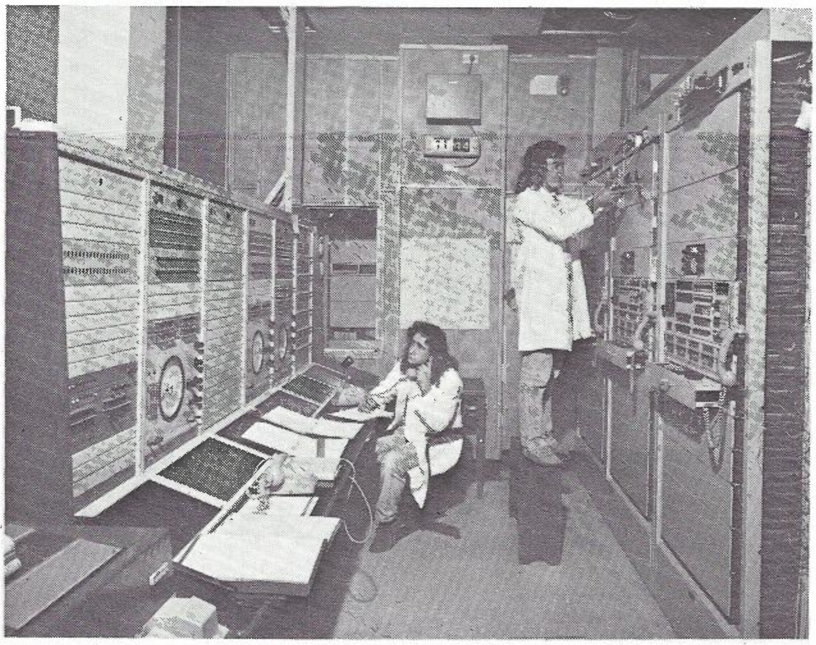


Fig. 4.—ARF Service Control Area with Traffic Route Testers (TRT) and Service Control Racks – 2nd Floor.

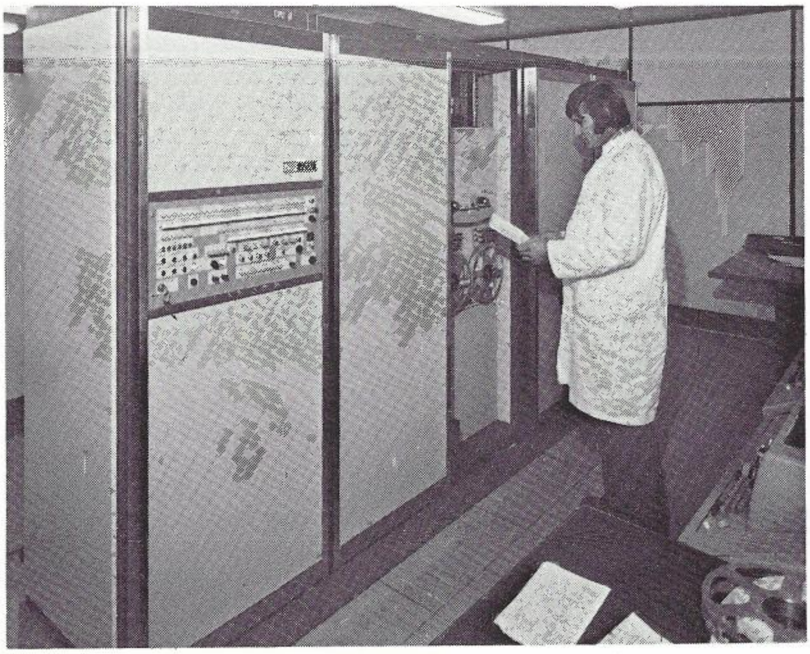


Fig. 5 — Pitt 10C Trunk – Processor Room with ITT3200 Central Processor Control Panel (left) and Paper Tape Reader.

vice test calls were made to subscribers as soon as possible after cutover, but the final test occurred when Sydney's heart resumed business on Tuesday morning 18th June after the long week-end. By 2.00 am on 15/6/74 the cutover was effectively completed and the post cutover testing commenced.

A publicity campaign using TV, radio and newspaper media was run to inform the public of the cutover and the number changes.

A team of 15 officers of the Telecommunications Division were involved in making telephone calls to cutover numbers on the morning of Saturday 15th June and on the following working days Tuesday and Wednesday. Special telephone numbers were advised for subscribers encountering problems at cutover and a temporary repair and dispatch centre was set up in the exchange to handle fault repair and complaint traffic. A team of technicians were on duty to clear exchange faults to attend problems at subscribers premises. Service advisors made a brief post cutover visit to each switchboard (PBX) after completion of the post cutover telephone calls.

A temporary manual exchange with 50 operators positions was installed in the Pitt building to handle the re-direction of calls to the new telephone codes after cutover. A further facility for up to 50 technicians to assist in the redirection of calls was provided and used on the first three working days following the cutover. The '28' and '25' cutover levels were intercepted with a voice announcement directing callers to a special code which accessed the interception operators.

The faults appearing in the post cutover period totalled only 222 of which 174 were exchange faults, 38 were external line faults and 10 were due to record or directory errors. By Tuesday 18/6/74 the number of outstanding faults had been reduced to fewer than 10. At 10.00 am on the Tuesday the re-direction manual exchange was handling approximately 11,500 calls per hour and an estimated 1800 Erlangs of traffic was being switched by the replacement exchange. Local TRT runs after cutover produced switching losses of 0.11% for the "232" exchange and 0.15% for "233". Network TRT runs through Pitt in June and July produced losses between 1.5% and 2.4%.

THE PITT 10C TRUNK EXCHANGE

The trunk exchange currently being installed in the Pitt Building is the first stored program controlled (SPC) trunk exchange installed for the Australian Post Office and is one of the largest of its type in the world.

Australia's requirements for telephone systems vary from those of other nations because of our particular geographical situation and widely dist-

Fig. 6.—Pitt 10C Trunk – Service Control Room with Magnetic Tape Reload Cabinets (in foreground) and Service Control Racks (in Background).

ributed population. The Pitt trunk exchange has virtually been "tailormade" for the Australian network and is known as a Metaconta 10C Exchange. It was designed by the Bell Telephone Manufacturing Co., Belgium, and is being installed under contract to the APO by Standard Telephones and Cables Pty. Ltd., (STC) Australia (see Figs. 5 and 6).

The introduction of the 10 C, SPC trunk exchange in Pitt Street led to the first manufacture of this type of equipment in Australia at a new plant built by STC (Aust.) at Alexandria. Local manufacture of this equipment, which is currently being supplied for similar exchanges in other Australian cities, was an important step in the progress of the Australian telecommunication industry.

The STD portion of the Pitt 10C Exchange was placed in service in September, 1974. This trunk exchange will share the total STD trunk load currently handled by the Haymarket ARM Exchange, and will progressively absorb the growth in trunk traffic to and from Sydney.

The manual assistance suites, which will be commissioned at a later date, have new and unique facilities, such as docketless positions, to handle the manual component of the increasing international and national traffic.

By 1975 some $9 million will have been spent on the trunk exchange Project.

THE PITT LONG LINE TERMINAL

To enable the trunk exchange to receive and process subscribers telephone calls, a complex network of trunk lines is required. Circuits to the exchange come from as far afield as Perth and Darwin, as well as from all other major cities of Australia. Moreover a dense network connects NSW country centres and the rapidly expanding Outer Sydney suburban area to the exchange.

The vast volume of telephone traffic passing over this interstate and intra-state network is carried to the Long Line Terminal by means of 12 MHz Coaxial Cable Carrier Systems each of which has the capacity to carry 2700 simultaneous telephone conversations on the pair of coaxial tubes contained within a cable composed of 12 such tubes.

The equipment used at Pitt, to receive the complex signals passing along the coaxial cable, is manufactured by Siemens (Germany), STC, (UK and Australia) and NEC (Japan) (Fig. 7). Its function is to separate the individual telephone communications one from the other, before connecting the circuits to the trunk and local exchanges for appropriate processing. In October 1974 this equipment provided some 2000 incoming and 2600 outgoing carrier circuits. Ultimately the Pitt Exchanges will have over 50,000 carrier circuits connected to them by means of the Long Line Terminal, while over

20,000 carrier circuits will be extended to other Sydney exchanges for switching.

Apart from its major function of directing telephone circuits to the Trunk Exchange, the Long Line Terminal conducts the feeding of some Radio Station programs to and from NSW country centres, and as a special function receives and distributes black and white and/or colour television programs from the Sydney Opera House.

THE SUPPORTING SERVICES AT PITT

The Pitt street building together with its electrical, mechanical and hydraulic equipment costing approximately $9.5m, posed many design problems. To accommodate the central processor equipment for the trunk exchange, environmental factors required special consideration, for example, the air conditioning units, which at the design stage, were the largest in the southern hemisphere, are capable of extracting 2 million watts of heat from the building and circulating 5663 cubic metres of air per minute.

Two units are required for this purpose, the largest filtering and conditioning unit being enclosed in a container 12.2m x 11.5m x 5.2m high and requiring reinforced concrete construction in lieu of the normal sheet metal. This contains heating, cooling (with chilled water) and humidity controls as well as dust filtering units. The cold outlet duct for this unit is approximately 1.82m x 1.82m cross section and the system operates at 6" of water gauge pressure which is about 4 times that required for a normal air system. Each unit is about 5 times the size of most large building units.

The fire protection system is a special "dry pipe" system, with Nitrogen gas at about twice atmospheric pressure fed to all sprinkler heads. When the electrical "early-warning" system detects an alarm condition from either smoke detectors or thermal sensors, throughout the building, hydraulic valves operate automatically and charge the sprinkler heads with high pressure water. This is released when required, when finally the sprinkler head fuses at the source of the fire.

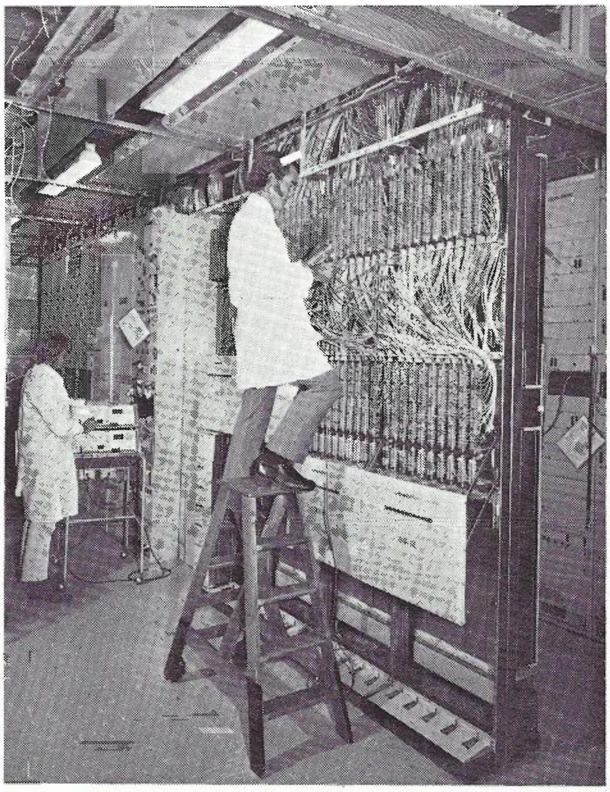


Fig. 7.—Broadband Transmission Equipment Racks and Super Group Distributing Frame (SGDF) – 10th Floor.

As would be expected, a building of such importance needs to be independent of failures to the supply of commercial electrical power. For this purpose a large electrical substation is provided in the building and two 1200 Kilowatt diesel alternators are installed, with compressed air automatic start.

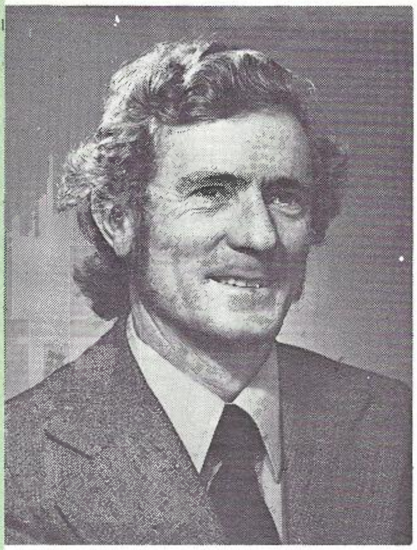
The technological developments as featured in the Pitt Building are significant in the world scene and reflect the status of Australia's telecommunications industry and service.

REFERENCE

1. McKinley B. J., "An Introduction to the 10C Trunk Exchange System"; Telecomm. Journal of Aust., June 1973, Vol. 23, No. 1, Page 85.

R. G. McCARTHY, joined the APO in 1952 as Cadet Engineer and graduated in 1956 as Bachelor of Engineering with first class Honours at the University of NSW. He spent eight years with the Trunk Service Section, Sydney, oversighting service aspects of trunk exchanges and in 1964 transferred to Country Installation eventually to take charge of a Project Division set up to establish the initial ARM trunk telephone network, comprising installations at Haymarket, Canberra and Newcastle. In 1967 he moved to the Transmission Planning Section to control a Bearer Utilization Sub-Section responsible for planning and programming LLE installations for the Central and Western sectors of NSW.

In 1972 he became the Supervising Engineer, Electronic Exchange Installation Section and was responsible for all APO installation activities in the Pitt Telephone Exchange building including ARF local exchanges, LLE installations and the 10C Trunk Exchange Project, as well as an Operations and Maintenance group for 10C. In 1974 the scope of the Section was expanded to include Metropolitan Installation activities in the Blacktown telephone district in the Western section of Sydney.



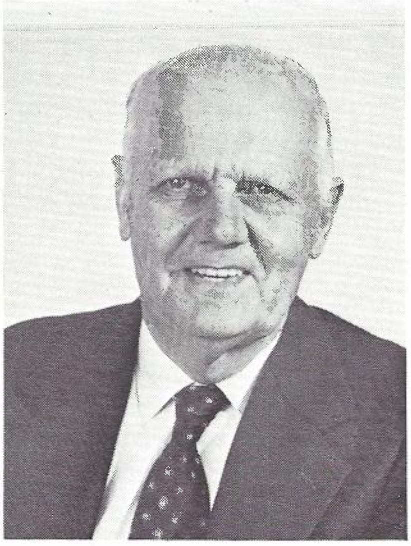
Retirement of Mr. E. J. Bulte, B.Sc.

Mr. Bulte retired on 29th August, 1974, after 47 years service in the Postmaster-General's Department. Following an early part of his career as an engineer in Victoria, he transferred to Headquarters where he spent 20 years mainly in the Telephone Equipment Section. In 1959 he returned to Victoria as Supervision Engineer, Metropolitan Service, later becoming Superintending Engineer, Metro and then Country Branch. At the time of his retirement he was serving as the Assistant Director, (Engineering) Victoria.

Ern Bulte played a number of significant roles in the Society and was made a life member in 1965. He was President of the former Postal Electrical Society in 1958/59, Chairman of the Victorian Division of the Telecommunication Society in 1961/62 and Editor of the Telecommunication Journal 1956/59. When he transferred back to Victoria in 1959, he became a sub-Editor for Victoria and continued in that position until he retired.

The Board of Editors wish Mr. Bulte a very happy retirement.

Mr. F. A. Waters has replaced Mr. E. J. Bulte as a sub-Editor for Victoria. Mr. Waters is a strong supporter of the Society and is at present Superintending Engineer, Planning and Programming Branch.



Portable Traffic Route Tester Model Q1.

R. M. TORKINGTON, B.E. (Elec.), M.I.E. AUST.

The solid state Traffic Route Tester described in this group of articles is among the first of a generation of instruments using extensive micrologic for the testing of telephone exchange operation. In this article, the philosophy of the design approach is outlined, and the motivation behind the various technical decisions made during its development.

INTRODUCTION

When it was proposed that the Queensland Equipment Design Co-ordination Group should develop the new Australian Traffic Route Tester (TRT), the project seemed formidable. The facilities previously requiring a rack of equipment had to be compressed into two boxes, with the usual higher performance expected of new models. The first box was to be a portable TRT with full facilities for analysing calls from one calling to one called line (1 to 1). The Programming Unit, which expands the capability out to 10 to 10 lines and includes less essential facilities, is equally portable but was not specified to be so. The original assumption was that the Programming Unit would be left behind at its normal static installation in a major exchange, while the portable TRT would be taken around small exchanges.

Obviously, the use of major relays was precluded, and extensive use of micrologic indicated. The prospect of performing a direct transcription of existing logical sequences used in earlier TRT's was also impractical, except for some ideas taken from an earlier Queensland electromechanical portable model developed by Mr. C. W. Bowman. Therefore the problem of traffic route testing had to be rethought from first principles.

USER ORIENTATION

Apparently, many a test instrument is designed by deriving suitable logic, circuitry and components, then determining which manual controls are necessary for it to function, choosing a case to contain it, and finally grouping and designating the controls on the front panel. This results in poor user acceptance, because the controls are usually cryptically signwritten, the handbook has to be consulted to find the operating sequence and interpret the readings, and background expertise is needed before easy operation of the instrument is obtained. Many manhours are lost in the field in this way, and test equipment is often ignored for lack of confidence.

It was felt that this design sequence had to be reversed, and severe restraints applied if the project was to be a success. One objective was that a technical person, in charge of the TRT for the first time, should be able to operate it successfully without a handbook. Before detailed circuitry was developed, a key for each function was selected from the specification. Keys and lamps were grouped logically inside heavy signwritten borders, and their function fully described. The circuitry was later devised to fit the key function without qualification or ambiguity.

An instrument which has to be mounted on a trolley does not invite routine use. A clip-in shelf for a BDH rack was designed so that the TRT and Programme Unit can sit side by side in a miscellaneous rack. This defined the depth and width of the cases, and incidentally allowed the Programme Unit to be converted into effectively an 80 to 10 unit, as the sockets alongside it can be wired up with different groups of 10 originating lines. Therefore by selecting a different socket on each run, the traffic can be widely dispersed.

Finally, detailed circuitry was devised, and again a point of operation confidence arose. The interface circuitry to the exchange must resemble normal subscriber conditions, so the switching and impulsing is via metallic contacts and the electronic sensing on control wires is through very high resistance. This eliminates suspicion that the TRT causes or masks faults by distorting normal working currents.

This rigid insistence on operational simplicity has been successful, it appears, to the point where the Technical Supervisor at a country head station can preset the keys, replace the cover, and hand the TRT to a Technical Assistant who is going out to an outlying exchange on routine duties. On arrival, he plugs the cord into a socket wired with power and an exchange line, and this starts the test run. On departure, he unplugs the TRT, and the statistical meters recording the result of the calls are read at the head station.

BASIC CIRCUITRY

There are 15 fundamental steps in originating a series of test calls. They are:

- Reset from previous call.
- Loop calling line.
- Sense predialling congestion failure.
- Send called number digits.
- Dialling completed.
- Ring tone detected.
- Answer signal detected.
- Answer tone detected.
- Busy tone detected.
- Congestion tone detected.
- Transmission test requested.
- Hold and trace fault condition.
- Timeout effective.
- Extend delay between calls.
- Total calls required completed.

This sequence could have been generated with a series of latching gates, but as there are many high voltage level functions to be performed, relays were considered more suitable, with microcircuits performing subroutines at each step. Therefore the circuitry appears as a central process generator of 15 relays, which latch up in sequence during a call, surrounded by solid state elements which are activated at various stages. Each of these is interesting in its own context, but the multitone detector and power supply warrant special mention.

The multitone detector owes its origin to Mr. Paul Travis, of Metro Service Laboratories, Victoria. It was taken to completion by Mr. Chi Chan of Circuit Design Subsection, Central Administration, for another purpose, and was adapted for use in the TRT in Queensland. Basically it detects bursts of tone, and in conjunction with the count of cycles within the burst, marks one of several output leads, indicating a specific service tone.

The five volt power supply involved a difficult decision. The drain of the TRT and Programme Unit is about three amps, or 15 watts. A dc converter plus linear regulator would have been about 40% efficient., thus dissipating 38 watts in the cases. The switching regulator used is 85% efficient, and dissipates 18 watts, which gives an acceptable temperature rise. Unfortunately, a switching regulator gives a rail voltage which must be intermediate between the supply voltages, i.e. negative to earth. Micrologic works with a rail voltage positive to earth, so we had two choices— to operate the micrologic inverted with its V_{cc} tied to earth, or against the negative exchange rail as ground. The former was discarded, because at that early phase of 74 series TTL development, manufacturers warned of the dangers of crossfire from improper voltage supply arrangements, and the latter was adopted because within a sealed case no essential distinction could be made between the exchange negative and positive supplies.

COMPONENT SELECTION

Reliability, lifetime, and spare parts availability problems made many difficult decisions necessary. Normally, test equipment should be ten times more reliable than the tested items for favourable user acceptance, so only high stability components were considered. The required lifetime of the TRT was estimated at 20 million calls over 10 years, in which time, one presumes, some more advanced device will make it obsolete. The spare parts availability problem resulted in our using only items multisourced in supply, and special items from particular manufacturers were disregarded.

The reliability problems of microcircuits were resolved by specifying that only ceramic or Epoxy-B packages were to be used, JEDEC coded transistors were specified, and some components such as the printed boards were called for by military specification. However, this does not assure that they come from a source which exercises good quality control. This latter problem was eliminated by specifying, where applicable for the other components, the ABC coded telephone equipment specification which embodies material inspection.

Lifetime was a difficult problem when selecting a suitable card mounting relay, as no background expertise was available in this context. The ITT PZ6 had just been released on the market, and looked attractive. Before selection groups of these were tested in 'rat race' arrangements, and proved their lifetime up to 180 million operations. Additionally, the design constraint was introduced that no relay, other than the impulsing reed relay, should operate more than once during a call. The only other components with a lifetime problem, incandescent lamps, were discarded in favour of light-emitting diodes.

Fig. 1—Portable TRT—Front View.

Some spare parts availability problems can never be overcome, and printed circuit boards are a prime example. The only solution is for spares of tailor-made items to be ordered on the first production run. Passive components are not a problem, and transistors are readily substituted as no special characteristics are essential to the design. When the choice of microcircuits was being considered, the widely sourced 74 series TTL series was being released, and it was felt that as long as the computers which used these were operational, there would be no supply problem. This choice of a new series in its commercial ascendancy delayed development while awaiting the first shipment of some types into Australia, but ensured that production runs can be made well into the future when other types have become obsolete.

All these careful efforts, of course, can be void if the instrument is not assembled on a production line which has a background of manufacturing expertise in this field, but several factories are well qualified for this work.

STYLING AND MECHANICALS

Good presentation is desirable for ready acceptance of a new instrument, and fortunately the Design Group was able to secure the services of a commercial artist for preparation of the anodising artwork on the aluminium escutcheon. The iridescent blue case colour was chosen to blend with but provide relief from the uniform colouring of an exchange.

Internally, many problems had to be solved. The density of circuitry dictated the use of double-sided artwork, but as many components such as the RJA371 capacitors and PZ6 relays prevented soldering in the top side, plated through holes were necessary. Shockproofing made stranded wire

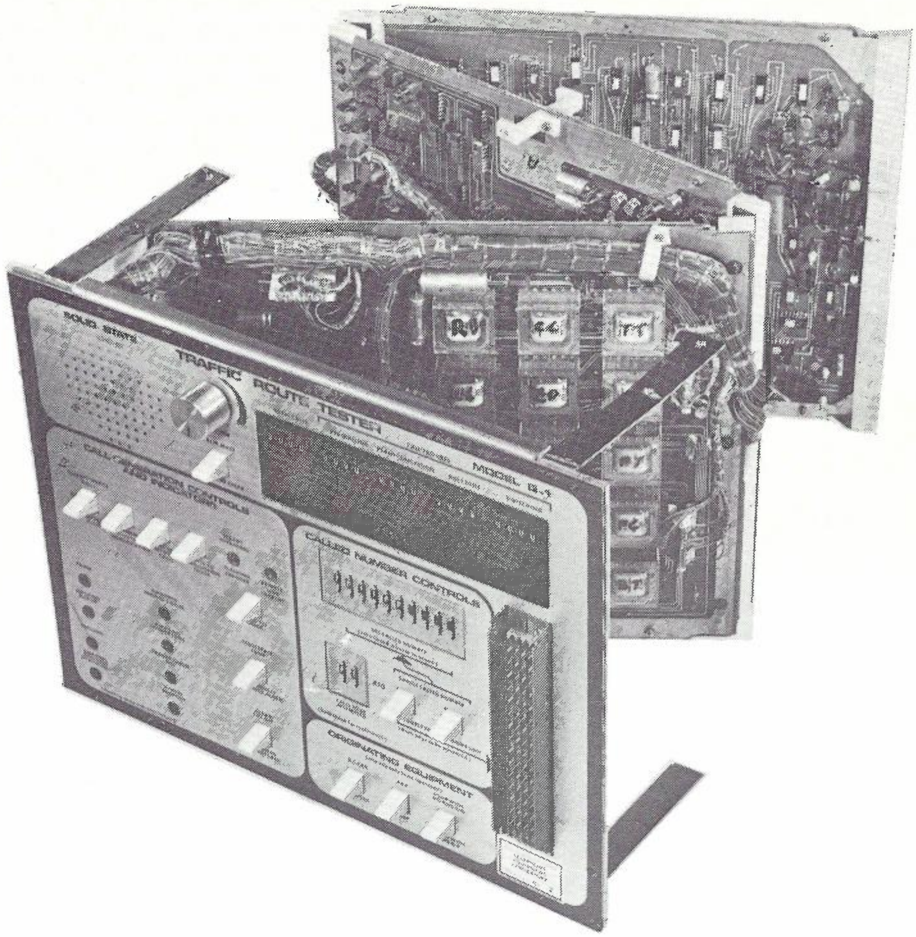


Fig. 2 Portable TRT, showing Z-Fold Assembly.

the obvious choice over the conventional solid wire, and similarly the printed boards were mounted on spring steel brackets to introduce a controlled degree of insulation against vibration. The particular shape of the case, dictated by its rack mounting requirement, and the numerous interconnections (244 wires), precluded small printed boards plugged into a bank of edge connectors. If large edge connectors were used, much of the board would be taken up with wiring between components and the edge. The solution was to use large boards, 34 x 28 cm, made rigid by sandwiching them with their shield plane, and using up to six 22 pin on-board connectors on each in positions which reduced the printed wiring runs to an absolute minimum. A component density of up to 276 per board was achieved. If more conventional techniques had been used, the TRT would have belied its claim to portability. (An ingenious solution to a similar problem, the connection of 100 edge wheel switches on to a component board, is described by the author of a following article.)

The printed boards were then mounted on hinged plastic blocks which allowed them to be opened out widely in a Z-fold arrangement for easy maintenance while fully operational. Figs. 1 and 2 show the TRT in both states.

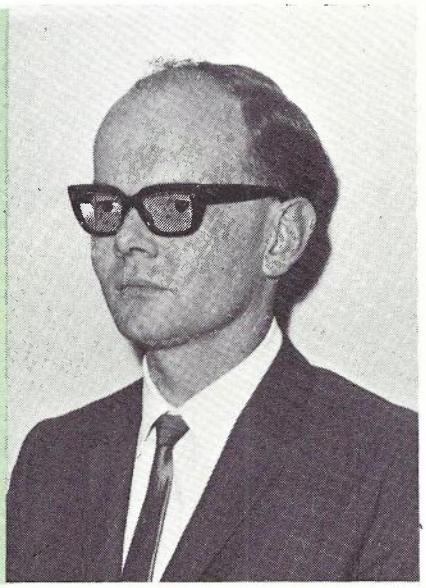
ACNOWLEDGMENTS

Some contributors have been mentioned in the text, who, with members of the Queensland Equipment Design Group, and several members of our Drafting Section, joined in a truly co-operative effort on this project.

CONCLUSION

As with any developmental project, one tends to be wiser after its completion, and to consider how the project might otherwise have been approached. It is now clear that the TRT, Programming Unit, and an elementary Transmission Test Unit, could all have been incorporated in one larger, but still portable, box. However, the savings in mechanical construction effort would have been offset by longer developmental time, and instead of the TRT being ready for production in 1972, and the Programming Unit in 1973, the whole item would have been delayed to 1974. The next generation of TRT's may well be of this form, as the use of complementary symmetry MOS microcircuits will reduce the internal heat generation, and permit greater density of construction with lower risk of transient cross-fire between components. Accordingly this device was named 'TRT Model Q1' rather than 'Solid State TRT', for history has shown that one must accept the inevitability of a Mark 2 version of any instrument being produced once field experience is gained with it.

ROD TORKINGTON joined the Postmaster-General's Department in 1955 as a Cadet Engineer, and after graduation from the University of Queensland spent four years in Exchange Installations. From 1964 to 1972 he was Design Engineer in charge of the Equipment Design Group, where the described project was undertaken. Since then he has been Senior Engineer, Switching, in City Operations Section, and recently moved to Metropolitan Installations No. 1 Section.



Quality Control and the APO Inspector

H. E. DODDS

This article and the accompanying article by J. Marchant in this issue of the Journal are part of a set of articles outlining the methods used to ensure that specified levels of quality are achieved in the purchase, installation and operation of plant comprising the telecommunications network. This article describes, in simple terms, the work of the APO Inspectors responsible for quality control. A survey is given of the various techniques used to ensure in the most efficient way, that the Post Office receives the specified quality in the goods purchased.

The next issue of the Journal will contain two more articles covering the application of quality control techniques to the installation and operational aspects of telecommunications plant.

INTRODUCTION

Everyone has experienced some difficulty, at one time or another, in obtaining the satisfaction which it is reasonable to expect from a purchase when factors such as price, use, and advertised specification or claims are considered. These experiences could range from say one bad egg in a dozen pack or a singlet too small after the first wash to a car with an incorrect ratio differential or a house with the damp course omitted. In each case the purchaser has paid for an article which is not fit for its purpose, an article which lacks quality, or to put it another way the purchaser has not obtained *value* for his dollar.

The APO is buying a large range of goods at a rate approaching $1,000,000 each working day and if works programmes and service standards are to be met these goods need to be quality goods. It is obviously desirable to have the quality of goods monitored by a centralised group of specialists and for this purpose the APO has an inspection authority and APO inspectors.

THE APO INSPECTING OFFICER

The APO inspector has the primary function of ensuring that the APO obtains *value* for each committed procurement dollar. This seems a simple enough objective but it is often difficult to reach. He works as one of a team made up of inspection officers, senior inspecting officers, and engineers. This group is the inspecting authority and is part of the Support Services Branch in the State Administration. The Inspector has as his tools a schedule, a contract, and a specification. For an increasing number of items he will also have a defect classification list (DCL) issued by the Materials Section, Central Administration, which will classify predicted potential defects and nominate quality levels for each class. The schedule sets out the commercial, delivery and specification information a potential contractor needs in order to submit a tender. When a contract is awarded it will either confirm or amend the specification information.

An example of a specification is given in Fig. 1 where a 3000 type relay, with which the reader may be familiar, is shown together with the relevant documents and drawings which contain the information defining the make up, adjustment, and performance of the relay. You will perhaps be surprised by the number of standards, specifications and drawings which apply to a 'simple' item. Consider then the scope and range of documentation needed for the manufacture of a more complex product. However, to return to the example, if any characteristic of the finished relay fails to meet the specification requirement then clearly the APO is not receiving the *value* for its dollar that is *expected* and that it is *entitled* to receive.

The specification itself introduces inspection problems. The documents can be very general or extremely detailed in content. Neither is entirely satisfactory from an inspection point of view because the specification cannot cover all aspects that arise at the time of inspection. The inspector therefore, working as part of the inspecting authority group, must first understand the meaning of the specification. He must also avoid allowing his own ideas to vary the intent of a contract. Should the need arise, perhaps because of differing interpretation, he must be able to communicate to the contractor the reasoning governing the inspection decision.

INSPECTION TECHNIQUES

The amount and style of inspection used is influenced more by the contractor's organisation than by the product. Contractors can be arranged into three broad groupings:

Group A Contractors without an inspection section. The APO can only use lot-by-lot (batch) inspection with this group.

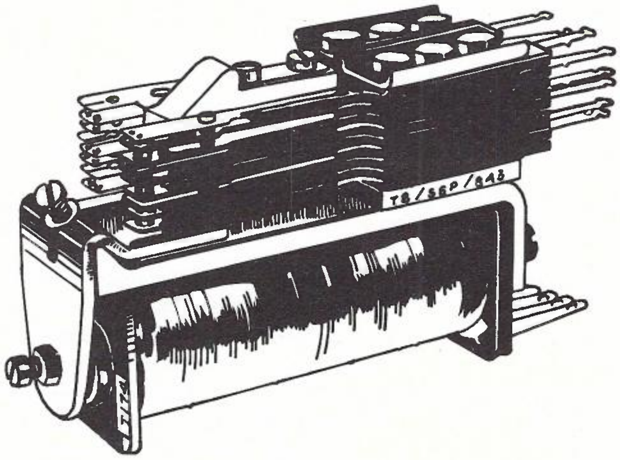
Group B Contractors with an inspection section. Here the APO can use lot-by-lot inspection or lot-by-lot inspection combined with validation of the contractor's inspection system.

Group C Contractors with a quality control organisation. With these contractors the APO prefers to use a surveillance type activity which includes system and product audit.

CONTRACTORS WITHOUT AN INSPECTION SECTION

Lot-by-lot inspections are carried out generally in accordance with the techniques set out in Australian Standard Guide AS1399-1973 for sampling methods based on the mathematical theory of probability. Usually when an inspector arrives at a Group A contractor's premises he finds that he is dealing with the salesman or the production foreman and that he has a batch of completed material to inspect which is already packed for despatch. If the product is a simple one where an attribute inspection can readily check each characteristic of the completed product the inspector's problem is small. He can determine that the specification is met, he is fulfilling his function, he knows *value* is being obtained. However, only simple or piece part type products fall into this category e.g. a nut, a bolt, insulated wire, cable jointing pits, etc.

When the product is more complex e.g. a relay, a sealed carrier frequency filter, a relay set, a test instrument, a telephone, a switching rack, a Private Manual Branch Exchange (PMBX) what can the inspector do? He can determine that the product functions correctly and that it continues to function



PART	SPECIFICATION	DRAWING
MAIN ASSEMBLY	TEQ 3001A	CE60001 CE31000 SERIES
YOKE		CE80013
ARMATURE		CE80019
CORE		CE60033
CHEEK	BS 2572	CE60033
SLUG	BS 198	CE80020
SPRING	BS 1824	CE80015
BUFFER BLOCK		CE80010
LIFTING PIN	BS 885	CE80015
RESIDUAL	BS 369	CE80019
COIL WIRE	BS 156 BS 1844 BS 3160 BS 3188	
KERAMOT	BS 234	CE80019
SCREWS	BS 57 AS B85 AS B46	CE80021 C619
SHIELD		CE80012
SPRING GUARD	BS 790	CE80011
PLATING	TEQ 1001 AS K133 AS K144	

Fig. 1 — Specification Documents for a 3000 type Relay

over the specified range of environmental conditions. However, short of dismantling the sample items under test, the inspector cannot determine whether they are constructed in accordance with the specification and of the specified materials. If the item is not as specified then, even though the item functions correctly at the time of inspection, it may not have the service life or service reliability that is intended. The inspector may, of course, check materials and components that are probably the same or similar to those used in the item being inspected. He may talk to the contractor about construction methods. He will no doubt come to a decision that the items should be accepted but he is aware that he is not fulfilling his function. He does not necessarily have full assurance that the item conforms to specification. He does not know that *value* is being obtained.

CONTRACTORS WITH AN INSPECTION SECTION

When dealing with contractors who have an inspection section (Group B above) the APO inspector will usually handle the inspection much as he would do if it were a submission from a Group A contractor. However, he will be dealing with a supplier representative at least partly separated from the production function. He will be inspecting items subjected at least to final inspection by the contractor. Basically however the APO inspector runs risks as already discussed, he still lacks full assurance that the specification has been met in all respects.

The inspector can add to his problems if he arrives at a 'reject' decision — which he must enforce — when the contractor's inspector has previously arrived at an 'accept' decision on the same batch. Such conflicting results are possible due to the risks involved in sampling. (Ref. 1).

Some contractors in Group B have developed strong independent inspection departments. When this is so it is possible to use a mathematically based technique to validate the contractor's inspection system. The method is outlined in the U.S. Defence Department inspection handbook H109. The technique enables the suppliers inspection system to be compared to that of the inspecting authority by statistical method. Provided there is no evidence of significant difference in the systems the material is accepted on the results obtained by supplier inspection. The authority to allow delivery however lies with the APO inspecting officer.

For the validation method to be used successfully it is necessary for the manufacturer and the inspecting authority to have agreed on the classification of defects. It is also desirable for each to verify defects found by the other whenever possible. Furthermore the contractor and the inspecting authority should have an agreement to trace defects in an effort to find an assignable cause.

The APO inspector now has an agreed way to involve himself, together with the contractor, in all stages of production. He can get 'inside' the contractor's system. He knows more about what is in the product and how it was built. He can obtain a greater degree of assurance that the specification is met. The inspector has a much improved opportunity to fulfil his function, a much improved opportunity to know that *value* is being obtained.

With validation the amount of inspection of completed product that the APO inspector performs is generally less than that required in the usual lot-by-lot situation for a given degree of assurance but the amount is still important as it forms the standard that allows the supplier inspection department to be judged.

CONTRACTORS WITH A QUALITY CONTROL ORGANISATION

Some manufacturers, those termed Group C above, have found that it is best for them to apply a system of Quality Control to their operations. When this is so the inspecting authority and the inspector can obtain assurance in a way very different from that used in other circumstances.

You will remember that quality is 'fitness for purpose' an idea which, in the inspection environment, might best be stated as 'conformance to specification'. If this is so what then makes a quality control organisation different from a lot-by-lot inspection situation?

Lot-by-lot inspection is the checking of samples from a batch of completed items in an effort to determine if that batch of items has been manufactured to the specification and to determine if the number of defects in that batch due to the manufacturing process exceeds the limits set by the customer's quality requirement.

Quality control provides a means of knowing whether items of a population are being manufactured to the specification and a means of assessing the number of defects occurring during the manufacturing processes so that the completed items will fully meet the customer's quality requirement. This is achieved by establishing an integrated system of formal controls governing design, documentation, purchasing, storing, tooling, processing, fabricating, inspecting, testing, and packing of product. The responsibility for quality control will rest with a quality manager who ideally should report directly to the chief executive. The quality manager should have a mandate which is set out in the written quality policy of the manufacturer.

System elements used by contractors with a quality control organisation will include:

- Documented work instructions of a type appropriate to the situation which will result in the production of material that will meet the customer specification.
- Documented inspection instructions and an inspection record system together with a means of reliably identifying the inspection status of materials, piece parts, and products.
- A system for the control of issue and retrieval of documentation.
- Laboratories appropriate to the product preferably at a standard enabling National Association of Testing Authorities (NATA) registration.
- A training system which not only teaches the necessary manipulative skills but also fosters quality attitudes.
- An independent audit of processes, controls, and products, at various stages of production to assure the manufacturer, and the customer, that the control system is effective. The function of proving the degree of control achieved by the quality control systems is sometimes referred to as quality assurance.

APO APPROVED FIRMS SCHEME

Manufacturers who implement these controls and do it well will almost certainly apply to the APO to be assessed for inclusion in the APO Approved Firms Scheme (Ref. 2). This scheme recognises the ability of the contractor to produce a quality article and allows him certain advantages not the least of which is the right to sign material release notes, which allows him to deliver material direct to APO stores generally without need to submit each batch of completed material for APO inspection. The manufacturer then has opportunities for considerable flexibility in the organisation of his production processes with attendant economies throughout his organisation.

What then of the APO inspector at an approved firm? What is his function? His function remains the same. He still needs to ensure that *value* is obtained for each dollar. He will not normally use any form of lot-by-lot inspection. He will rely on surveillance of the control systems and audits of products and processes but will carry out detailed inspections of first delivery items.

The term surveillance, in the APO inspection context, is not used in the sense that has become popular in the detective stories of the TV and paperback world. It does not mean to shadow, to see without being seen, to spy — indeed nothing could be more counter productive, more self defeating, than attempting to disguise inspection activity. Surveillance means "careful watching" and is an open activity. Open, however, does not mean that the contractor is aware in advance of what specific inspection activity is going to occur at any point in time. With the exception of contractor submitted first deliveries all inspection activity is both random and unannounced.

Fig. 2 illustrates the inspection alternatives. You will recall that at a Group A factory the inspector had a batch of completed material to appraise. I should point out that it is unlikely that he penetrates beyond the despatch area in that situation. At a Group B factory he will in some cases penetrate to the production area he may also, especially where validation is used, be involved with the contractor in investigation in some production areas. With approved firms the inspector has what amounts to freedom of the factory!

Freedom of the factory! Think about what that means to the customer. It means the inspector is no longer faced with the need to make an acceptance decision about a black box which functions and which may be as specified. He knows what is in that box. He knows how the purchased components get through incoming inspection, how they are stored and how stock is rotated. He knows how other parts are made and what they are made from and how they are inspected. He knows how the black box is assembled and what the workmanship standards are, even what type of gloves, if any, that an operator wears. He knows how the test room works, what its standards are and how they are maintained and controlled. He knows about the documentation that controls each and every operation in the chain from design to delivery. He knows about each inspection stage and each set of inspection records. He knows that that black box meets the specification. He is fulfilling his function. He knows *value* is being obtained.

Freedom of the factory! Think what it must mean to the manufacturer. It must mean that he, the manufacturer, has confidence in his control systems. He is demonstrating his confidence by allowing customer representatives to observe, to check, to question, and to comment on any aspect that has anything at all to do with producing a quality article. It means the manufacturer is allowing customer representatives, the inspecting officers, to become aware, directly and indirectly, of his total organisation, techniques, and methods. It means the manufacturer is displaying a great trust in the inspecting officers to act responsibly at all times.

Surveillance inspection at approved firms is the

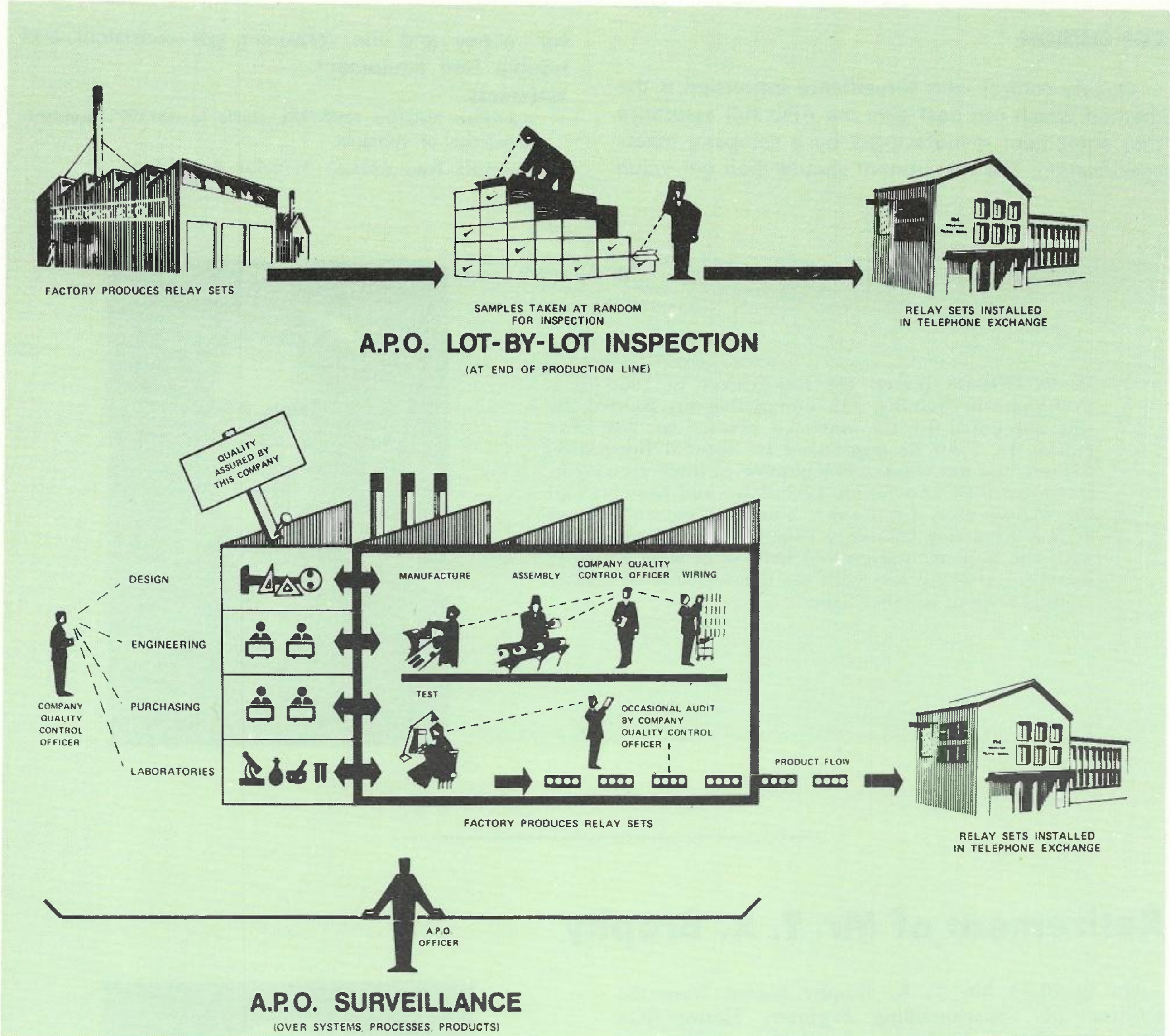


Fig. 2 — The Inspection Alternatives

most economical of the various inspection situations that exist in the APO. Firstly, because the ratio of inspector manhours to unit of product delivered to store is by far the most advantageous and secondly because an item from such an area is, in general, more likely to meet APO requirements than a similar item from a non-approved source. Other economies are likely to come from quality control systems and the approved firms scheme but as they are more closely related to the manufacturer's and the consumer's areas they are outside the scope of this article.

The surveillance method is very demanding of the inspector. No APO inspector has more responsibility than those stationed in the factories of approved firms, no other APO inspector needs a wider range of skills yet undeniably surveillance is better for the inspector. It is better because he can establish beyond any doubt that specifications are met, he can be quite certain that *value* is being obtained for the committed procurement dollar. He therefore has the satisfaction of knowing he is able to do his job and do it well.

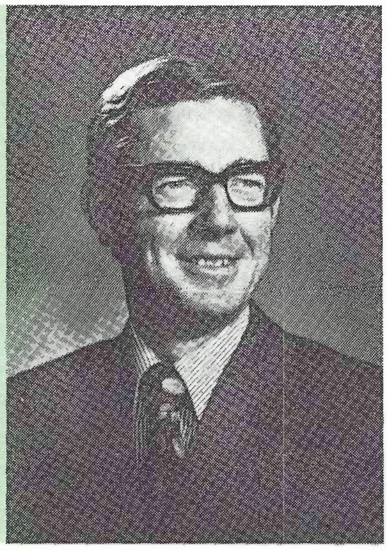
CONCLUSION

Quality control with surveillance inspection is the method which can best give the APO full assurance that equipment manufactured by a company meets specification. The department should then get value for money and the consumer get consistent and trouble free equipment.

REFERENCES

1. 'Australian Standard 1399-1973. Guide to AS1199'; Standards Association of Australia.
2. 'Approved firms scheme'; Australian Post Office.

H. E. DODDS joined the Department in 1950 as a Technician-in-Training. On completing his training he was appointed to the one-man district of Wee Waa N.S.W. In 1959 he transferred to Material Inspection, Sydney and has worked in a number of inspection areas. He is qualified as a Senior Technician and has obtained the Management Certificate. Since his appointment as Senior Inspecting Officer in 1968 he has been concerned with the implementation and control of APO activities in approved firms, and with the development of quality control systems in other firms.



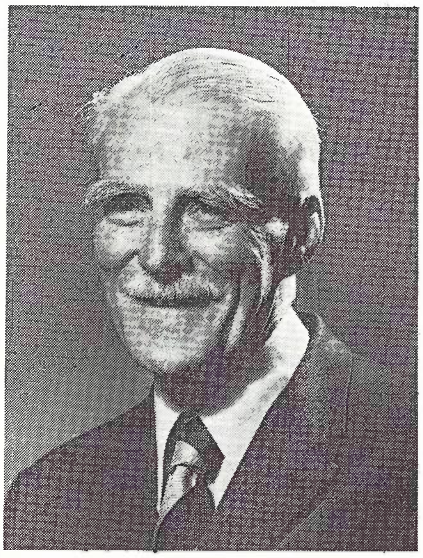
Retirement of Mr. T. R. Brophy

On 26.10.73 Mr. T. R. Brophy retired from the position of Superintending Engineer, Metropolitan Operations Branch, in the New South Wales Engineering Division of the APO.

Mr. Brophy's first contribution in the communications field occurred on 11th November, 1918 when, as the ten-years-old son of the non-official Postmistress at Upper Manilla in northern NSW, he was given the job of calling the twenty-two subscribers to tell them that peace had been declared, a public holiday had been proclaimed and all were invited to celebrations in the town. Fifty-five years later he was controlling a staff of more than 6,000, providing service to approximately one million subscribers in the largest city in the nation.

After joining the Department as a Cadet Engineer in 1926, Tom worked extensively throughout NSW, predominantly in areas concerned with external plant and, after many years as Supervising Engineer, Lines Planning, was recognised as the leading authority in that field in NSW.

With a personality that made him very popular with all levels of staff, he will be most remembered for the assistance and guidance he gave to the many younger Engineers who were fortunate enough to make his acquaintance.



On behalf of all readers, the Board of Editors congratulates Tom Brophy on his achievements and wishes him a long and happy retirement.

Quality Control and the Manufacturer

J. MARCHANT

This article outlines the role of Quality Control both as a management system and an integral phase of the manufacturing process, interfaced between the customer and the manufacturers design and industrial engineering department. As well as setting out the need to obtain agreements with the customer on Acceptable Quality Levels (A.Q.L.), it indicates the techniques employed to ensure early warning of any deterioration in standards during manufacture, thus ensuring that the customer receives a product which will provide good performance with low maintenance effort at a reasonable cost.

INTRODUCTION

"Quality Control is a management system for planning, programming and co-ordinating the establishment, maintenance and improvement of quality and reliability by the various groups in any or all of design, procurement and manufacturing organisations so as to enable production at the most economical level and with such quality assurance as will provide for full customer satisfaction".

This definition of Quality Control was adopted by a committee of Scientific, Industrial and Governmental Organisations set up by the Standards Association of Australia and of which the Postmaster General's Department was a prominent member. It was published as Standard AS.1057 in 1971.

It lists in a concise manner all the important elements of Quality Control and is a very useful summary of what follows.

QUALITY

At the first mention of the word 'Quality', people conjure up a vision of a highly polished, highly efficient piece of equipment, completely free from defects of any kind, such as every manufacturer would want to produce but can't because the purchaser would not be prepared to spend the amount of money it would cost. There must, therefore, be an agreement in the purchasing contract which sets out the degree of variance from the ideal which is acceptable to both the purchaser and the manufacturer.

It is not possible to manufacture two items which are exactly the same nor is it possible to manufacture complex articles which are defect free. Even that most sophisticated and carefully controlled product, the space rocket, can have a number of defects, as the small but significant number of failures will testify.

Each item that is produced from a die in a machine varies slightly from the one before and the one after it and when one considers the vast number of components which the manufacturer produces, the task of mass-producing the perfect and consistent article becomes largely impossible.

Each batch of raw material received varies between sources of supply in chemical analysis and physical characteristics such as hardness, machinability, size and finish; every stroke of a machine causes some wear; changes in temperature and humidity affect material being processed and tested; but most important of all, workmanship will vary since training, skill and experience are different for each operator and his health, boredom and tiredness will affect his efficiency from day to day.

Imagine the task confronting the manufacturer of a Crossbar Switch Rack.

Each rack contains over 30,000 piece parts made from various materials of differing thickness, hardness and finish; an average of 14,000 terminations which have to be stripped, joined and soldered correctly. Each rack requires 7.2 km of wire which has to be formed to cross-connect to the terminations and then there are over 12,000 spring tensions or adjustments which have to be made to close limits. A formidable task to manufacture one, let alone produce 60 racks per week requiring employment of over 100 different people; when one considers the total number of possible defects which could occur the probability of some variance is indeed very high.

It is the occurrence of these variances that Quality Control sets out to limit. It is also because of these variances that it is essential for the customer to state the maximum amount of variance he is prepared to accept when calling for tenders.

The limit of variance is expressed in Australian Post Office contracts as the 'Acceptable Quality Level' which varies according to the importance of the potential defect.

Acceptable Quality Level or 'A.Q.L.' as it is usually called, is expressed either as per-cent defective units or defects per 100 units, depending on the circumstances.

For example, A.Q.Ls. for R-series relays as used in the crossbar system, are:

- 0.1% for Special defects;
- 0.65% for Major defects;
- 2.5% for Minor defects;

whereas for rack wiring the A.Q.L. for Major defects is 0.02%, which reflects the very great importance given to wiring quality in the maintenance of the switching system.

By definition (Aust. Standard AS.1199):

- A *Special Defect* is a defect, other than a critical defect, which makes an item or unit of product useless for the purpose for which it is designed or which is otherwise completely unacceptable.
- A *Major Defect* is a defect, other than critical or special, that is likely to result in failure, or to reduce materially the usability of the item or unit of product for its intended purpose.
- A *Minor Defect* is a defect that is not likely to reduce materially the usability of the item or unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the item or unit of product.

Quality then can be described as 'Fitness for Purpose', and it is important to emphasise that the term 'Fitness' is ultimately bound up with cost, or what the customer is prepared to pay.

It is the function of the Quality Control Department then to ensure that the Purpose is clearly specified and attainable, that controls are built into the method of manufacture which will alert all concerned, when the Fitness is not being built in and finally that the Purpose has been achieved as economically as possible.

QUALITY CONTROL

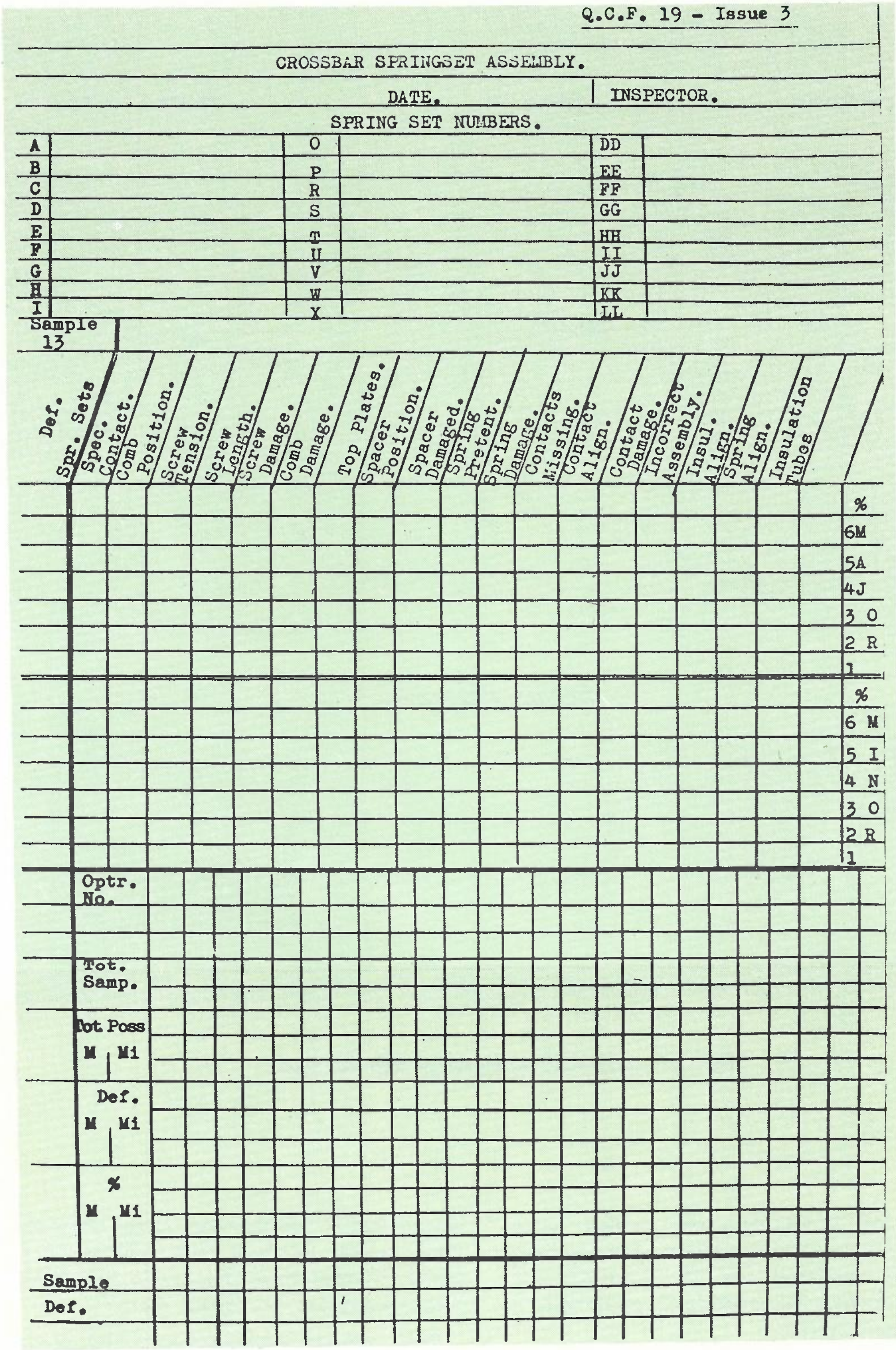
In the early days of manufacture, the design, the method, the actual production itself and the quality of the article were all left to a skilled or master craftsman who made his own decisions using his technical skill, experience and inbuilt feedback system.

Mass production created the need for less skilled labour and Inspectors became necessary to ensure that only satisfactory items were delivered to the customer. Except in certain circumstances, this is not an entirely satisfactory procedure. Firstly, it leads to arguments over matters of opinion between the Inspector, the Production Foreman and the Accepting or Purchasing Authority; secondly, one hundred percent inspection is rarely better than eighty-five percent efficient; and thirdly, whether acceptable or not the product has already been made and there is invariably a quantity of defective work in the pipeline; there is a natural tendency to attempt to use the rejected items.

Under mass production conditions with the use of process workers, the skills and characteristics of the master craftsman devolved into separate groups of technical specialists. Thus new disciplines came into the world of manufacture. The Design Engineer determines what is required, the Industrial Engineer plans each step of manufacture and the Quality Control Engineer, in conjunction with the other two ensures that potential defects are limited at each step of manufacture. Of equal importance to the determination of the *number* of defects is the recording of the findings and the feedback of information to assist the other two groups or departments to improve design and method. Thus the 'after the event' inspection is replaced by an in process recording of 'events as they occur' which allows the production team to determine the cause of the defects and correct future production. Control is thus established of both the process and the product and a team spirit replaces the previous punitive relationship between worker and inspector.

Efficient manufacture is dependent upon two main quality aspects, 'Quality of Design' and 'Quality of Conformance'.

Quality of Design is too often taken to refer only to functional requirements, reliability and basic standards. It is much more. It includes consideration of economy of manufacture, design of tooling, planning of the sequence of operations, process capability studies, segregation of characteristics into defect potentials and classifications. It includes the design of Sampling Plans and the preparation of Inspection Procedures which will keep the whole production team aware of the quality levels at all stages of manufacture. The procedures when implemented provide evidence of quality changes, the need for corrective action and evidence for the purchasing authority of the quality they are getting at all stages of manufacture.



Q.C.F. 19 - Issue 3

CROSSBAR SPRINGSET ASSEMBLY.

DATE.	INSPECTOR.

SPRING SET NUMBERS.

A		O		DD	
B		P		EE	
C		R		FF	
D		S		GG	
E		T		HH	
F		U		II	
G		V		JJ	
H		W		KK	
I		X		LL	

Sample 13

Def. / Spr. Sets / Spec. Contact. / Comb Position. / Screw Tension. / Screw Length. / Screw Damage. / Comb Damage. / Top Plates. / Spacer Position. / Spacer Damaged. / Spring Pretent. / Spring Damage. / Contacts Missing. / Contact Align. / Contact Damage. / Incorrect Assembly. / Insul. Align. / Spring Align. / Insulation Tubes.

% / 6M / 5A / 4J / 3 O / 2 R / 1

% / 6 M / 5 I / 4 N / 3 O / 2 R / 1

Optr. No.

Tot. Samp.

Tot Poss M | Mi

Def. M | Mi

% M | Mi

Sample Def.

Fig. 1 — Quality Control Form 19.

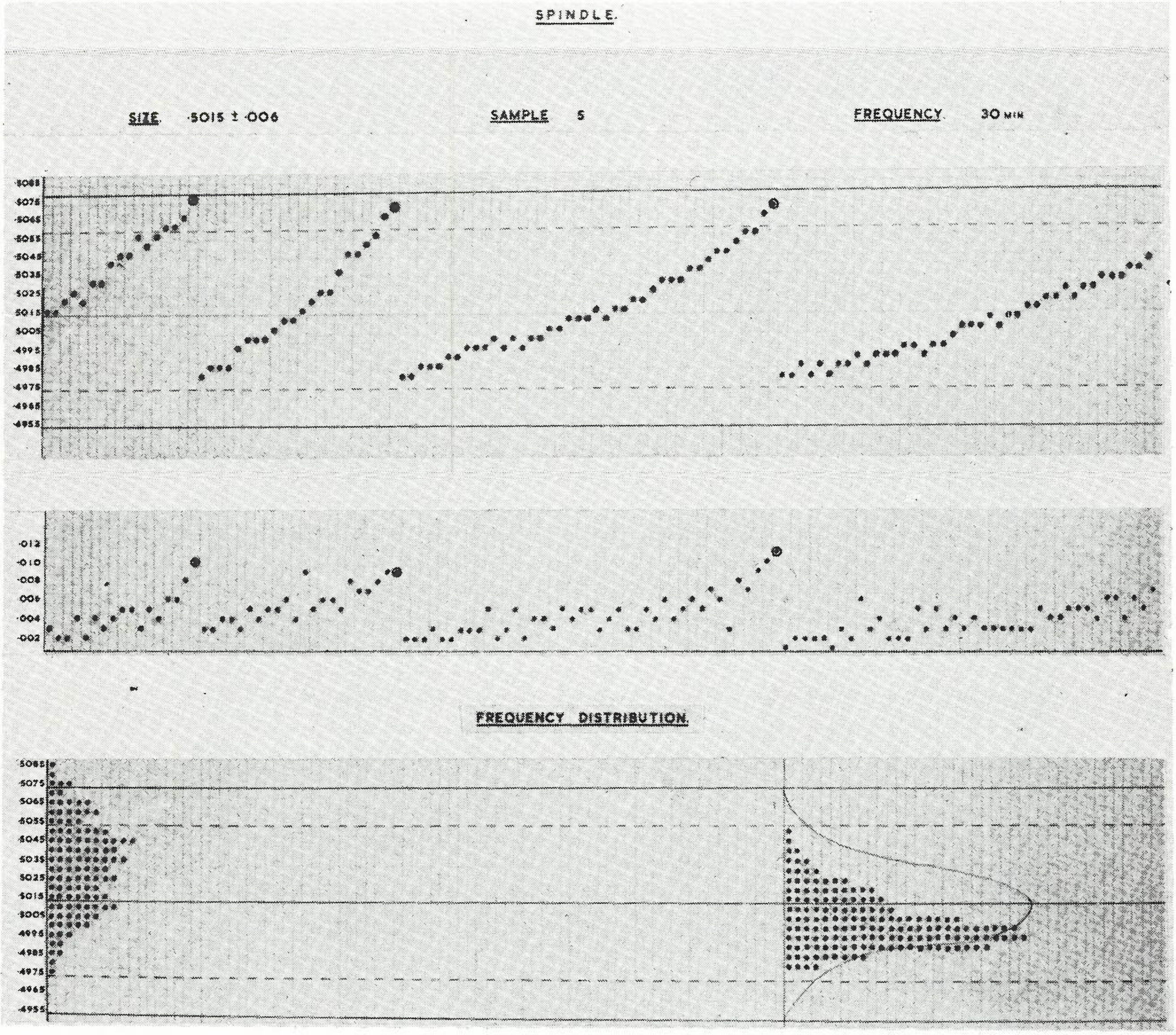


Fig. 2 — Statistical Analysis of Spindle Sizes.

Quality Control is therefore not another name for Inspection but is an integral part of the sphere of manufacture interfaced with the Customer, the Design and Industrial Engineering Departments; it is a management system.

The second area of Quality Control is, of course, on the production line itself and it is here that 'Conformance' becomes important. It is also here that the Quality of Design becomes apparent.

It is essential that the production line knows what it is committed to produce, what are the characteristics which need close attention and to what quality levels it must adhere. More importantly, it must have immediate information when these levels are not being met.

This requires continuous sampling and recording usually on charts specially designed to show dimensions or attributes of the items being produced. The Inspector's role is thus changed from one of sorting good from bad to one of recording evidence of conformity to quality standards aimed at taking corrective action; he is in fact a 'system' monitor

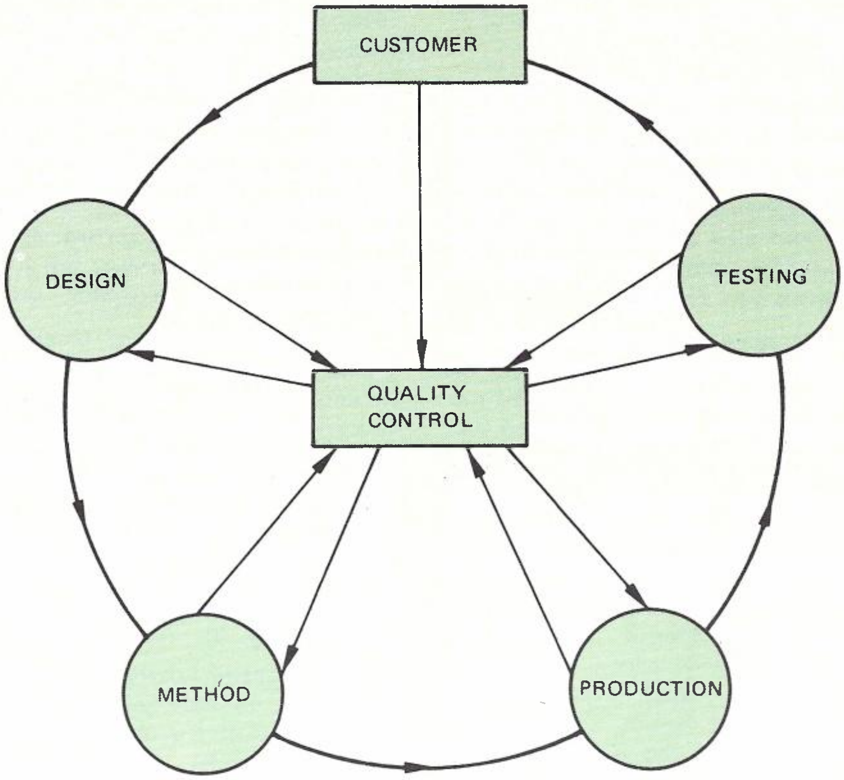


Fig. 3 — Quality Control Feedback Loop.

and not a policeman.

Quality Control uses the evidence of defects to improve the quality of its production. By analysis of the information collected, the team is able to correct the cause. This is one reason why *feedback* from the field is important.

THE CONTROL SYSTEM

A complete knowledge of what the customer requires and confidence in the Company's ability to produce a satisfactory article are essential for a good Quality Control System. It is then necessary to have an efficient feedback system to alert all concerned when it is not being achieved.

The first step in control is to determine on which potential defect characteristic concentrated attention must be placed, and to prove to everyone concerned in the manufacture that the operation is feasible.

Process capability studies are conducted by the team of Designers, Planners and Quality Controllers.

Tool tryouts and operator training are conducted and procedures designed to collect information on the efficiency of these.

A pilot production run is then instituted to prove to all concerned that the items required can in fact be produced. If found to be successful a Production Approval is issued and production is allowed to start.

Bringing production to this stage is a team effort in which all Departments of the Company are involved in achieving a Quality of Design, i.e., Quality Levels to be achieved, Quality characteristics which are essential for proper functioning, Quality of Method to ensure continued satisfaction, Quality of the skill of the operators and Quality of the means of recording the essential feedback of variation from the standard.

The second step is quality of conformance.

This is achieved by the continuous sampling of work as it is produced. The results are recorded on specially designed charts. Fig. 1 illustrates a typical Quality Control Chart used for recording the level of major and minor defects detected on a sample of Crossbar Springset Assemblies. Fig. 2 indicates the method of plotting size and tolerance to ensure an acceptable quality level in the manufacture of a spindle.

The feedback or control loop concept is the very essence of the quality control function. Its effectiveness largely depends on the ability of the Quality Controllers to analyse results and in conjunction with the Industrial Engineers, correct tooling, jigs, fixtures or methods and also allow the production supervisors to improve operators' skills before the allowable quality levels are exceeded.

Of course it is not possible or economical for each part or assembly to be inspected and so sampling, based on sound statistical method, is employed. The results of the samples checked are recorded on charts.

It can be seen that the occurrence of defects and any tendency for the number of defects to exceed the acceptable quality level can be detected and corrective action taken before this occurs.

It is this continued surveillance followed by analysis and team action which allows production to achieve a desired quality level; e.g. it is only by the introduction of Sound Quality Control techniques that, at the request of the Australian Post Office, the manufacturers have been able to raise the standard of wiring from 0.65% to 0.02%, i.e. one defective joint in five thousand.

It is essential that the Quality Control Department has confidence in the information being provided and it is imperative that this be obtained by a group independent of production. This is the job of the Quality Control staff.

Not only does their verification ensure that the feedback information is accurate, but it provides evidence to the customer's representative of the quality being achieved.

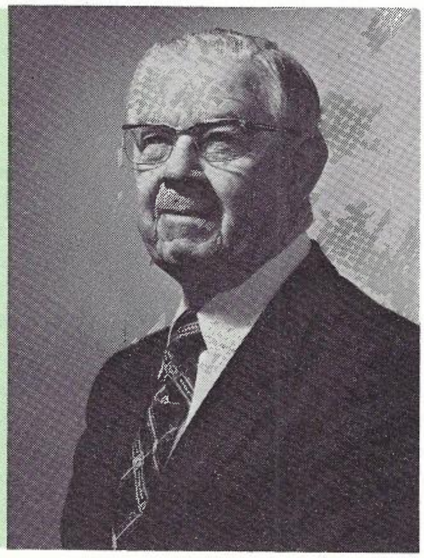
All that is done must be supported by the knowledge that the information obtained is accurate and hence it is the responsibility of the Quality Control Department to ensure for example that drawings and specifications are correct; that primary electrical and mechanical standards are maintained and that test equipment is accurately calibrated.

The whole success of Quality Control is based on being aware of the existence of defects and having corrective action taken to prevent defects occurring beyond the mutually acceptable level, and this can only be done by having a well designed loop in the system which feeds back to the designer, the production planner, the supervisor and the operator, information which advises them where defects are occurring and an indication of what action is necessary to correct an undesirable situation (Fig. 3). This is Quality Control.

All aspects of failure are important to the Quality Controller, not only because of the economic value, but because of the use to which knowledge of its existence can be put to correct its cause. Great importance is placed by the Quality Controller on the investigation into all failures whether from within the factory or from the field. Quality Control begins with product conception. It continues through every phase of manufacture and even continues through to the function of the equipment in the field.

By virtue of its cyclical nature it never really ends.

JOHN MARCHANT, B.E.M., is the Quality Assurance Manager of Plessey Australia Pty. Limited, Telecommunications Division. He transferred to the Company, then known as Telephone and Electrical Industries Pty. Ltd., at the conclusion of the second world war from the Ministry of Munitions where he was an Assistant Engineer (Technical Services). In 1956, together with APO Engineers, Mr. Marchant started on a plan to develop Quality Control in the telephone industry, a plan which ultimately led to the operation of the APO 'Approved Firm Scheme'. Mr. Marchant is a foundation member of the Australian Organisation for Quality Control and has given lectures on its operation to seminars in Australia and New Zealand.



Telecommunication Society Of Australia — Centenary Celebrations

COVER DESIGN

The cover of this issue of the Journal features one of the limited edition of 5000 specially designed commemorative covers, franked with the centenary postmarker on 1st August, 1974, to celebrate the centenary of the Telegraph Electrical Society, Melbourne. The cover features the seven cent stamp issued in November, 1973, which celebrates the 50th anniversary of regular radio broadcasting in Australia when Station 2BL Sydney first commenced regular transmission.

The commemorative covers were distributed to members of the Society by State Divisions generally in association with social functions, which are reported in the following few pages.

NSW DIVISION CENTENARY CELEBRATIONS

The NSW Division sponsors each year a Social Function involving a lecture, or demonstration in conjunction with the Annual General Meeting which is aimed specifically at members, their families and friends; the usual response varies between 80-150 people attending.

On the occasion of the Centenary Celebrations, the usual concept was expanded and in anticipation of a better than usual result, the whole of the 9th floor of the GPO building, dressed for the occasion, was taken over for the presentation of a variety of entertainment on the evening of Friday 16th, August 1974. The result greatly exceeded expectations with an attendance of over 800 people, and from all reports they enjoyed the "something for everybody" programme.

The presentation of video tape programmes through colour TV monitors was one of the most popular entertainments but Telecommunication films and working demonstration equipments (facsimile, switching, computer) were also very popular with the non-technical visitors, both children and adults alike. Over 500 Commemorative Envelopes (designed by Ted Acton of the NSW Publicity Section for the NSW Division) were sold on the evening, in addition to the 1600 previously issued free of charge to members and friends of the Society.

The Australian Postal Institute Music and Drama Society presented a well received singing and musical programme to a seated audience of more than 600 people, in conjunction with a 3-part lecture-cum-discussion on the past 100 years and the future of telecommunications in Australia. The three speakers were:

- Mr. G. Black — Life Member of the Society, and TV Quiz Show Personality, who described the Telecommunications development of the past 100 years and their relationship to the Society.
- Mr. A. Kellock — Assistant Director-General, National Telecommunication Plan, who described possible future technical developments particularly in their relationship to the domestic scene and
- Mr. D. Young — Social Scientist National Telecommunication Plan, who discussed the social implications of these future developments.

Fig. 1 — Cutting of the Centenary Birthday Cake by the Chairman, Council of Control of Telecommunications Society, Mr. R. W. Turnbull, assisted by friend "Jenny".

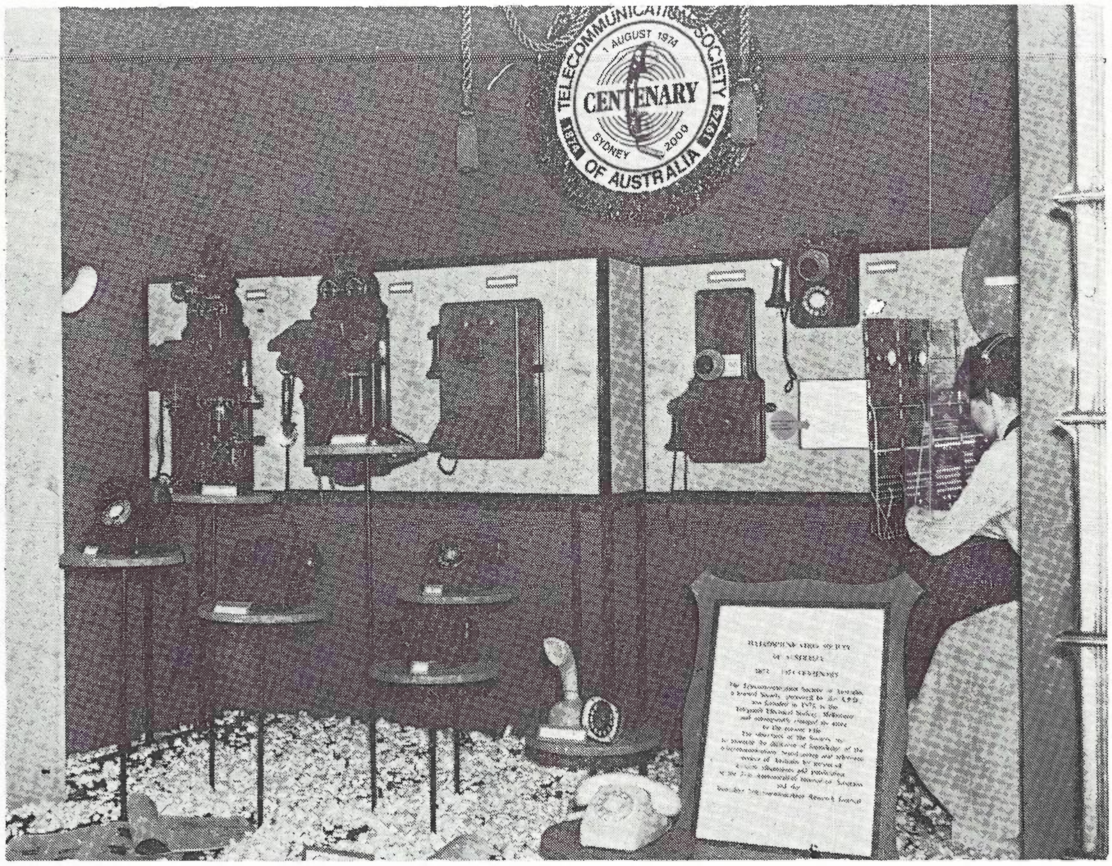


Fig. 2 — Display window of Sydney GPO, featuring old and modern telephones and a glimpse of a manual switchboard complete with "operator".

Perhaps the highlight of the evening was the cutting of the "Birthday Cake" of some proportions by the Chairman of the Council of Control, Mr. R. W. Turnbull. In speaking to this ceremonial of the cutting of the cake, Mr. Turnbull chose as his theme the relevance of the future of telecommunications and the Telecommunication Society to the future generation; his unscheduled choice of a very small and attractive member of the audience, known only as "Jenny", to represent the future generation and assist him in his task, had considerable impact on the audience and provided an unusual and memorable finish to a very successful function.

In addition to the function of 16th August for members, the general public was able to view the very fine photographic and historical equipment exhibition in the GPO Main Hall and Colonnade during August and September.

Of all the impressions gained by the organisers of the NSW Celebrations, the most significant were the great interest shown by members in the Society's activities and the very real support given by the Society's friends, which included almost every Branch of the APO and, many outside organisations, who, with no likely gain to themselves, came in behind the Committee to produce the result achieved.

VICTORIAN DIVISION CENTENARY CELEBRATIONS

The Victorian State Committee each year organises a programme of lectures on Telecommunication and allied subjects in Melbourne as well as a series of lectures in 8 Country Centres. The Melbourne lecture date scheduled for the 12th August was considered particularly appropriate for centenary celebrations, as, to quote from the first issue of the Transactions of the Telegraph Electricity Society, "The first Ordinary General Meeting of this Society was held on Wednesday, 12th August (1874), at 8 p.m. at the Melbourne Athenaeum, Mr. D. J. McGauran in the chair".

The programmed lecture — "High Capacity Co-axial Cable Systems" by Mr. R. Smith — was followed by intermission during which refresh-

Fig. 3 — Melbourne Post Office Museum Reception. Left to right: Mr. J. A. Kline, Mr. C. J. Griffiths, Mr. R. M. Osborne who produced the Telecom Journal in the 1930's and 1940's.

ments were served, and provided members with an opportunity for group discussion. This was followed by a showing of selected films. The function was held at the usual venue, the H. C. Sleigh Theatre, and the management of H. C. Sleigh Ltd., kindly agreed to provide refreshments. The demand for tickets for this function far exceeded the Committee's expectations and it became necessary to arrange a second showing of the films 2 days later, on August 14th. The films shown were:

- "A Momentous Occasion" — The Story of the Construction of the Overland Telegraph Route to Darwin by Sir Charles Todd in 1872. (August 14th only).
- "North West Link" — The laying of the co-axial cable from Perth to Carnarvon.
- "New Generation" — The design and development of the 10C local exchange.
- "Mars — The Search Begins" — A NASA film dealing with the coming search for life on the planet.

In addition to the free distribution of commemorative postal covers, members also received a souvenir brochure consisting of a facsimile reproduction of the cover of the first issue of the Transactions of the Telegraph Electrical Society, and two rather quaint advertisements of the period.

Arrangements were made with the Victorian Post Office Historian for a display of early telegraph equipment and material relating to the early days of the Society at the Post Office Museum in Richmond. Several issues of the Transactions of the Telegraph Electrical Society were shown, together with other items such as the Minute Book of the Postal Electrical Society for the period 1921-1952.

Finally, on August 19th, a small reception was held at the Post Office Museum. Among those invited were ex-officers of the Society and Life Members, and it was pleasing to see many Officers, now retired, who were prominently associated with the Society in other days. In particular, one should note the presence of Mr. J. A. Kline and Mr. R. M. Osborne. These two gentlemen, both Life Members, were present at the meeting of the Postal Electrical Society on 10th October, 1932, when it was moved "That the Postal Electrical Society be reformed and reconstructed", and both were involved to a large degree in the action that followed. They were also members of the inaugural Board of Editors when the Telecommunication Journal of Australia was launched in 1935, and continued to serve in this role for many years.

Mr. A. Morton, Chairman of the Victorian Division, welcomed guests and spoke on the significance of the Centenary, mentioning that 1874 was also the year in which Marconi was born; he then introduced Mr. Osborne, who talked of the early days of the reformed Postal Electrical Society, and paid special tribute to Mr. A. R. Gourley, who was the first Secretary of the Society and the third member (with Messrs. Kline and Osborne) of the original Board of Editors. Mr. Morton then introduced Mr. E. J. Bulte ex-Chairman and Life Member, who expressed his hopes for a further 100 years of activity by the Society.

After inspection of exhibits and a demonstration of a switching position from old Central Exchange by Mr. R. R. Nelder, guests adjourned to the adjacent offices of the Victorian Radio Section, where a buffet meal and drinks were served. Later 2 films were shown. These were "North West Link" and "New Generation", previously shown at the film nights, and served to round off the evening by giving the retired members present some idea of the present state of the art in the telecommunications field. It seems safe today that all those present enjoyed a pleasant evening among friends and associates with a common interest and involvement in the Society.

The Committee would like to thank all those who assisted in the organisation of the various functions, and in particular the then Director, Posts and Telegraphs, Victoria, Mr. I. M. Gunn, for his permission to use the Post Office Museum; Mr. Derek Baker, Post Officer Historian, for his assistance at the Museum; and Mr. A. J. Varey, Supervising Engineer, Radio Section, for making the Radio Section lunch room available for the social function.

QUEENSLAND DIVISION CENTENARY CELEBRATIONS

The Queensland Division chose Wednesday, the 10th September, 1974, for their centenary celebrations. Activities commenced with a display of historical telecommunications equipment contrasted with modern equipment in the Functions Room, APO Centre, Brisbane, at 2 pm. Approximately 120 students from schools adjacent to the APO Centre and some fifty people from departmental establishments visited the display during the afternoon. A great deal of interest was displayed by the visitors.

The evening's proceedings commenced at 6 pm with refreshments and a viewing of the display. One hundred and ten people attended this session.

The Chairman of the Queensland Division, Mr. F. M. Scott, opened the evening session and briefly outlined the history of the Society. He thanked the Historical Society and Public Relations Section for their assistance in providing the display of equipment. He then introduced Mr. P. J. Gribble who is presently writing the history of Telegraphy in Queensland. Mr. Gribble discussed the topic under four main categories: Lines, Buildings, Equipment and Staff; and illustrated the lecture with slides made from old photographs. Some historical highlights from the address were:

- The Postal Building at the Brisbane GPO was erected in 1816 and was followed in 1879 by the Telegraph Block.

Fig. 4 — Mr. P. J. Gribble delivering his address "the History of Telegraphy in Queensland".

Fig. 5 — Historical Discussion Panel, left to right: Mr. G. Dixon, Mr. C. Faragher, Mr. C. R. Anderson (chairman), Mr. W. Rohde and Mr. G. Roden.

- The first Telegraph line in Queensland was from Brisbane to Ipswich in 1861.
- Equipment changes included Telegraph Key and Sounder, Morse Inker, Wheatstone, Murray Multiplex, 5 unit-code, Teleprinter, Perforator, Transmitter and Teletype.

The lecture was followed by Panel Discussion, the panel consisting of Messrs. C. R. Anderson (Chairman), C. Faragher, G. E. K. Dixon, G. F. Roden and W. C. Rohde. Mr. Anderson said that the panel spanned approximately 70 years of the 100 years of the centenary.

- Mr. C. Faragher spoke on personalities he had contacted during his employment in the Department. Some of the people mentioned were Mr. Templeton, and Mr. H. P. Brown who came from India to reconstruct the Technical Section of the Department. He later became Director-General of the PMG Department. Mr. Oxenham and some of his characteristics were commented on. Mr. Faragher also talked on some of his administrative activities as Director, Posts and Telegraphs, Queensland.
- Mr. G. E. K. Dixon talked on the progression of Exchange Equipment, commencing with the Magneto Central Exchange at the GPO Brisbane, which was disconnected in 1929. He mentioned the exchanges at Albion, Toowong, Sandgate and Wynnum, all of which were standard magneto switchboards. Toowoomba had a type of lamp signalling switchboard and Townsville had a system of self-restoring indicators. He commented on the progression of installations from CB in the outer suburbs to small automatic exchanges. In 1960 crossbar working was introduced in Toowoomba, then some metropolitan exchanges were equipped with crossbar equipment and later country exchanges. He closed by saying that he had talked about five different types of systems in his time and wondered what would succeed these in the next 100 years.
- Mr. G. F. Roden discussed the training he received as Mechanic in Training and compared it with present day facilities. He reminisced on some of his experiences in the various jobs he has performed, and personalities with whom he had come in contact. Some of the experiences he discussed were riding bicycles, fully laden, to perform his duties, and riding horses, sometimes stubborn and fractious, on inspection duties.
- Mr. W. C. Rohde spoke on the entry of the PMG Department into the Radio field, firstly in the building at the corner of Elizabeth and George Streets. He progressed from this small beginning to developments which produced the present wide coverage throughout the State. He finished his discussion by introducing the subject of Radio Telephony which provides bearers for high density telephony systems and radio and TV links. During his talk Mr. Rohde made comments on some of the hardships and amusing incidents experienced during his period with the Department.

The Acting Director of the APO Queensland administration, Mr. P. L. Dubois, closed the panel discussion by proposing a vote of thanks, and this was followed by supper in the Cafeteria.

The celebration results were very pleasing to the Committee from the point of view of the high attendances and the interesting subject matter presented.

TASMANIAN DIVISION CENTENARY CELEBRATIONS

The Convention Complex of the multi-million dollar international Wrest Point Casino in Hobart was the setting for the Centenary Invitation Lecture of the Tasmanian Division of the Telecom Society of Australia given by Mr. Harold White, General Manager, Overseas Telecommunications Commission (Australia), on the night of 15th August, 1974.

At a press interview, in the Derwent Room, Mr. White met various sections of the news media including television representatives and detailed the reason for his visit. The interview concluded with an informal question period where Mr. White discussed controversial issues on present and future communications.

Later more than 150 members and associates of the Society gathered at a pre-lecture cocktail party where souvenir literature and complimentary tokens marking the Centenary were distributed to the background of intimate piano music by a local TV personality. Among the guests were several leading identities from the academic and technical fields in Tasmania. Mr. Max Dunstone, Tasmanian President of the Society, delivered the opening address and introduced Mr. White whose story of the part communication has played in man's progress from dawnlight to satellite — punctuated with informative colour slides — made for fascinating listening.

Question time followed, which produced an avalanche of provocative and probing queries but, unfortunately, time ran out and stopped what could have become an all-night gabfest.

A vote of thanks was given by Professor G. Newstead, Emeritus Professor of Engineering Physics at the Australian National University, and Mr. White then mingled informally with guests during supper. A pleasant end to an unforgettable evening.

Fig. 6 — Mr. White arrives at lecture locale. (Photograph courtesy of "The Mercury", Hobart).

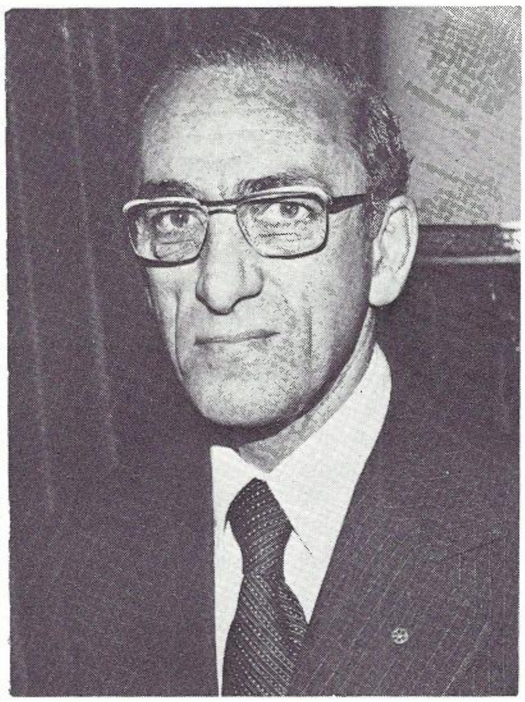


Fig. 7 — Mr. H. White, General Manager of OTC (Aust.), who delivered the lecture "Dawnlight to Satellite." (Photograph courtesy of "The Mercury", Hobart).

New Telephone Order Procedures for Metropolitan Fault Despatch Centres

R.P.S. DUNNE, A.R.M.I.T.

This article discusses the reasons for improving telephone order procedures in Metropolitan Operations, and describes the new system which has been introduced using Fault Despatch Centres as the control point within each Operations area.

INTRODUCTION

In response to verbal or written requests from members of the public, telephone orders are issued from a Sales office for the provision, alterations and cancellation of telephone services, via teleprinter to two main areas, the engineering Operations Section for the work to be performed and to the Clerical Records and Accounts areas.

This article discusses the merits of the established 'Tel. 2' procedure, and the newly-introduced procedure now generally known as the 'Completion Advice' system. Broadly, the Tel. 2 system was administratively cumbersome and slow in execution because it depended on the mail. Long delays were experienced between the time a telephone service was cancelled and when the final account was rendered, attempts to monitor the quantity and progress of orders in circulation were frustrated. It was also difficult to maintain accurate details concerning equipment actually installed if the installation varied from the text of the telephone order. Morever, there were many links in the chain between installer and the final completion advice.

Revenue Section of Finance and Accounting Branch, Victorian Administration, suggested that prompt advice of a cancelled service, together with improved methods within their section, would permit rendering of an account to the subscriber within days. This would give an annual return to the Department approaching five figures for the Melbourne metropolitan area. A working group of representatives from Sales, Accounts, Engineering and Personnel was set up under the chairmanship of Mr. R. Cupit, Supervising Engineer, Network Performance. Following a thorough investigation into all aspects of operational, recording and statistical activities associated with telephone orders, recommendations for in all areas were made. A detailed review of procedures in the Engineering Division led to a decision to use Fault Despatch Centres (FDC), as the clearing and information centres for work associated with telephone orders. As the centre for all information related to subscribers services from a maintenance viewpoint, FDCs were easily adapted to absorb the completion advice function.

The following targets were set:

- Information transfer to be via teleprinter wherever practicable to reduce transit delays.
- A completion advice to reach Accounts Branch in less than two days from the date of a connection, or cancellation.
- Direct (verbal) communication between an installer and the person preparing a completion advice.
- Close monitoring of the quantity and progress on all types of order.
- Minimise clerical work in exchanges.

THE TEL 2 SYSTEM

In Fig. 1, the flow of a new service telephone order from issue at a Sales office until a final completion advice has been transmitted to all relevant areas is outlined.

From the time the service is completed (A) details of the installed service are telephoned to an exchange clerical assistant (CA) for recording on a Tel 2 advice (B). The Tel 2 is then sent by mail

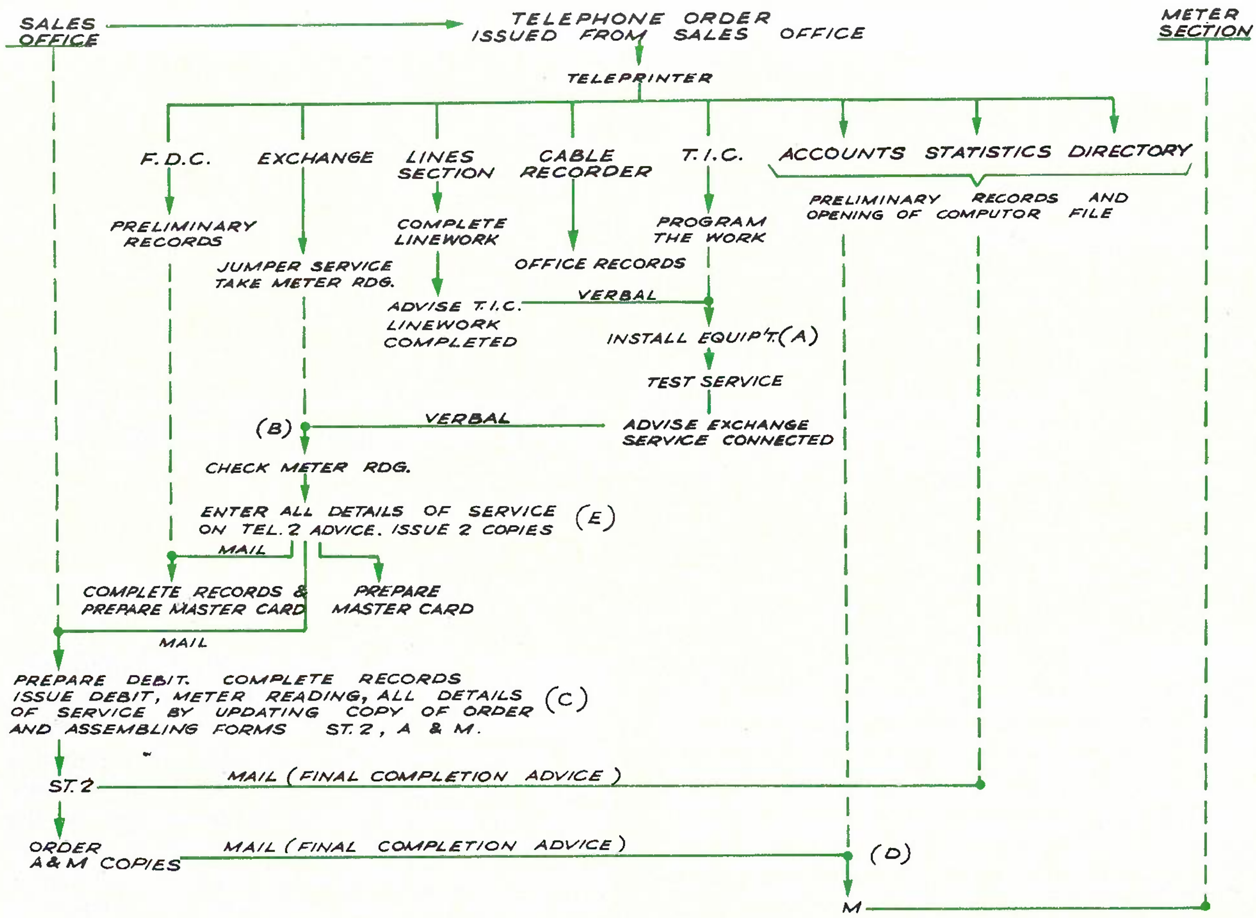


Fig. 1—The Tel 2 System.

to the FDC, and to Sales (C) where debit information is prepared and local records completed. The Sales office then transcribes all details of the newly installed service onto three other forms as well as updating a copy of the original order. This information is then forwarded by mail to Statistics, Meter Section and Accounts, of which Accounts (D), in particular requires the information promptly and accurately.

The difficulties with the above are readily apparent. There are too many persons in the chain between the installer, who is the only reliable source of information regarding the equipment provided and date of connection, and the Accounts Branch who require this information quickly and accurately. Each time the service details are rewritten they can be reinterpreted, and any numerical information distorted (e.g., meter reading 1234 becomes 7234, or 1243, etc.).

The Tel 2 system is prone to error when the installer provides exactly what the text of the order requires. The accuracy of the system for cases where the order requires amendment because of altered provision at subscibers' request, or due to unavailability of a particular item of equipment at the time of installation, leaves little to the imagination.

The Tel 2 system, being dependent on the mail, is a slow acting system causing delays in the final billing of a subscriber who has cancelled his service with consequent difficulty in attempting to recover outstanding monies. The Tel 2 system is not suited to answer enquiries because the only information centre is the exchange (B), where a clerical assistant has received the installation details.

It was realised that any new method adopted must allow for direct, verbal advice between the

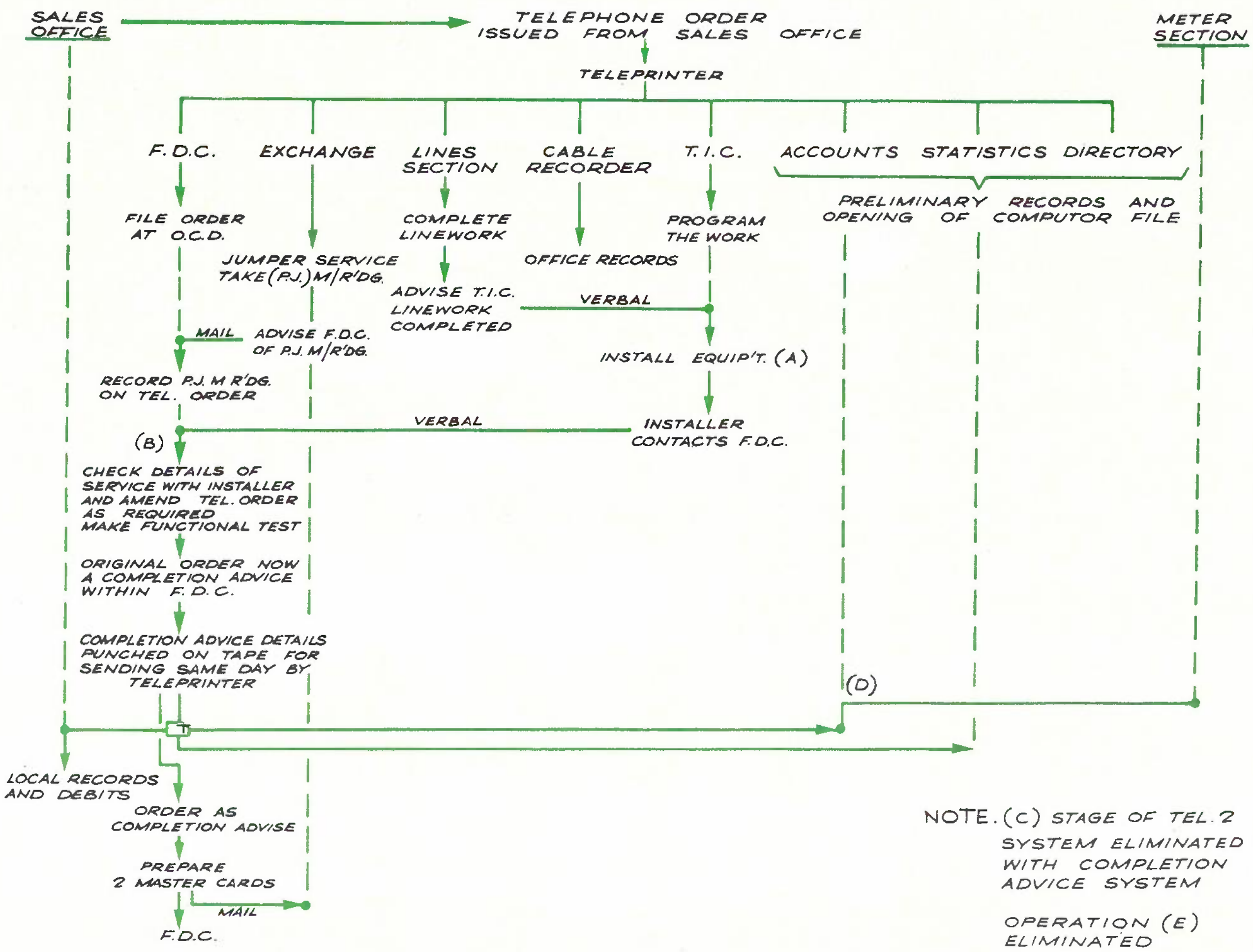


Fig. 2—The Completion Advice System.

installer and the assembler of completion advice information, and that this information should be sent direct to all interested parties by teleprinter to reduce a delay of weeks to days. One centre to serve each Section for assembly, and transmission, of completion advice information appeared desirable to facilitate close monitoring of telephone order progress, and simplify enquiry follow up. The logical choice was the already established Fault Despatch Centre.

THE COMPLETION ADVICE SYSTEM

The flow diagram shown in Fig. 2 outlines all the main activities associated with a 'new service' telephone order under the 'Completion Advice System, in its final form as at the Brunswick FDC.

It can be seen that the installer (A), a Lineman for the simpler installations or a Technician for the more complex installations, calls the Order Completion Desk (OCD) (B) where he discusses all details relating to the equipment he has provided with an officer trained in telephone order procedures, and assembly of completion advices. Any amendments to the text of the original order will be made during this discussion, and the OCD officer will then carry out functional tests with the installer as required.

Throughout the day completion advices, which are in fact a copy of the original order suitably amended where necessary, are collected and taken to the teleprinter operator for preparation of a send tape. As tapes of the day's work are sent to line each night, all areas concerned have accurate completion advice information to hand on the day following the actual connection, alteration to a service, or cancellation.

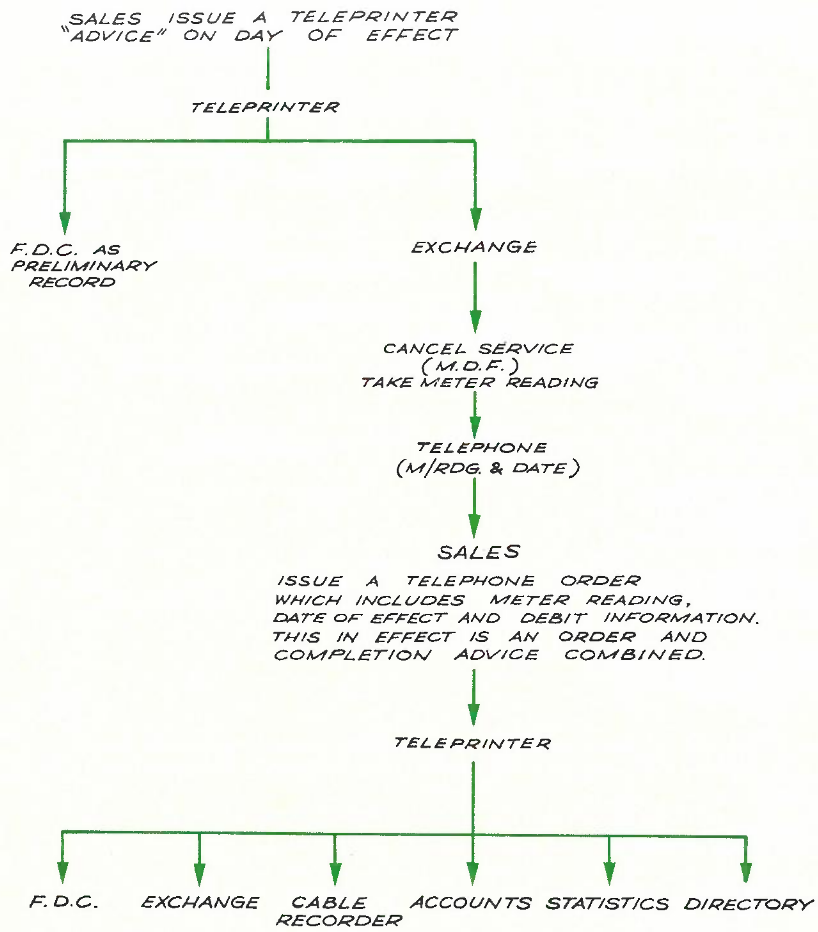


Fig. 3—New Procedure for Handling Cancellation Type Orders. (Inplace orders follow a similar procedure.)

The introduction of this completion advice system into the Melbourne Metro North West Section has brought about the following improvements:

- Reduced incidence of error in completion advice information.
- Rapid transmission of legible completion advice to all pertinent areas.
- One contact point for attention to telephone order enquiries.
- Close monitoring of quantity and progress of telephone orders.

Cancellation and Inplace Orders

During the development of the Completion Advice system, it became apparent that procedures used between Sales and Operations, for cancellation and inplace orders, could be considerably simplified if a method on trial in the South District was adopted. This system, designed for handling cancellation type orders, was introduced on the initiative of the Senior Sales Officer (Mr. G. Taylor).

Orders for inplace services and cancellations had followed a similar procedure to that shown in Fig. 1. As has been discussed, this is not only cumbersome and too slow in taking effect, but it was difficult to avoid errors in issuing amending orders when a subscriber gives last-minute advice of an alteration to date of effect.

Fig. 3 shows that application of what has become known as the 'Taylor' system has permitted elimination of potential errors, and rapid issue of completion advice information.

The key point to this system is that an order is not issued by Sales until the field work has actually been performed. Therefore, any changes to date of effect need only be put into a 'refer again' system at Sales, and will not require issue of amending or withdrawal type orders and all the

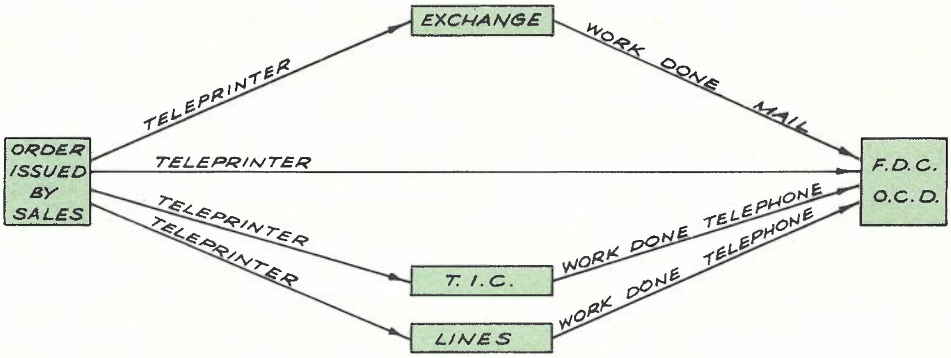


Fig. 4—Sources of Input Information to OCD at FDC.

Fig. 5—Dissemination of Completion Advice Information from OCD to FDC.

consequent alterations to records in a number of centres.

On the day when field work is required, Sales issues a 'teletype advice' to the exchange concerned, and to the FDC for records. On the following working day the exchange advises Sales by telephone of meter readings, and confirms that the 'inplace', or 'cancellation', has been carried out. Sales then issue a telephone order for this work, which by including the relevant meter readings, and 'debit' information, becomes a completion advice as well; this gives accuracy, fast transfer of accurate information, and reduces clerical effort.

THE COMPLETION ADVICE SYSTEM WITHIN AN FDC

As the centre for all enquiries associated with existing subscribers' services, and faults, the FDC becomes the centre for enquiries related to the final clearance of orders for provision and cancellation of subscribers' equipment.

The introduction of the completion advice system required the setting up of another functional cell within the FDC for 'order completion' and 'completion advice' transmission; a flow diagram is shown in Fig. 6, together with the concept in Figs. 4 and 5.

The flow of telephone orders from Sales to initiate the various phases of work associated with provision, alteration, and cancellation in the subscribers equipment area is shown in Fig. 4, and as each centre completes its work activity, advice is given to the FDC.

When the final installation has been completed, the installer contacts the Order Completion Desk (OCD) at the FDC, where completion advice information is assembled, and distributed as shown in Fig. 5.

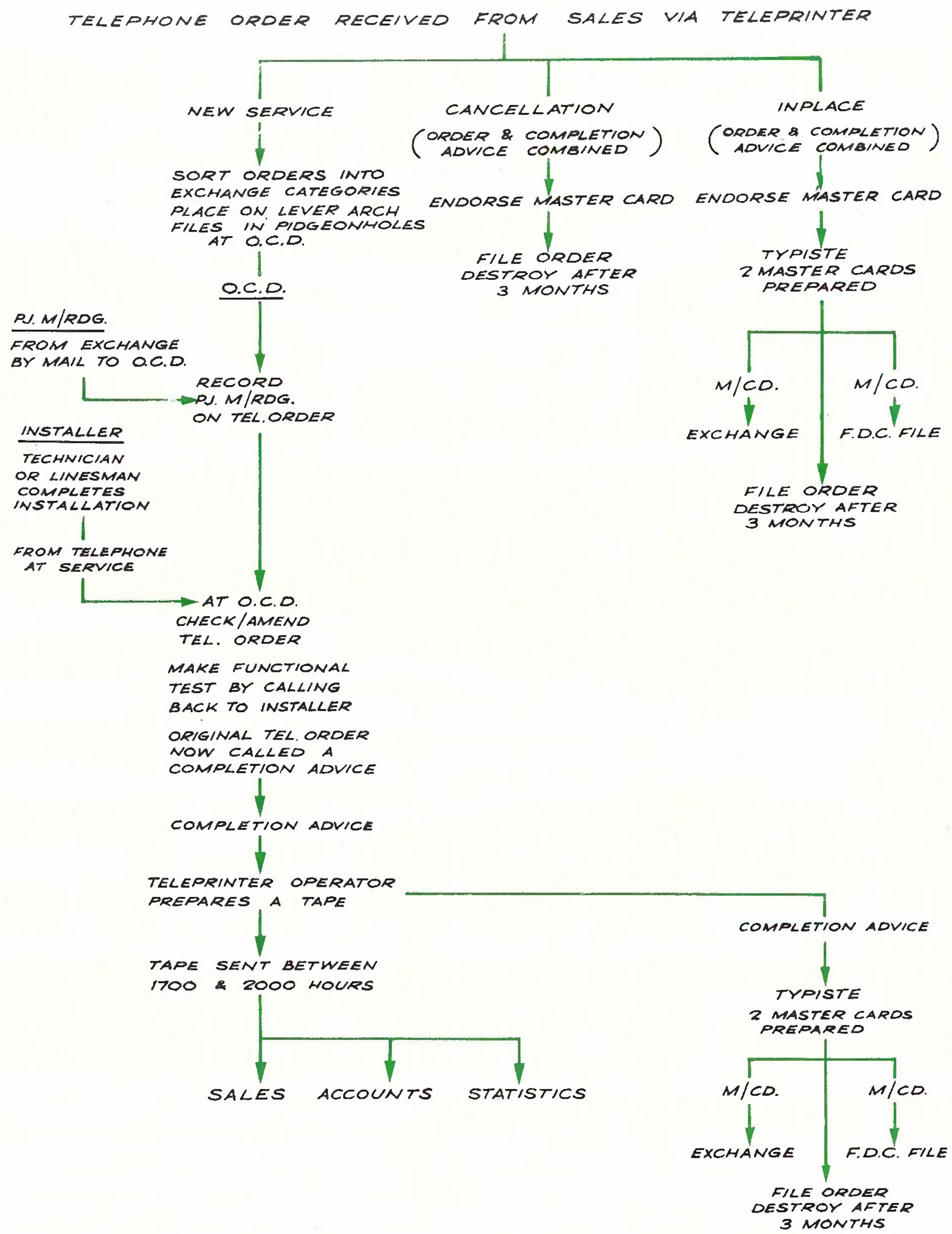


Fig. 6—Procedure within an FDC.

An examination of Fig. 6 will give an understanding of the activity within an FDC from the time a telephone order is received by teleprinter from Sales, until final completion advices have been despatched to the various centres.

The following points should be kept in mind during an examination of Fig. 6:

- The OCD is staffed by one Clerical Assistant Grade 2 (CA2), who has been trained in telephone order interpretation, and the detailed requirements of a completion advice.
- Queries on details of a complex installation, and any follow up action, is handled by the TTO1, who is in charge of the OCD; the TTO1 also assists the CA2 during 'peak' load conditions.
- The OCD has a centrally mounted pigeon hole type file containing all telephone orders waiting completion; these are kept in exchange groups, each group being filed on a lever arch file in (exchange) numerical order.

Fig. 8—Order Completion Desk Staffed by Mr. F. Turner and Miss H. O'Brien.

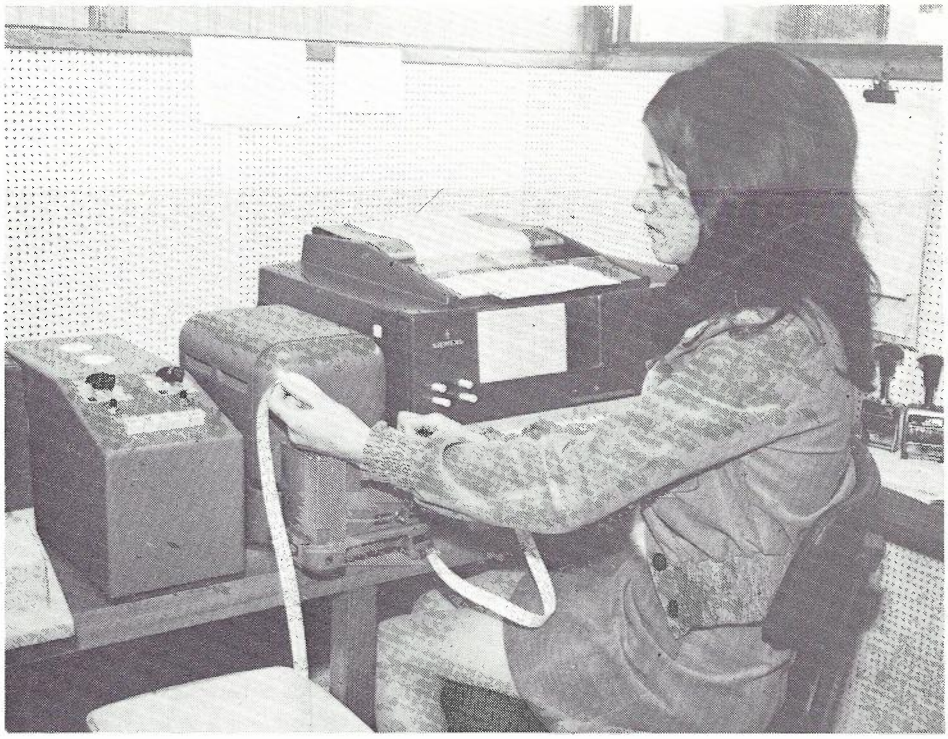


Fig. 9—Miss H. O'Brien Preparing Tape of Completion Advices.

FAULT DESPATCH CENTRE
TELEPHONE ORDER

TEL. No.☐	O/No.☐		NAME☐		ADDRESS☐		
PREJUMPERED METER READING		DATE				INITIALS	
LINE PAIRS NoS.	CABLE	PAIR	CAB	'B' PAIR	PILLAR	'O' PAIR	T. BOX
MASTER CARDS—	MADE UP ☐			CR. SEQ.			
CAPACITY & GROWTH RECORDS COMPLETED—		YES NO-REASON					
OTHER DETAILS—							
NAME OF INSTALLER		DATE		INS.			
SERVICE COMPLETED	YES NO-REASON						
SERVICE	CONNECTED DISMANTLED CANCELLED	DATE		TIME		AM PM	
SERVICE TESTED BY A.T.D.	YES NO-REASON						
POTENTIAL FAULTS—							
TELEPHONE ORDER AMENDED		YES-DETAILS ENTERED NO -					
EQUIPMENT RECOVERED		YES-DETAILS ENTERED NO -					
INSTALLER CALLED BACK ON				LINE LINES			
SEQUENCE TO INSTALLER				INITIALS			

Fig. 7—Completion Advice Check List.

- Incoming calls from field staff are received on non-metering lines which terminate on answering units; these units also have outgoing lines to allow the CA2 to make functional tests on a completed service by calling the installer back.

- An exchange pre-jumpers a service prior to external plant work being carried out; a pre-jumpered meter reading is taken and sent by mail to the OCD, where it is recorded on the telephone order already held in file.

- The CA2 adds the information received from the installer directly onto the original order (refer Fig. 7), which then becomes a completion advice within the FDC and is used to prepare the completion advice tape, prepare master cards for the FDC, and the particular relevant exchange, and to assist in compiling Capacity and Growth statistics.

- A rubber stamp is used to add the questionnaire, shown in Fig. 7, to the telephone order before it is filled at the OCD. The layout ensures that the installer is correctly interrogated during preparation of the 'Completion Advice'.

STAFFING AND EQUIPMENT

The establishment of the OCD at Brunswick FDC required approximately 17 square metres of floor space, a tape preparation, and an on-line teleprinter, construction of several special pigeon holed files, and some additional furniture.

The staff at Brunswick FDC was increased by one TTO1 and two CA2s. The TTO1 handles all complex installation completions, follow up type enquiries, and is a 'trouble shooter' for all difficulties associated with telephone orders. This position may prove to be not required after further experience and when better trained CAs are operating a stable system. The two CAs operate as teletype operator and OCD officer, several persons are trained to carry out these functions and the work is rotated amongst several clerical staff at the FDC.

CONCLUSION

The decision has been taken to establish this system to all Melbourne Metropolitan Operations areas before the end of 1974.

It is expected that compilation of Capacity and Growth statistics at FDCs will be the next development, as most of the main bulk of source information will then be available within an FDC.

ACKNOWLEDGMENTS

As is usual in developing a new concept for one functional area, all of the allied, but on the surface separate, areas become involved. The ground work leading to the Brunswick FDC system, was carried out at Footscray FDC, and then developed by Metro Operations North West to its final form. It is doubtful whether this completion advice system could have developed without the wholehearted support from the Coburg Sales Office staff, who have experienced some major alterations to their internal procedures.

Furthermore, the development of this new system through some quite awkward 'growing pains' has been featured by a high degree of co-operation between all of the Branches involved, and of course would have been a much more difficult enterprise without the initiative and support of the staff in the North West Operations area, to whom much of the credit must be directed.

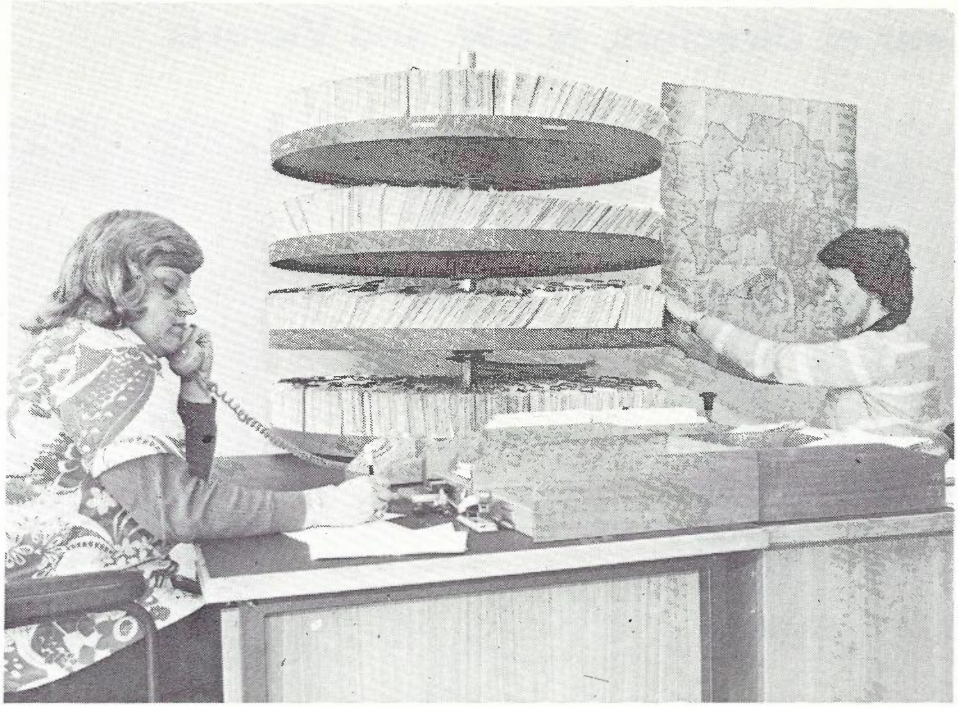
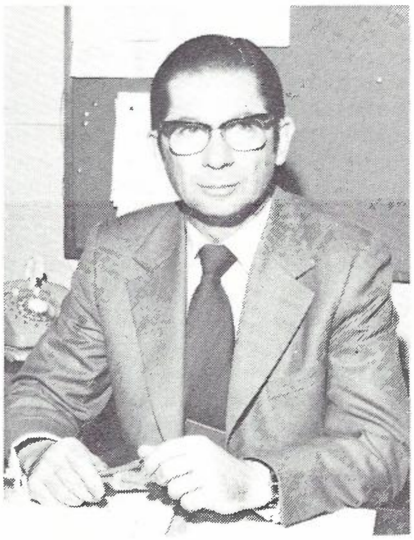


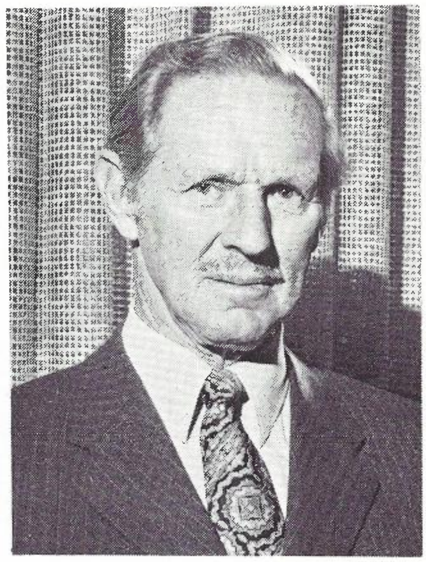
Fig. 10—Miss R. Hoolahan and Mrs. J. McKay Staffing Card File and Preparing Telephone Orders.

R. P. S. DUNNE, joined the Department as a Junior Postal Officer in 1945, and after passing through the ranks of Technician and Technical Instructor, qualified as an Engineer in 1968.

Since then he has worked in Melbourne Metropolitan Operations, and has been Senior Engineer in the North West Section since 1972.



Retirement of Directors, N.S.W. and Victoria



Mr. R. T. O'Donnell

On 23.8.74 the Director, New South Wales, Mr. R. T. O'Donnell, FIE (Aust.) retired after almost fifty years' service in the Australian Post Office. (See Vol. 22, No. 2, Page 137).

After a long career in the Engineering Division, Mr. O'Donnell was promoted to the position of Director in 1972 to control both the Telecommunications and Postal activities for the whole of New South Wales.

Mr. O'Donnell's wide experience was climaxed by the cutover of the Pitt 20,000 line ARF Exchange which replaced 12,000 lines of step-by-step equipment at City North, some of which he worked on whilst employed as a Technician earlier in his career. Unfortunately, retirement came before the establishment of the Pitt 10C Stored Programme Controlled (SPC) Exchange and, thus, his career narrowly missed encompassing three generations of automatic equipment—step-by-step, ARF and SPC. Nevertheless, the mark of R. T. O'Donnell's engineering and management expertise will remain with the APO for many years hence, due to his influence on planning, installation and management.

Second only to his interest in the Telecommunications organisation of the APO was his interest in the Engineering profession itself. This interest culminated in his participation as a member of the Industries Advisory Panel to the School of Electrical Engineering, University of Sydney. Mr. O'Donnell was convenor of the Standing Committee on Electronics and Communication and the most significant achievement of this panel was the establishment in 1974 of a University Post-Graduate course in Telephone Switching Theory, the first of its type in Australia and one of the very few such courses in the world.

Mr. I. M. Gunn, M.B.E.

Mr. Gunn recently retired from the position of Director, Posts and Telegraphs, Victoria. He began his career as a Cadet Engineer in Victoria in 1928.

During his service with the Department, he occupied a number of Engineering positions including that of First Assistant Director-General Engineering Works.

One of the highlights of his career was his appointment as Chairman of the 1956 Melbourne Olympic Games Branch Committee for communication facilities at the various sporting venues. He was awarded the M.B.E. in 1957 for his work in this area.

Mr. Gunn also played a major role in the restructuring of the Engineering side of the Department which took place in 1972.

The Board of Editors records its appreciation of the significant contributions made by Mr. Gunn to the work of the Telecommunication Society. He was the inaugural Chairman of the present Society when it was reconstituted in 1959 and he served again as Chairman of the Society in 1971.

On behalf of all readers, the Board of Editors wish Mr. Gunn a happy retirement.

Mr. O'Donnell has been a friend to the Society throughout his career and, on behalf of all readers, the Board of Editors congratulates him on his achievements and wishes him and Mrs. O'Donnell a long and happy retirement.

New Directors for N.S.W. and Victoria

Mr. F. L. C. Taylor

Mr. Charles Taylor has been appointed Director, Posts and Telegraphs, New South Wales.

Mr. Taylor, who was previously First Assistant Director-General, Engineering Works, joined the Department as a clerk at Headquarters in March 1937. After completing his engineering cadetship, during which he graduated Bachelor of Science at Melbourne University, he was appointed engineer at Benalla, Victoria. In December 1943, he went to Brisbane where he spent two years as an engineer in Metropolitan Exchange Equipment and Metropolitan Lines. Next was three years with the Victorian Administration until he was promoted as an Engineer Class 3 at Headquarters. Mr. Taylor has held several executive positions in Engineering Works and Planning, including four years as APO Liaison Engineer in London. There he represented Australia as a delegate to two international telecommunications conferences.

Mr. W. J. B. Pollock

Mr. Bill Pollock has been appointed Director, Posts and Telegraphs, Victoria following the retirement of Mr. Ivan Gunn.

Mr. Pollock, previously Senior Assistant Director-General, Industrial Relations, joined the Department as a junior mechanic in 1938. Three years later, he was promoted to a clerical position in the Engineering Division. Following discharge from the Army in 1945, he was appointed traffic officer at Central Office and completed his Bachelor of Commerce at Melbourne University.

He remained at Central Office until 1962 when he returned to the Victorian Telecommunications Division to head the Development Branch. He then held several executive positions in the Telecommunications Division, and was promoted Assistant Director Telecommunications in 1971. Mr. Pollock is a graduate of the Advanced Australian Administrative Staff College and has served on several departmental and inter-departmental committees.

Operation of a Large Metropolitan Subscribers District Centre Organisation

D. R. HAMILTON

This article describes the internal and external plant aspect of operating a Subscriber District Centre (SDC) organisation in the Sydney Metropolitan area. The author is the Technical Grade officer in charge of the SDC in the Newtown Engineering Operations Section, and the article refers particularly to this centre.

The management objectives for each cell in the organisation are stated and various control parameters used in assessing progress are discussed.

INTRODUCTION

The telephone subscribers of the City of Sydney have a total of 1.3 million telephones, which are provided and maintained by the Sydney Metropolitan Operations Branch of the Australian Post Office. The Engineering Branch is divided into an inner city and nine suburban operations sections, and each has a Subscribers District Centre (SDC) organisation, to administer these maintenance and installation functions.

The Metropolitan Operation No. 8 Section (Newtown) covers an area of 68 square kilometres in the inner southern suburbs of Sydney (see Fig. 1). This region adjoins the city proper and extends from the Glebe and Balmain waterfront areas on the southern shores of Port Jackson, through the commercial and industrial areas of Newtown and Petersham, over the Cooks River, to residential areas in the vicinity of Botany Bay. The Newtown SDC maintains 120,000 telephones, which are connected to the network via 75,000 exchange lines. These lines are associated with eight telephone exchanges, all of which are relatively large by Sydney standards.

FUNCTIONAL GROUPS

The SDC organisation provides and maintains subscribers services in the previously described region and this work can be conveniently divided into six distinct functional groups.

The six phases are:

(i) Subscribers Equipment Maintenance.

(ii) Public Telephone Maintenance.

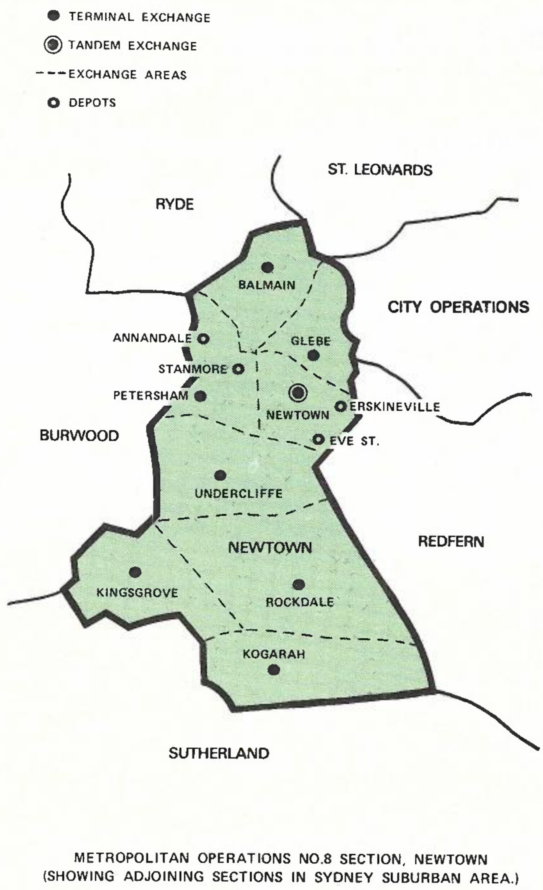


Fig. 1—Map of Sydney, Showing Newtown Section.

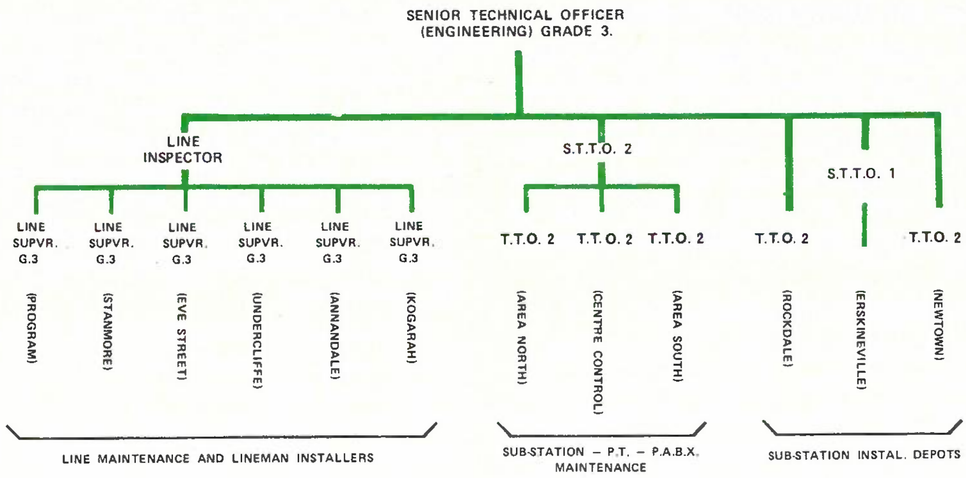


Fig. 2—SDC Organisation.

(iii) Private automatic Branch Exchange (PABX) Maintenance.
(iv) Subscribers Equipment Installation.
(v) Linemen Installations.
(vi) Line Maintenance.

This functional division makes it possible to derive separate parameters for management control of:

(a) Quality.
(b) Performance.
(c) Production.
(d) Productivity in each of the six phases of operations.

The activities of Linemen, Technical Officers, Telecommunications Technicians, Tradesmen and Assistants are controlled by the relevant industrial awards and determinations and the SDC organisation (see Fig. 2) is arranged within the framework of these conditions of service.

The SDC provides for centralised programming and despatch of staff engaged on the maintenance of lines, subscribers equipment, public telephones (PT's), private automatic branch exchanges (PABX's), and switchboards (PMBX's). The SDC is integrated with all six phases of operations by virtue of its programming and despatch functions, its role in the telephone order system and by 2-way mobile radio communication with supervisors. Similar centres in other States are operating under the name of Fault Despatch Centre (FDC), although these centres do not always control the linemen and subscribers installation function as is done by an SDC in NSW.

MONITORING OF SDC PERFORMANCE

The service performance objectives for the various Metropolitan Operations Sections and for the Metropolitan Branch as a whole, are set down in local instructions (Metropolitan Service Instructions). Recently a management monitoring system has been introduced in which the key results from each Operations Section and the Branch as a whole are summarised in a monthly information bulletin. The bulletin is particularly useful for Section Managers because objectives are clearly stated for each functional area, and each month's performance can be evaluated against the Branch or that of similar Sections. Appendix A lists the typical items on which progress is reported.

The Branch Statistical Officer, who prepares the Management Information Bulletin, draws data from a number of sources such as the Sales Branch, Network Performance, Costing Section and the 10 Operations Sections. The data forwarded to Branch level from the Sections consists of a Subscribers' Repair Summary, Exchange Capacity and Growth Returns, separate fortnightly Fault Returns for subscriber, public telephone and line faults, plus a Monthly Telephone Order Return.

Some of the above statistics are collected manually and some are semi-automatically compiled with the aid of an IBM 082 card sorter. Partly because the effort required to collect this data is considerable and because Branch and Section objectives are the same, Newtown uses control parameters which are sub-sets of the data sent on to the Branch.

MAINTENANCE OF SUBSCRIBERS SERVICES

The overall quality of the repair service from the subscriber's point of view may be gauged from the Repair Requests (RR's) per 100 telephone stations per month. During 1973/74 the RR rate for Newtown was approximately 10.5. The Section target was 9.5, with an upper control limit of 11.5. These figures are for subscriber repair reports, excluding PT's.

SUBSCRIBER EQUIPMENT MAINTENANCE

The Senior Telecommunications Technical Officer Grade 2 (STTO2) in charge of the subscriber maintenance activity has three subordinate TTO2's (see Fig. 2); one position has day-to-day control of programmers and the Centre's staff, while the remaining two positions have direct control of field staff engaged on subscribers' equipment, PT and PABX maintenance. Each of these latter officers control approximately half of the total field staff divided geographically into a northern and southern area. This arrangement is varied slightly with some PABX's which are allocated on a functional basis to make better use of trained TTO's in this field.

The quality of service from subscribers equipment is gauged by the fault plus FOK rate per hundred units of plant per month. Typical results achieved at Newtown during 1973/74 are shown in Table 1.

TABLE 1

Units of Plant	RR Rate	Target	Upper Control Limit
120,000 telephones	2.2	2.0	2.5
1,900 intercom units	6.3	6.0	8.0
38,000 PMBX working ends	1.7	2.0	2.5

Quality control of individual services is covered by EM52 (Special Inspection Docket) procedure. Whenever more than two coded entries occur on a service in a two-month period, or in the case of a PMBX a one month period, the master card and IBM card (RR) are referred to the TTO2 in charge of the centre for assessment. If the recurring entries relate to obviously unconnected circumstances probably no further action would be required. On the other hand, a special inspection procedure could be instigated in one or more of the three plant areas; exchange, external or subscribers.

The RR rate, the fault plus FOK rate, EM52's, written complaints and letters of appreciation from subscribers are all indicators of the quality of service.

The *performance* criteria are detailed in a Branch Instruction known as MSI No. 33 with set objectives for unworkable, workable, urgent and non-urgent categories which are closely followed by the fault programmer. The key parameters for checking at Sectional level at Newtown have been the percentage of unworkable faults cleared on the first and the second day of the report and the percentage of workable faults cleared by the end of the second day.

Another guide to performance is the number of second and subsequent reports (PR's) received between the time of the original report and the time the subscriber's master card is filed after fault clearance. The Newtown PR's run at about 1.8 per hundred telephones per month, compared with a target of 1.75 and an upper control limit of 2.5.

Fig. 3 shows typical performance results for subscribers equipment maintained by the Newtown SDC organisation.

The total *production* effort required is gradually increasing as the number of units of plant in service is increased. The average figure for a month is 3500 faults plus FOK's, with the level rising to 4000 on occasions.

A number of separate steps have been taken to increase *productivity*. Morale has improved since new depot facilities have been provided for maintenance staff at the northern and southern ends of the section. The consequent easier access to stores (held at each depot) has helped to increase productivity in this phase of our operations and ineffective time for field staff due to 'down time' of out-of-order vehicles has been reduced to typically nine hours per week, mainly by better co-ordination of vehicle repairs.

Productivity of field staff has varied from 36 minutes per fault plus FOK to 60 minutes, with 46 minutes a consistently achieved figure during 1973.

There are a number of factors that directly affect productivity, such as morale, availability of stores, adequate training and efficient supervision, but provided these requirements are being reasonably met there is a cost penalty in terms of productivity when increases in performance are pursued. This penalty in the Newtown SDC has been found to be in the viciinity of 5 minutes per 10% improvement in performance within the range of 40% to 90% clearance by the second day. In short, this means that goals of maximum performance and minimum labour content are somewhat contradictory, and what can be achieved in practice is a balance between productivity and performance.

Major improvements in this field of operation in the future are expected from the increasing

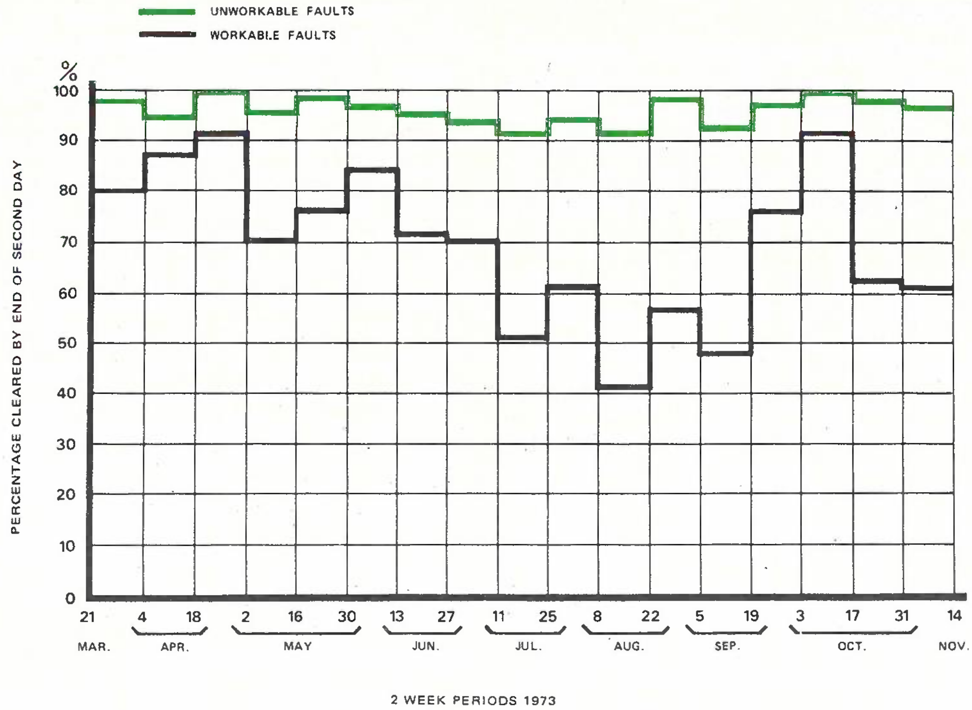


Fig. 3—Performance Results.

use at improved components such as the DMS-3 dials, the new plug and socket combination, the reliability of new subscribers equipment now coming into the field, and the proposed introduction of 2-way mobile radio facilities for supervisory staff, specialist technical personnel and mobile stores.

Surveys of clearance codes for faults repaired are carried out with the aid of the IBM 082 card sorter to detect trends in component or apparatus failures.

PUBLIC TELEPHONE MAINTENANCE

The *quality* of service of public telephones (PT's) is measured by the fault plus FOK incidence per hundred PT's per month. A typical figure for Newtown during 1973/74 was 106 faults plus FOK's per 100 PT's compared with a Branch target of 150 and an upper control limit of 200 per 100 PT's per month.

The *performance* standards vary for PT's depending on whether the PT is in an isolated location or one of a group of PT's at a post office or similar location. Coins-no-service (CNS) repair requests are held in a PT trap until a predetermined number of reports are received, and these can be verified by the Public Telephone Service Indicator (PTSI), (see Ref. 6) device before faultmen are despatched. At the section level, the percentage of faults cleared by the end of the second day is a good indicator of performance. Although 90% of faults cleared by the end of the second day has been achieved at times, 70% appears to be a more general result in this area.

Production runs at about 900 faults plus FOK per month on the 850 PT's installed in the Section.

Productivity has been maintained at a constant level and results in about 20 minutes per PT fault plus FOK. This has been achieved without detriment to the other areas of equipment maintenance.

Two years ago PT faults plus FOK were in the vicinity of 150 per hundred PT's per month and now they are only a little over a hundred. This improvement is directly attributable to modifications developed by the Postal Workshops Sections and a reduction in the number of visits by faultmen, brought about by verifying CNS (coins, no service) complaints on the PTSI. Further improvements can be expected in the near future from the use of improved reinforced handset cords, sealed handsets, and greater penetration of the new Multi Purpose Coin Telephone (CT3) in the field.

PABX MAINTENANCE

The PABX maintenance phase of SDC operations is in a technological sense the most challenging with installations of twelve different basic designs of PABX, including the three standard step-by-step types and other models manufactured by L. M. Ericsson, S.T.C. (Pentaconta), Hitachi and Plessey to maintain.

The overall *quality* of service from PABX equipment is measured by the faults plus FOK's per hundred extensions connected via PABX equipment and the target is 1.5 per hundred extensions per month, with an upper control limit of 2.5. Results at Newtown SDC in 1973/74 have ranged from 1.4 to 3.3, with a mean of 2.4, which puts it in the upper quartile in regard to fault incidence in the Sydney Metropolitan Branch. Individual PABX's have the quality of service monitored by the normal EM52 procedure, and also by a system of two monthly reports where the average quality of each model of PABX is recorded, and troublesome PABX's, which deviate significantly from the mean for their type, become the subject of investigation during the following two-month period.

The *performance* in PABX fault clearance can be difficult to gauge, because in addition to faults reported by the subscriber there are others detected on the scheduled visits which are invariably repaired on the same day. This tends to contribute to a misleading result of typical 80% of all faults cleared on the first day. A more realistic view of performance is gained by checking the percentage of reported faults repaired, which is usually 60% on the day of report and about 90% by the end of the second day.

Total *production* ranges from 200 to 380 faults plus FOK per month, with a mean level of 280 during 1973/74. These repairs are carried out on 120 PABX's, which are loaded with 12,000 working extensions.

Productivity during 1971/72 yielded a rate of 278 hours per hundred extensions connected to PABX equipment per year and in the financial year (1972/73) 224 hours per hundred extensions was recorded. Productivity checking will be easier with the introduction of new sub-accounts for PABX maintenance to separately record the hours expended on step-by-step and crossbar equipment and also to record hours spent on acceptance testing of new PABX's and other associated work. The end result of this innovation will be to make comparisons between sections more meaningful.

A two-monthly report system on PABX equipment maintenance has been recently introduced at Newtown which should result in more effective use of labour in this phase of our operations and allow for objective comparisons to be made between PABX's within the section.

Step-by-step equipment caters for 45% of PABX extensions connected in the Section and SxS equipment has an average repair time of approximately 1.2 hours per fault plus FOK. The remaining 55% of extensions are connected via crossbar type equipment where PABX repairs are at a rate of about 1.5 hours per fault plus FOK.

The overall rate of hours expended on maintenance of PABX equipment expressed as a ratio of hours per hundred extensions is decreasing each year as the percentage of crossbar equipment increases. This is due to the general lower fault incidence of the new generation of equipment. It is sufficient to say that the full potential of increased productivity in this area has not yet been realised.

SUBSTATION INSTALLATION

Simple telephone services (Plans 1 to 5) are completed by Lineman Installers and the more complex installations such as switchboards, intercom systems and other equipment are installed by Telecommunications Technicians, Tradesmen and Assistants from three subscriber equipment Installation depots (SID's) under the supervision of TTO's (see Fig. 2).

Quality control in this phase of operations is carried out by inspection and any new installations which develop faults within 2 weeks of completion are referred by the TT02 (Centre Control) back to the SID's for remedial action by installers.

The present *performance* target laid down in local instruction MSI 33 is completion within fourteen days from date of issue of the telephone order and Newtown's results have been typically 25% of this work completed within target and 57% completed within 28 days. Approximately 30% of those orders which exceed the target do so because of delays attributable to the subscriber and are beyond Departmental control. The remainder are waiting Departmental labour and/or material.

The total *production* from the three depots is 108 new lines (mainly Plan 6 and above) and also 940 miscellaneous and disconnection telephone orders per month.

Productivity measurement is difficult in this functional area because the work content of miscellaneous telephone orders varies considerably. Some measure of this variation can be seen from the results of a recent survey, where the number of stations (telephones or answering points) to be provided or removed on each miscellaneous type Telephone order was recorded:

Newtown SID	....	4.4 stations per order
Erskineville SID	... .	2.5 " " "
Rockdale SID	....	1.5 " " "

LINEMEN INSTALLERS

Mobile Linemen Installers complete the linework for new telephone services, external extensions and non-exchange (NEX) type services up to the line ready (SE579) stage for final completion by technician staff from SID's. Simple services are fully completed by Lineman Installers in the range:

Plan 1 One telephone permanently connected to an exchange line.
Plan 2 Parallel telephone; one exchange line and 2 or 3 parallel telephones.
Plan 3 Portable telephone service.
Plan 4 Parallel-portable telephones.
Plan 5 Alternative telephones.

The *quality* of work carried out by Lineman Installers is checked by inspections and any new services which develop faults within 2 months of installation are referred by the Line Programmer to the Line Supervisor Grade 3 in charge of the relevant area to specially inspect plant to ascertain if the service failure is due to poor quality workmanship or plant.

The *performance* target for connection of telephone services is fourteen days and 35% of the work is completed within the target and 68% within twenty-eight days. Approximately 30% of telephone orders, which are connected after the target, are delayed, due to non-completion of buildings and other reasons, which are classified as waiting subscriber.

The total *production* in the latter months of 1973 was 650 new telephone services monthly. In addition, Lineman Installers complete the line work portion of many miscellaneous orders for NEX services, external extensions, and also provide telecommunication earths for PBX's and intercom systems.

The *productivity* of Lineman Installers is checked daily by Line Supervisors on the daily telephone order return (see Fig. 4), and a fortnightly produc-

EN.597 (July '72)

POSTMASTER-GENERAL'S DEPARTMENT
Engineering Division
DAILY TELEPHONE ORDER RETURN

EXCHANGE | DEPOT

DAY	ACTION	NUMBER OF DAYS FROM DATE OF ISSUE							E/F	T/O	D/L	PLAN 1-5	SE 579		
		7	14	21	28	35	36+	Total					N/L	Xtns	TGO's
THURSDAY	Carried Forwarded														
	Received														
	Completed														
	Withdrawn														
	To External Plant														
	Waiting Sub — Sub Out (Card Left)														
	Waiting Sub — Sub Date Requested														
	On Hand														
FRIDAY	Received														
	Completed														
	Withdrawn														
	To External Plant														
	Waiting Sub — Sub Out (Card Left)														
	Waiting Sub — Sub Date Requested														
	On Hand														
...AY	Received														
	Completed														
	Withdr...														

Fig. 4—Daily Telephone Order Return.

tivity form is prepared by each Line Supervisor and has proved to be a factor in improved job control at this level. The work content of the line and subscribers equipment sections of the work varies greatly and survey fields have been included at the right hand side of the daily telephone order return to help when making productivity comparisons in this phase of operations.

LINE MAINTENANCE

Mobile line maintenance linemen and Lineman Installers are arranged in five geographical groups under the control of a Line Supervisor Grade 3. These groups service from 12,000 to 18,000 exchange lines, and are intended to be independent viable units in which staff can be flexibly used on line maintenance or installation as required. Overloads are met by assistance from external plant staff who are normally engaged in providing new or larger size cables in the same geographical area and are accommodated near or adjacent to SDC staff.

The *quality* of service from line plant is measured by the fault plus FOK rate per hundred exchange lines per month. During 1973/74 the rate was 1.5 per hundred exchange lines per month, a fall of 12% on the previous year's figures.

Regular inspections by the Line Inspector and Line Supervisors are a big factor in keeping the line plant up to standard and faults down to a minimum. A variety of surveys are carried out on our IBM 082 card sorter with data gathered when line faults are cleared and conclusions drawn from analysis of these surveys give direction to our efforts in the field.

The following surveys are carried out:

Monthly

(1) Description and location of faults in exchange area.
(2) Faults recorded in each Distribution Area (DA).
(3) Detailed fault history of selected high fault incidence DA's.

Ad Hoc

(1) Pillar faults.
(2) Faults due to re-arrangements.
(3) Faults in joints.
(4) Faults coded Y (ALFA2).
(5) Faults coded K (ALFA2).
(6 Faults coded T (ALFA2).
(7) Insulation resistance tests (ALIR).

The card sorter discriminates on punched alpha and numeric characters which are basic input for the Line Fault Analysis system ALFA2.

The *performance* on line fault repairs is typically 64% of faults cleared within 2 days with better performances around 80% and poorer results in the vicinity of 50%. The containing of staff in strict geographical areas tends to reduce performance slightly, but this is more than made up by greater accountability and responsibility of Line staff for the plant in their area and has led to a reduction in the line fault incidence generally.

The *production* figure for the section is about 1100 line faults plus FOK per month.

The *productivity* of staff is checked in the field and at a sectional level and the effects of changes in methods and/or technology are monitored.

CONCLUSION

The six phases of operation of the Newtown SDC have been reviewed in objective terms. The control function theme of:

(1) Measurement of work progress.
(2) Comparison of progress against Targets or Objectives.
(3) Corrective action (to compensate for any differential detected in (2);

runs right through the day-to-day operation of the SDC and is an essential element in the management of such a diversified organisation.

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APPENDIX 1—TYPICAL MANAGEMENT CONTROL DATA.

The following are typical data published monthly in the Sydney Metropolitan Branch Management Information Bulletin. The statistical data includes the results for each Section, and the Branch as a whole.

Telephone Orders

Demand annual prediction.
Monthly demand.
Progressive demand.

Progressive prediction.
Variation on prediction.
Connections original annual target.
Connections for month.
Progressive connections
Original progressive target.
Variation on original target.

Telephone Orders — Deferred Applications
Cable.
Equipment.
Total.
Total as at (eg) 30.6.1974.

Telephone Orders — New Lines
Completed.
Average Comp./week.
On hand.
Estimated week's work on hand.
On hand at (eg) 30.6.74.
Variation monthly against 30/6/74.

On Hand Over 21 days:
Waiting Subscriber.
Waiting Department.

Work Completed:
% completed 0-14 days.
% completed 0-28 days.
Week 75% work complete.

Internal Plant Providing Man-hours
Budget 1973/74.
Progressive Budget.
Actual usage.
Variation.
Percentage.
Usage 1972/73.
Forecast 1973/74.

Internal Plant Maintenance Man-hours (M and F a/cs)
Similar to Providing man-hours as above.

Subscriber Repair Reports
Repair requests/100 stations, upper limit.
Repair requests/100 stations, target.
Repair requests/100 stations, period.
Repair requests/100 stations, progressive.
RWT's/100 stations.
PR's/100 stations.

Subscriber Equipment Repairs
Faults & FOKS/100 stations, upper limit.
Faults & FOKS/100 stations, target.
Faults & FOKS/100 stations, period.
Faults & FOKS/100 stations, progressive.
% faults cleared <2 days, unworkable.
% faults cleared <2 days, total.
PABX faults plus FOKS/100 tele extns.
Public telephone repairs.
Repair requests/100 PT's.
Faults + FOKS/100 PT's.
% faults cleared <2 days, total.

External Plant Repairs
Faults & FOKS/100 exch. lines (upper limit).
Faults & FOKS/100 exch. lines target.
Faults & FOKS/100 exch. lines period.
Faults & FOKS/100 exch. lines progressive.
% faults cleared <2 days, unworkable.
% faults cleared <2 days, total.

Plant and Staff Totals
Telephone stations
Technical staff.
Stations/Technical staff.
Exchange lines.
Lines staff.
Exchange lines/lines staff.
Area in square kilometres.
Weather.

Man-hours
XIM2+4 (Subs. Fault + FOK).
XIM2+4 (Subs. Fault + FOK), progressive.
XIM2+4/100 stations/annum, progressive.
XIM8 (P.T. fault + FOK).
XIM8 (P.T. fault + FOK), progressive.
XIM8/P.T./annum, progressive.
XXM/100 PABX extns/annum, progressive.
XAM1-5/100 stations/annum, progressive.
External Plant:
- XUF + XWF (fault + FOK).
- XUF + XWF (fault + FOK), progressive.
- XUF + XWF/100 line/annum, progressive.

Network Switching Performance Measurements
Local Service Assessment (SA), Sample Size, Calls.
SA switching loss %.
SA plant congestion loss %.
SA call loss %.
TRT call loss %.
Tech. assistance complaints (orig)/100 tel/period.
Junction circuit gains.
Carrier channels installed.
Carrier channels connected.
Physical junctions connected.

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He joined the Department as a Technician-in-Training in 1951, qualified as Senior Technician in 1958 and was subsequently advanced as Supervising Technician in Country and later Metropolitan Installation.

He completed a Sydney Technical College Certificate in Electronics and Communication in 1966 and has been employed on Senior Technical Officer (Engineering) duties in Subscribers District Centres since 1969.

Final Route Traffic Supervision

D. V. OCKLEY, FRMTC.

This article describes a simple method of approximating the offered traffics, grade of service and circuit requirements on final routes at main or tandem switching points in alternatively routed networks, using a time-shared computer terminal to perform calculations. Application of the method at Melbourne ARM exchange is discussed.

INTRODUCTION

Operations Engineers are responsible for ensuring among other things that the grade of service (g.o.s.) provided in the telephone network is within acceptable limits and therefore require:

- a method of measurement of g.o.s. on key routes and
- a method of determination of number of additional circuits required immediately on such routes where it is found that g.o.s. is outside acceptable limits.

At ARM exchanges where high trunk traffic growth rates are common, there is a need for frequent traffic measurements and prompt processing in order to:

- keep top management intormed on the state of the network,
- draw attention of all concerned to network deficiencies,
- permit Planning and Construction engineers to review priorities and provide equipment and effort where it will have best effect.

APO policy is to read traffics on all circuit groups throughout an exchange at various intervals determined by:

- date of last reading,
- date of next equipment extension,
- importance of exchange,
- seasonal variations,
- subscribers growth rate.

These official traffic readings, which in practice may be issued at intervals ranging from six months to two years or more, are a detailed study and audit of an exchange and may take several months to prepare and distribute.

They are the only reliable and consistent assessment of the state of trunking at an exchange. In the periods between reports, responsibility for maintaining the g.o.s. and all manual traffic measurement and analysis that may be required to do this, rests with the Operations Staff. An outline is given of the use of a computer to improve on manual methods in use and focus attention more quickly on problem areas.

FINAL ROUTE TRAFFIC

Networks such as the crossbar ARF and ARM networks employ alternative routing where traffic is first offered to a direct route which overflows to a second choice and maybe third and fourth choice route to a final route. These networks may be supervised for operations purposes by monitoring *ONLY* the final route. The answer to relief of traffic congestion may not lie in the immediately obvious solution of increasing the number of circuits on the final route; in many cases the problems on the final route will be caused by insufficient provision of direct or other choice routes elsewhere. However, continuous supervision of traffic on final routes does provide an immediate indication of problem areas and directs attention to specific portions of the network.

Erlang-hour meters are available in all ARM exchanges for use in the measurement of traffics on important early choice and final routes incoming to or outgoing from the exchanges (Ref. 1).

At Melbourne ARM these meters are connected to all outgoing final routes plus any other routes which are considered worthy of supervision, and are read weekly by the maintenance staff. The meters have telemetering contacts which are connected to feed positive pulses, generated at a rate determined by the traffic measured, to a group of exchange statistical meters located together for ease of reading. The battery commons to the statistical meters are switched by time clocks so that each meter operates

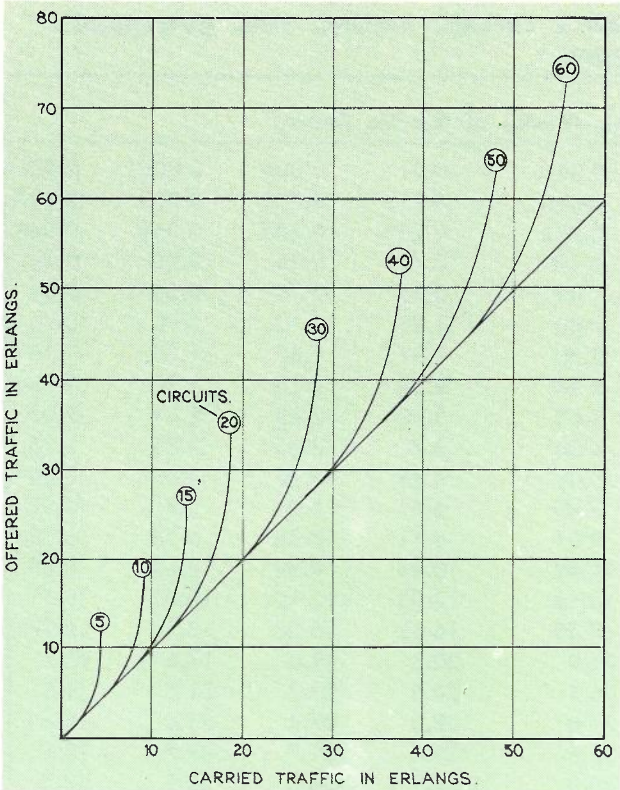

Fig. 1—Extract from Traffic Offered Correction Curves (Ref. 3).

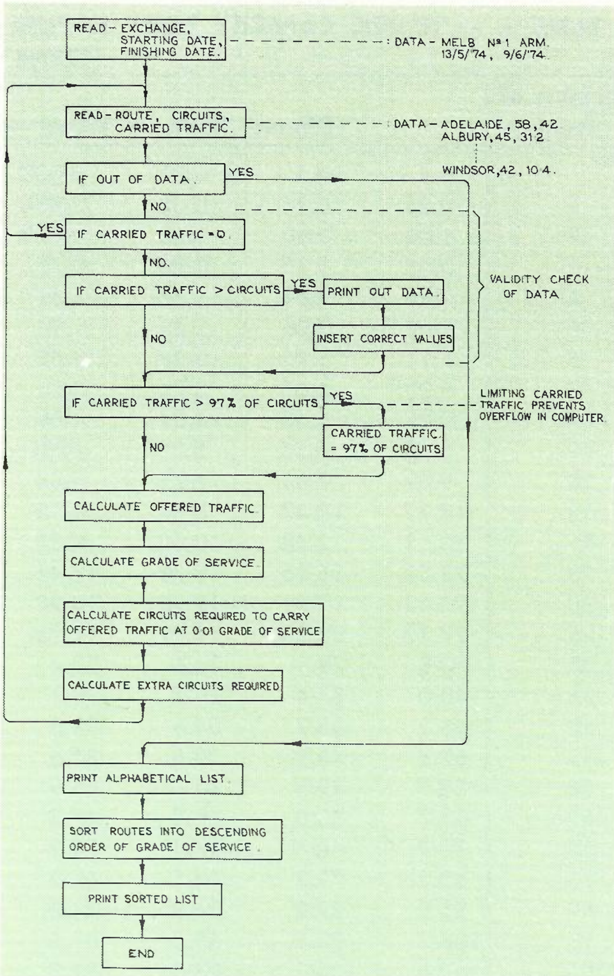

Fig. 2—Flow Chart of Computer Programme.

only during the busy hour of the route to which it is connected. In this way the need to switch traffic leads to Erlang-hour meters, where currents of one amp or more may be encountered, is avoided. Thus the difference between weekly statistical meter readings, when multiplied by a factor to compensate for the range on which the Erlang-hour meter is set and divided by the number of hours during which traffic is observed, gives the busy hour traffic in Erlangs carried on final routes.

Once a measurement of busy hour traffic carried on a final route is available and the number of circuits on the route is known, providing the following assumptions are acceptable, offered traffic, g.o.s. and circuits required to restore g.o.s. to within specified limits may be calculated. In order to obtain a fast yet reasonably accurate result it is assumed that offered traffic is pure chance in nature, full availability conditions apply and internal link congestion has no significant effect. If in a particular case one of the above is not true then the calculated offered traffic will be less than the real offered traffic and the calculated g.o.s. will be better than actual. The assumptions are considered acceptable when it is remembered that the purpose of the exercise is to provide an indicator of the overall adequacy of trunking to meet the traffics being offered, and to not only sound an alarm signal but give a pointer as to the action required to overcome the trouble when congestion is occurring.

If trouble is indicated and we know an assumption to be incorrect, eg traffic offered may be rougher than pure chance having been first offered to a direct route, then it will be realised that the magnitude of the trouble may be greater than indicated.

The method of automatic traffic surveillance previously described in this journal (Ref. 2), introduced initially at Melbourne ARM to avoid frequent manual reading of Erlang-hour meters, has now been rearranged from automatic *TRAFFIC* surveillance to automatic *ROUTE* surveillance. Instead of automatically monitoring whether safe traffic limits

TABLE 1 — TRAFFIC CAPACITY TABLE A: PURE CHANCE OFFERED TRAFFIC, FULL AVAILABILITY TRUNK GROUPS

Number of Trunks	'Offered Traffic in Erlang for the Grades of Service Shown'								
	0.2	0.1	0.05	0.033	0 02	0.01	0.005	0.002	0.001
1	0.25	0.11	0.05	0.034	0.020	0.010	0.005	0.002	0.001
2	1.00	0.60	0.38	0.299	0.224	0.153	0.105	0.065	0.046
3	1.93	1.27	0.90	0.75	0.60	0.46	0.35	0.25	0.19
4	2.95	2.05	1.52	1.31	1 09	0.87	0.70	0.53	0.44
5	4.01	2.88	2.22	1.94	1.66	1.36	1.13	0.90	0.76
6	5.11	3.76	2.96	2.62	2.28	1.91	1.62	1.33	1.15
7	6.23	4.67	3.74	3.34	2.94	2.50	2.16	1.80	1.58
8	7.37	5.60	4.54	4.09	3.63	3.13	2.73	2.31	2.05
9	8.52	6.55	5.37	4.86	4.34	3.78	3.33	2.85	2.56
10	9.69	7.51	6.22	5.66	5.08	4.46	3.96	3.43	3.09
13	13.22	10.47	8.83	8.13	7.41	6.61	5.96	5.27	4.83
15	15.61	12.48	10.63	9.84	9.01	8.11	7.38	6.58	6.08
18	19.22	15.55	13.38	12.45	11.49	10.44	9.58	8.64	8.05
20	21.64	17.61	15.25	14.22	13.18	12.03	11.10	10.07	9.41
25	27.72	22.83	19.99	18.78	17.50	16.12	15.00	13.76	12.97
30	33.8	28.1	24.8	23.4	21.9	20.3	19.0	17.6	16.7
35	40.0	33.4	29.7	28.1	26.4	24.6	23.2	21.6	20.5
40	46.2	38.7	34.6	32.8	31.0	29.0	27.4	25.6	24.4
45	52.3	44.1	39.5	37.6	35.6	33.4	31.7	29.7	28.5
50	58.5	49.6	44.5	42.5	40.3	37.9	36.0	33.9	32.5
55	64.7	55.0	49.5	47.3	45.0	42.4	40.3	38.1	36.6
60	70.9	60.4	54.4	52.2	49.7	46.9	44.7	42.4	40.8
70	83.3	71.3	64.5	62.0	59.1	56.1	53.7	50.9	49.2
80	95.8	82.2	74.8	71.8	68.6	65.4	62.7	59.4	57.8
90	108.2	93.1	85.0	81.5	78.2	74.7	71.8	67.9	66.5
100	120.6	104.1	95.3	91.3	87.6	84.1	80.9	76.4	75.2

on a route are exceeded, the method now in use monitors whether the time during which all circuits on a route are busy exceeds pre-set limits. The latter method has been found to be more satisfactory as once it is connected in the exchange it does not have to be altered whereas the former method necessitated frequent alterations to the supervisory unit strapping block to compensate for circuit alterations and traffic growth. High traffic growth rates on trunk routes and a constant problem of circuit underprovision prompted a decision to reintroduce manual reading of Erlang-hour meters to more rigidly supervise trunk network traffics.

Automatic route surveillance is a good guide to the maintenance staff that a route congestion problem has occurred, eg. a bearer failure, but it is not a substitute for traffic supervision. Regular measurement of traffic is a far more reliable guide to network supervision, and provides data for use by planners in assessing traffic growth on specific trunk routes, but having supervised final route traffics, how are the measurements put to work?

MANUAL METHOD

Given the traffic caried on a number of circuits, an estimation of the traffic offered can be made by reference to a set of published curves (Ref. 3) of which an extract is included (Fig. 1) for the case of pure chance traffic, full availability and no internal congestion in the switching stage. These conditions are met in practice in most cases at an ARM exchange.

Using the figure obtained for offered traffic, estimates of the g.o.s. provided, and number of circuits required in order to restore the g.o.s. to within the acceptable limit of one lost call in 100 offered (0.01), may be obtained from published tables (Ref. 4), an extract of which is included as Table 1.

Such an exercise carried out manually over many routes every four weeks can become tedious, time consuming, and inaccurate due to the interpolations which must be made. If it were then decided to

TABLE 2 — COMPUTER PRINTOUT LISTED IN DESCENDING ORDER OF GRADE OF SERVICE MELB. NO. 1 ARM EXCHANGE, PERFORMANCE OF FINAL ROUTES 13/5/74 TO 9/6/74

Route	Circuits in Situ	Traffic Carried (Erlang)	Traffic Offered (Erlang)	Grade of Service	Circuit Required For 0.01 G.O.S.	Extra Required
FERNTREE GULLY	31	29.00	41.19	.296	54	23
EUROA	8	5.90	7.37	.200	15	7
ECHUCA	13	10.50	12.97	.191	22	9
FINLEY	10	7.40	8.78	.157	16	6
SEYMOUR	16	12.80	14.91	.142	24	8
NUMURKAH	12	8.60	9.61	.105	17	5
ST. ARNAUD	10	6.80	7.58	.103	15	5
KERANG	14	10.30	11.42	.098	20	6
CRANBOURNE	22	17.60	19.43	.094	29	7
DENILIQUIN	14	8.80	9.13	.036	17	3
PAKENHAM	26	19.20	19.92	.036	30	4
KYABRAM	16	10.30	10.64	.032	19	3
EMERALD	23	16.00	16.45	.027	26	3
SWAN HILL	32	23.80	24.42	.026	35	3
KYNETON	32	23.20	23.66	.020	34	2
CAMPERDOWN	26	17.90	18.24	.019	28	2
WARBURTON	18	10.90	11.07	.015	19	1
SHEPPARTON	36	25.60	25.90	.012	37	1
BENDIGO	43	31.20	31.50	.009	43	0
ALBURY	45	32.80	33.09	.009	45	0
MANSFIELD	11	4.90	4.94	.008	11	0
WANGARATTA	16	8.40	8.46	.007	16	0
KILMORE	19	10.40	10.46	.006	19	0
MARYBOROUGH	13	6.00	6.03	.005	13	0
HEALESVILLE	22	12.10	12.14	.003	21	0
MORWELL	90	69.60	69.80	.003	85	0

sort the results so that the worst route headed the list, more time would elapse, so that by the time the processing was completed and a report typed it would have lost impetus.

Clearly, a faster yet simple method of processing the data was needed and an answer was found in the employment of an accessible time-shared computer terminal.

COMPUTER METHOD

Apart from illustrating the simplicity of a computer application, this project clearly indicates to technical and engineering staff in operations areas, the value of using computers whenever an economically attractive application presents itself. The use of 'BASIC' language (Ref. 5) is illustrated here in performing by computer the same operations and obtaining the same result as with the manual approach above, but in a fraction of the time. The method of programming Erlang's well known formula for the probability of congestion in Basic language is included as Appendix 1.

Appendix 2 describes how the same formula is used in a simple iterative process to calculate offered traffic and grade of service.

A broad outline of the programme is given as a flow chart in Fig. 2; some brief explanation follows. The programme was prepared for use in any exchange at any time and therefore exchange name and dates of traffic readings are input as data, as are route names, traffics carried, and numbers of circuits on the routes. Up to an hour of typing may be involved for an exchange where traffics on 80 routes are being examined as input data and, apart from the work involved in the actual traffic measurement, there it ends; the computer performs the calculations and types the report.

The flow chart indicates some data checks which have been included in the programme, eg. traffic carried should be less than the number of circuits on the route. If the measured traffic carried is greater than 97% of the number of circuits, calculations of very high offered traffics will result; in order to keep calculations within practical limits when this unlikely situation occurs, the carried traffic is set at 97% of the number of circuits.

PRINTOUT

Two outputs are provided as indicated on the flow chart, one listing the routes in the order they were input as data, the other sorting routes into descending order of grade of service and arranging to cut off at three lost calls in 1000 offered (0.003). Table 2 is an example of this second and more salient output.

This output is arranged in such a manner that the worst route is in the featured position and in the example is obviously in need of attention.

By publication of such relevant information at four-weekly intervals and by distribution to the right quarters the aims as set out in the introduction may be achieved. A marked improvement in congested routes at Melbourne ARM is noticable since more vigilant traffic supervision of final routes has been implemented as a normal procedure.

By comparison of printout (Table 2) with both the traffic offered correction curves (Fig. 1) and pure chance offered traffic dimensioning table (Table 1), it will be seen that the programme is accurately performing the desired calculations.

Regardless of simplicity and accuracy of calculations performed, it is stressed that the information presented in the printout is an indicator only of the state of congestion of the network at a particular time. An indication of congested final routes is a starting point for provision of relief; actual relief will more than likely be most economically provided at early choice routes rather than on the final routes where congestion is apparent. However, where expansion of a final route is the correct means of overcoming a particular problem, the method of supervision outlined dimensions the *MINIMUM* of relief required to restore the grade of service provided to an acceptable figure.

CONCLUSION

A method has been stated whereby supervision of portion of the Victorian Trunk Network has been rendered more simple and effective. Similar procedures could be employed in any alternatively routed networks at locations such as tandem or trunk switching exchanges, where the *CONTINUOUS* monitoring of traffic may provide Management with information to more quickly overcome network congestion problems. Strength of the approach lies in:

- provision of accumulating Erlang-hour meters to continuously monitor *FINAL* routes,
- use of a computer to manipulate the information provided by the Erlang-hour meters, and
- regular distribution of recent information to those responsible for maintaining network standards.

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FURTHER READING

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APPENDIX 1: CALCULATION OF GRADE OF SERVICE

Erlang's formula is $B = (A^N/N!)/(1 + A + A^2/2! + A^3/3! + \ldots A^N/N!)$ .... (i)

where B = Grade of service = Lost calls/Offered calls
A = Pure chance traffic offered to route in erlangs
N = Number of trunks on route

For large values of A and N, this expression can result in values of A^N and N! larger than 10^{38} and so exceed the capacity of the computer used.

Therefore an approach to the final result is made by incrementing the value of N from 1 to N in successive calculations. Using 'Basic' language this is simply programmed as follows:

Programme Line Numbers

```
200   X = 1
210   Y = 1
220   FOR I = 1 TO N
230   X = X (A/I)
240   Y = Y + X
250   B + X/Y
260   NEXT I
```

Thus when I = 1; X = A, Y = 1 + A, B = A/(1 + A)

when I = 2; $X = A^2/2!$, $Y = 1 + A + A^2/2!$, $B = (A^2/2!)/(1 + A + A^2/2!)$

when I = N; $X = A^N/N!$, $Y = 1 + A + A^2/N! + \ldots\ldots\ldots A^N/N!$

and B = Erlang's formula (i) above

APPENDIX 2: CALCULATION OF OFFERED TRAFFIC

There are precise and rather involved methods of deriving offered traffic from carried traffic; however a simple approach may be made as follows if the following assumptions are accepted:

- Assume that grade of service B is equal to (Traffic lost) / (Traffic offered) rather than (Calls lost) / (Calls offered)
- Assume pure chance offered traffic
- Assume full availability conditions prevail
- Assume link congestion is negligible

The first assumption leads to the expression $B = (A - A_c)/A$

Therefore $A = A_c/(1-B)$ .... (ii)

where B = Grade of Service = Lost traffic/ Offered traffic

A = Offered traffic

A_c = Carried traffic

In Appendix 1, B was expressed in terms of A and N, so by substituting *Ac* for A in (i), (Erlang's formula), a first approximation to B is made.

By substitution of B in (ii) above a second approx. of A is made.

This value of A in (i) gives a second approximation to B which in (ii) gives a better approximation to A, etc., until the difference between successive approximations of A is less than 0.01. Using 'Basic' this is simply programmed as follows:

```
(190   A = Ac)
 200   X = 1
 210   Y = 1
 220   FOR I = 1 TO N      As explained in
 230   X = Y (A/I)           Appendix 1
 240   Y = Y + X
 250   B = X/Y
 260   NEXT I
 270   A1 = A/ (1-B)  (Approximations of A)
 280   IF(A1-A) < 0.01 THEN 310
                            (Finishing point)
 290   A = A1           (A is updated to the
                            higher value)
 300   GO TO 200        (And start next approx-
                            imation of B)
(310   A = A1)          (The offered traffic has
                            been calculated)
```

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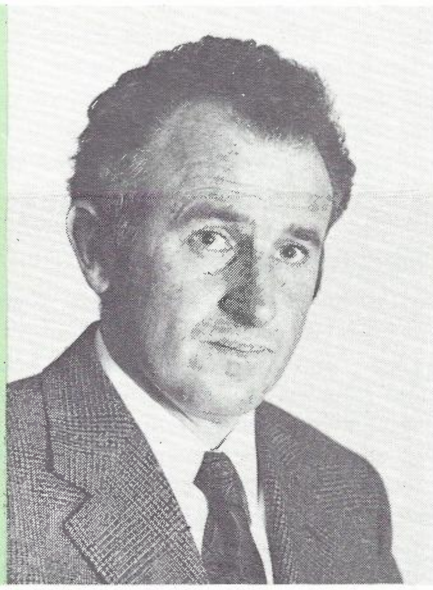


'Customphone' Development in New South Wales

M. B. ELGIE

This article briefly outlines the development in N.S.W. of the Customphone, the modern counterpart of the Non Switching Unit (NSU) facility. The initial NSU installations catered for rather simple executive-secretarial communication functions which did not require diverse switching of calls to other points; hence the term NSU became generally accepted as the name for these early types of services. As the demand for more complex arrangements has emerged, a more appropriate designation, Customphone, has been adopted for modern type units installed since 1972.

HISTORY OF THE NON-SWITCHING UNIT (NSU)

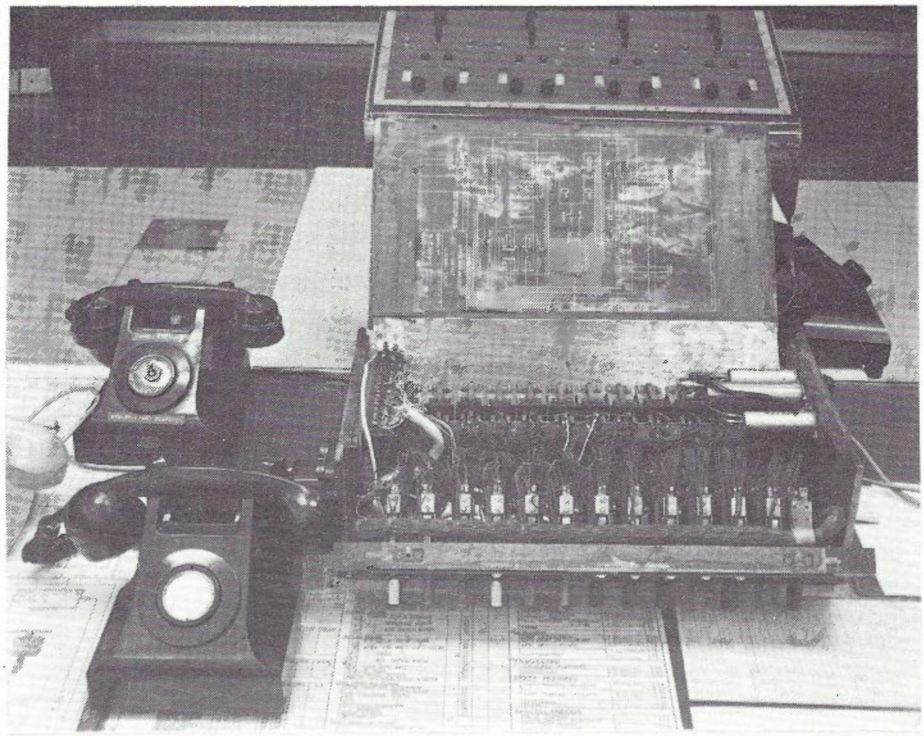
The precise date of the first NSU installation in NSW is not known. However, it would seem that the first NSU service was installed in the business sector of Sydney during 1932. Some of these early units are still operational. The Electricity Commission of NSW has an NSU installation, still in use, which was manufactured by the Sydney Postal Workshops in 1933. The oldest drawing held in the Customphone Installation Depot is dated 23.9.1935 and is for an NSU terminal appropriation. The oldest circuit diagram drawing held in the depot is dated January 1945; this circuit diagram would appear to be common to most circuits in use up to that date.

BASIC PRINCIPLES OF EARLY NSU's

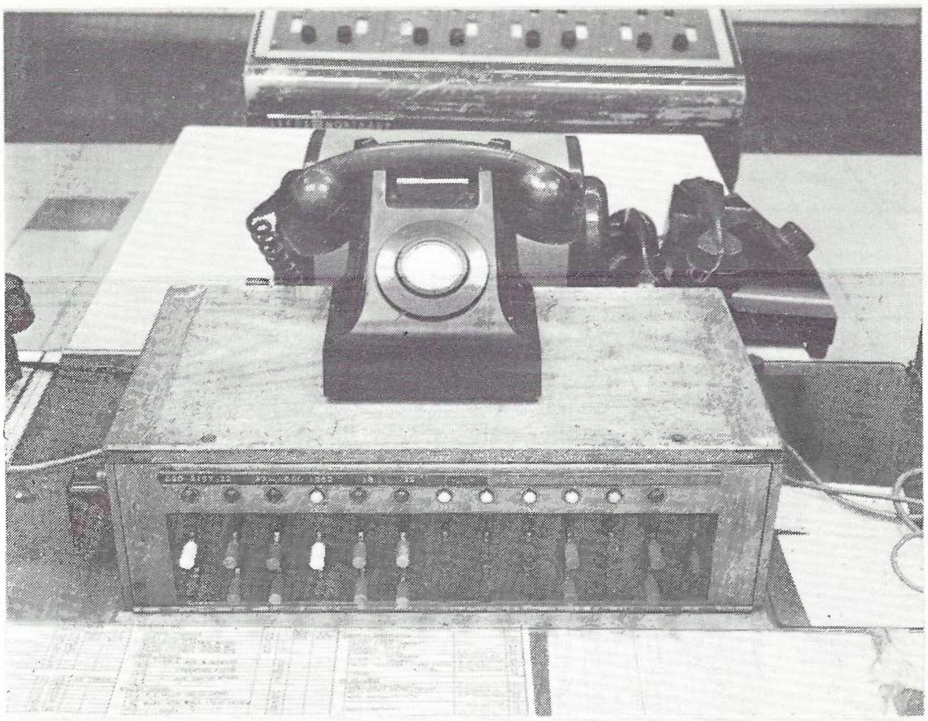
The basic function of these early installations was to concentrate a number of various types of circuits, e.g., exchange lines, PMBX and PABX extensions, private lines, order wires, on a single piece of equipment rather than to have the services appearing on several telephones. Hence, the adoption of the original title 'non switching unit'. The later developments in NSU's included the facility to automatically transfer calls to other predetermined points. Once this facility was provided confusion arose in some minds due to the fact that the non "switching" unit apparently performed a switching function. However, unlike the PABX transfer, only the incoming signal is transferred, the line itself remaining available at both points and is not physically switched. The term NSU persisted until 1972, when a more appropriate title, 'Customphone', came into use. This new designation implies an installation which is to provide the customer's requirements; the name does not have the limitations of the term NSU. In the following text the title NSU will apply to units manufactured prior to 1972, and the term 'Customphone' for units provided since 1972.

RESPONSIBILITY FOR PROVISION OF NSU's

Early NSU's were manufactured by the Sydney Postal Workshops to individual circuit arrangements, and the local Subscriber Installation Group carried out the installation; Fig. 1 shows early NSU's. About 1939 the PABX Installation Section was expanded to cater for all NSU facilities associated with PABX equipment and also for the more complex NSU installations. Finally, in 1966, the PABX Installation Section became responsible for the circuit design, supply and installation of Departmental NSU apparatus, and for the approval of circuit design and installation of all NSU equipment supplied by private enterprise in the Sydney Metropolitan Area, with the exception of a small number installed by private contractors in conjunction with the installation of PABX's. In May 1972 this concession was withdrawn from private contractors and from that date all Customphone installations have been carried out by the PMG Department. It still remains the responsibility of the private manufacturer of Customphones to rectify any faults found in his equipment during PMG acceptance testing. For country areas the responsibility for ordering and installation has remained with the controlling Regional Engineer.



(a)



(b)

Fig. 1—Early Non-Switching Units.

HANDLING SUBSCRIBER NSU APPLICATIONS

Where the normal range of substation equipment does not meet the requirements of the customer the local Telephone Sales Branch will refer the client to the Sales Advisory Section, Telecommunication Division, for assistance in providing alternative non-standard apparatus.

The Sales Advisory Section and the customer discuss the facilities required, and when these have been decided the local Sales Branch sends a memorandum to the Engineering Branch describing the units and requesting the manufacturing and installation costs.

The facility brief is forwarded to the Customphone Installation Depot. Here a technical officer estimates the cost of manufacturing the units and then, after a visit to the subscriber's premises, estimates the installation costs, including cabling, material and labour requirements, etc. The costs are sent to the Sales Branch, which forwards them together with a letter of cost acceptance (Tel. 40) to the subscriber for acceptance or otherwise.

As each Customphone is custom built to the subscriber's own requirements, they are non-standard items; therefore, the subscriber must purchase the unit and also pay a fee based on total costs for its maintenance.

If the subscriber is agreeable to the costs quoted, the application (Tel. 40) is signed and returned to the Sales Branch.

Telephone orders are then issued to the Engineering Division for the units to be manufactured and installed.

NSU DESIGN DEVELOPMENT

The first NSU's were floor mounted consoles equipped with 'Ericsson' (push type) keys which in turn operated relays to perform the connecting arrangements. The next development introduced a table-top timber unit equipped with standard lever keys. The units were hard-wired, terminating on a tag type terminal block; also, in all early NSU's the telephone was a separate unit connected to the NSU cabinet. One of these early NSU's is shown in Figure 1. This arrangement continued until 1963 when the wooden case was superseded by a metal cabinet. At the same time the separate telephone instrument was replaced with a telephone circuit incorporated in the unit. The new range of units are "cord connected" to allow movement of the unit. Figure 2 shows these new features.

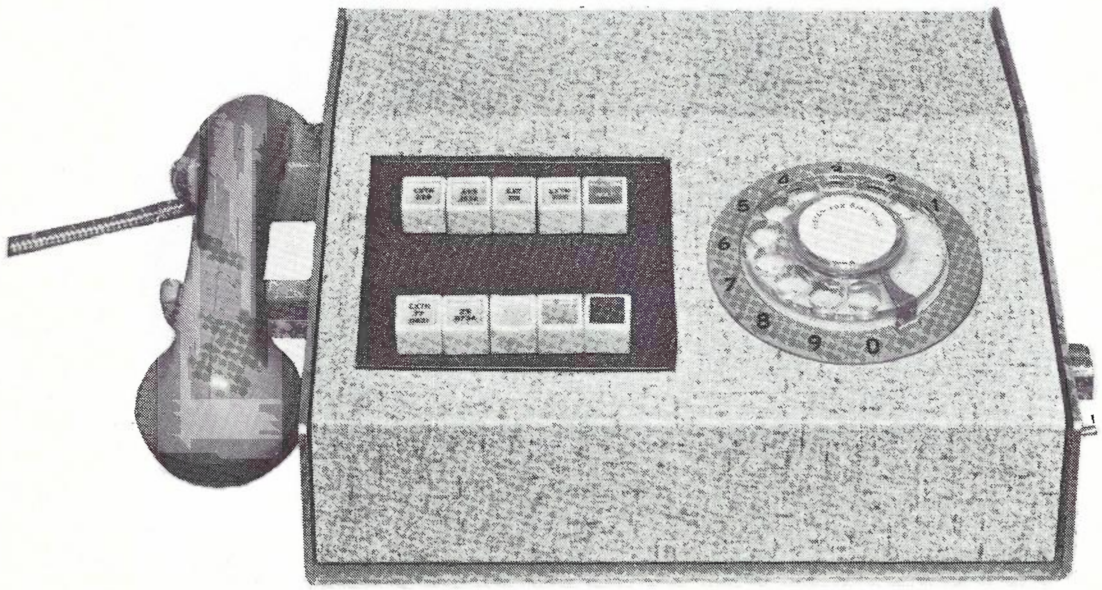


Fig. 2—Modern 'Customphone'.

FURTHER MODERN DESIGN TECHNIQUES

Prior to 1960, except for the earliest units, the NSU cabinet was fitted with lever type keys and switchboard type lamps with lamp caps mounted separately above and below the keys. About 1960 the illuminated push-button keys, manufactured by TMC and Widmaier, were introduced into the design of the NSU. These "press to operate" keys include a lamp in the key assembly; the lamp can be illuminated to indicate an incoming call or a call in the 'hold' condition or any other particular function of the key. The design features of these keys also enabled more NSU circuit facilities to be provided, whilst at the same time the overall appearance of the NSU was improved (see Fig. 2). Another advantage gained by the combination of key and lamp as a single unit is the reduction in the size of the cabinet for equivalent numbers of circuit appearances.

RECENT IMPROVEMENTS

Since 1960 the whole concept of the NSU has changed. Original circuitry could not be suitably modified to provide the more complex requirements of the customer. New units illustrated in Fig. 3 are now offered which include the following design features:

- Printed circuitry is now being used. This reduces initial manufacturing costs and also lowers maintenance costs.
- Miniature relays are used wherever possible. This enables more equipment to be mounted in the Customphone console, often eliminating the need for a separate relay rack.
- Thermal relays were introduced. These enable incoming calls to be transferred from one position to another automatically after a preset period.
- The console can be made from 'Marviplate' which is steel plate with a vinyl material bonded to it. The Customphone illustrated in Fig. 2 has a Marviplate case.
- Following Victorian practice the 'common hold' circuit was introduced. Using this facility only one key on the unit is required to apply the 'hold' condition to any exchange line, the 'hold' being removed automatically when the line key is operated. The 'common hold' can also operate between units which have multiple appearances of the same line. Also, 'common hold' reduces by half the number of keys required in most of the old circuitry, which needed a hold key for each exchange, PABX or PMBX line.
- The old type dc buzzer, which could not be regulated, has been replaced by an electronic oscillator The oscillator has variable pitch and tone controls. The pitch is preset by the installation technician and the volume can be adjusted by the customer using a potentiometer mounted on the side of the unit, see Fig. 2. The oscillator incorporated a 4T receiver inset as a transducer. The cost of the oscillator unit is significantly less than the cost of the old type buzzer unit. This oscillator is manufactured by the Postal Workshops, Sydney, and is also available in kit form, with all necessary mountings, spacers and screws, for fitting to older type NSU's.

A TYPICAL LARGE SCALE CUSTOMPHONE INSTALLATION

Should a customer require a special facility, basic Customphone circuits can usually meet the requirements; a minimum of new circuit design is called for. An example of an actual facility schedule provided in Sydney is as follows (to be multipled over a number of units):

(a) Thirty exchange lines.

(b) Forty order wires to CB telephones in remote locations.

(c) Interconnecting order wires between units.

(d) Dial control locks on all units.

(e) Traffic meters on all units to indicate exchange line calls answered by that unit.

(f) Exchange calls not answered after a specified period to have the flashing periodicity of the calling lamps varied.

(g) Common hold.

(h) Priority hold (similar to common hold, but with a different flashing periodicity to indicate that the call is one requiring special attention).

(i) Some of the units to be capable of being switched from full access to half access, i.e. all calls will appear on the unit until the switch is operated, after which only half the calls will be indicated.

DEVELOPMENTS IN PROGRESS

- One of the developments currently in progress in the Customphone Installation Section is that of a Modular Customphone. In this unit most of the circuitry will be on printed circuit cards, which will plug into jacks. The jacks will be wired identically so that any of the standard circuits in use will fit into any jack.

- The customer will be able to change some or all the facilities on the unit by simply having the printed circuit boards changed. Fault technicians will be able to restore service quickly by changing circuit cards. The faulty cards will be sent to a card repair centre.

• Although on the prototype the 20-point end connectors are wired to a back-board, it is envisaged that this wiring will be replaced by a printed circuit 'mother' board, so that the end connectors will be soldered direct onto this board, and the printed circuit relay cards will jack into the end connectors.

• The prototype has facilities for nine basic circuit cards, plus four auxiliary circuit cards. The basic cards are used to provide exchange line circuits, PABX extension circuits, order wires and other normal circuitry. The auxiliary cards provide any additional circuitry such as lock-up circuits, which are explained in more detail below.

• Circuits may be exclusive to one unit or they may be multipled over a number of units.

• Only one basic circuit card and any associated auxiliary card is required for a circuit regardless of the number of multiple appearances of the circuit.

• Where more than four auxiliary circuits are needed, e.g., nine PMBX extension circuits multipled over a number of units; the auxiliary cards for the nine circuits may be distributed over three units.

• Calls from PMBX extensions will lock up on the first half cycle of ring current. The visual and audible signal will be maintained for approximately sixty seconds, after which, if the call is unanswered, the call will release and the circuit will restore to normal. This ensures that calls coming into an unattended unit will not signal for a prolonged period.

• By using a delay circuit, an unanswered call may be transferred to a second answering position. These delay circuits are transistorised, and unlike the old thermal relay delay circuits, are unaffected by temperature and may be accurately timed for switching periods between five and fifteen seconds.

• Following Victorian practice, the first key on the unit may be made a "unit line" circuit. With this facility an exchange or PABX line is connected automatically when the handset is lifted. It is not

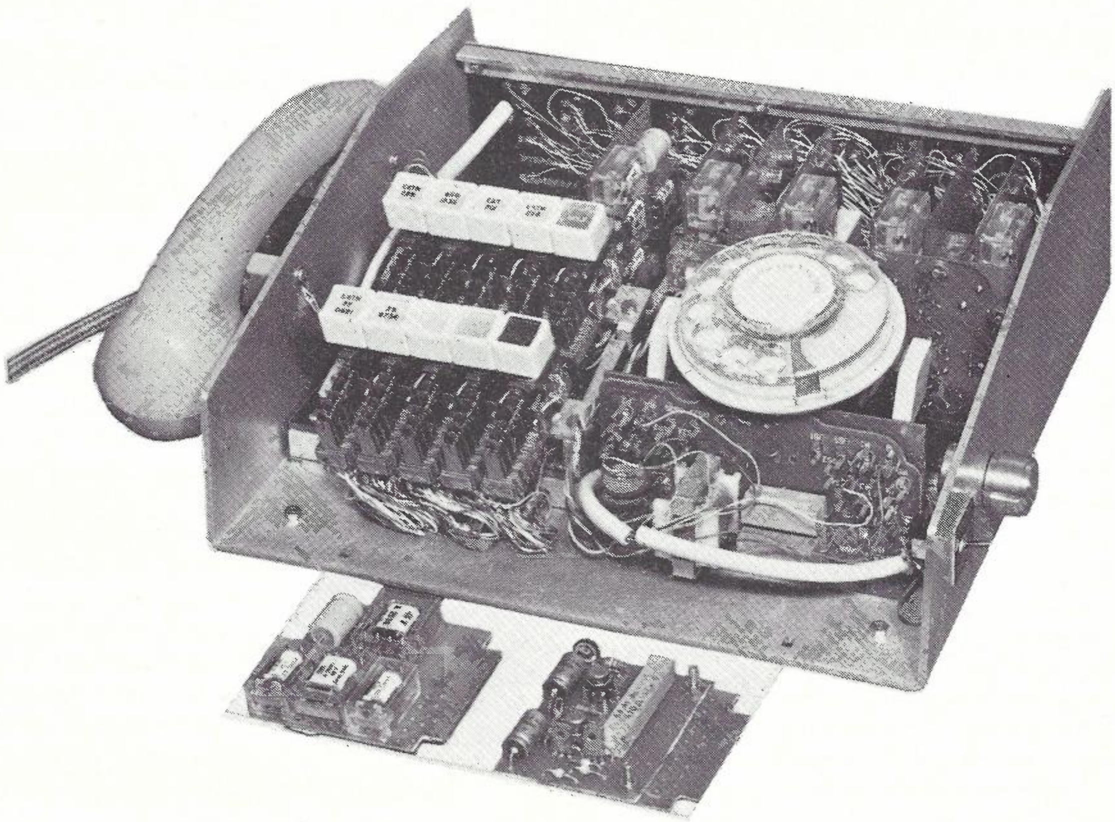


Fig. 3—'Customphone' with Cover Removal, Showing Design Features. Typical plug-in circuit cards are shown.

necessary to operate any keys. This feature is also valuable if power to the unit is disconnected.

• As all units have identical wiring the manufacturing delay will be considerably reduced. The only differences apparent in installed units will be in the printed circuit cards providing the various facilities; but these cards too will be standard items.

• Although only a ten key unit is being planned at this stage, it will be possible to increase the size of the units.

• It is expected that 65% of the demand for Customphones will be satisfied by the ten key unit. Special units will be required for complex installations similar to the 'Large Scale Installation' described previously, and for units required to be fitted into desk drawers, or mounted on panels which may be dropped into desk tops or fitted onto other equipment consoles.

• When a customer asks for some special facility not currently provided as standard, the design is undertaken with a view to offering it to the general public as a standard facility.

• Each new piece of telephone equipment offered to subscribers by other sections is examined by the Customphone Installation Section to ensure compatibility with the Customphone design concepts.

ACKNOWLEDGEMENT

It is acknowledged that this article treats a very broad and diversified subject only briefly; much could be written of many other APO personnel and those in industry who have been involved in the development of these facilities.

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Mr. Elgie is a part-time student at the University of NSW where he is currently attending the 6th stage of a degree course for B.Sc. Technology.

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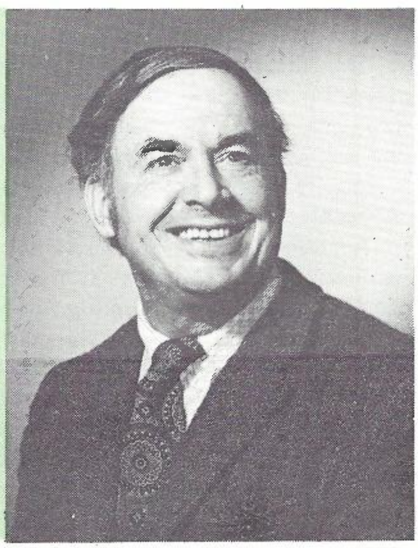


The Bellenden-Ker Television Project – Part 1

A. B. POULSEN, B.Sc.,

The selection of Bellenden Ker as a television transmitting site for the Cairns region of North Queensland was a decision of some moment, necessitating the construction of a passenger cableway to the top of the Bellenden Ker Range for site access. Part 1 of this article outlines the factors leading to this decision, and describes the construction and operation of the cableway. Part 2 in the next issue of the Journal will describe the equipment installed in the transmitter building, and the operation of this equipment by remote control. This was the major factor permitting the integration of all radio operations in the Cairns area into a functional Radio District.

INTRODUCTION

This project had its genesis in the decision by the Australian Government in 1962 to provide a television service for the Cairns area in Phase 4 of the television expansion programme. The television transmitters installed were similar to those which had been provided at many other stations in Australia. The particular factors which made this project noteworthy were the difficulty of selection of a suitable site, and that the only practicable access to the site chosen was through a National Park. This required the provision of the most sophisticated cable-car system which had been provided in Australia at that time. As this mode of access would not be available in the extreme weather conditions which frequently prevail at the site, it was necessary to remotely control the television transmitters from the radio-communications terminal in Cairns, approximately 50 km from the site. This centre is the terminal of the Brisbane-Cairns microwave systems and also remotely controls three sound broadcasting stations located within the region.

Survey

From a general consideration of the parameters of propagation in the VHF spectrum, practicable transmitter powers and aerial gains, and community factors, it was decided that the area to be served should be as shown in Fig. 1. This area is bounded by the Cardwell Ranges in the south, includes the towns of Tully, Innisfail and Cairns along the coast and extends to Mossman in the north. Inland it encompasses the Atherton Tableland and the towns of Atherton, Mareeba, Herberton and Ravenshoe. The most significant feature of this region from a propagation viewpoint is the extremely rugged

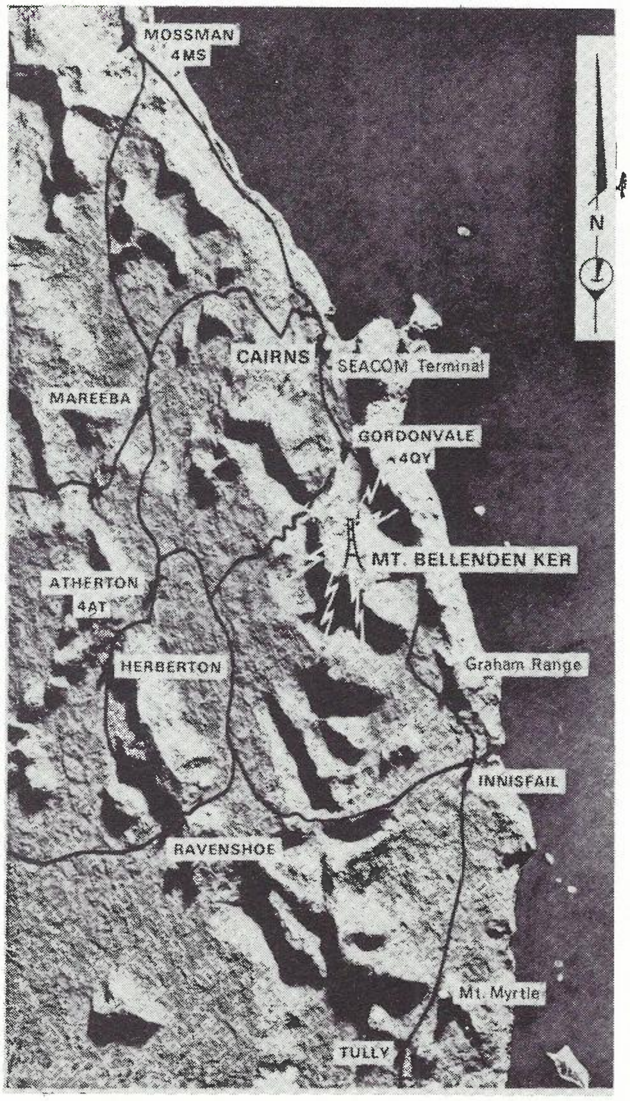


Fig. 1 — Topographic Model of the Region.

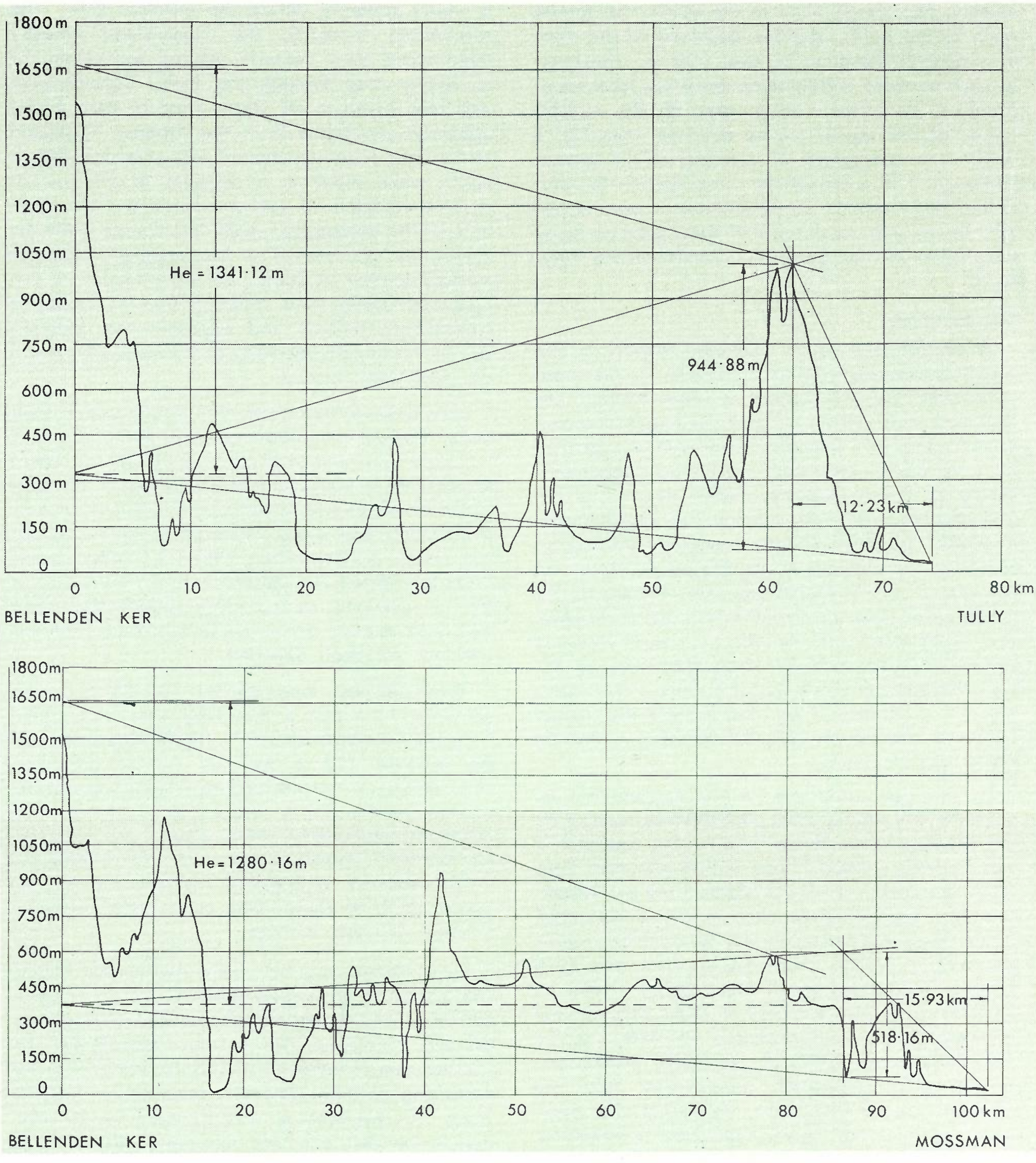


Fig. 2—Typical Profiles from Bellenden Ker to Towns of Interest.

nature of the terrain. In the centre of the region is the Bellenden Ker Range with peaks over 1500 m, dividing the region into three separate areas, namely, the coastal plain to the south, the coastal plain to the north, and the tableland to the west at a general elevation of over 600 m. However, in each of these subdivisions there are local topographical variations. Some idea of the rugged nature of this region can be obtained from Fig. 1 which is a photograph of a model of the region. Although it is a convenient simplification to refer to the main centres of population, it was necessary to consider most parts of the region in some detail due to the generally closely settled rural areas.

Site Selection

A suitable site for a television station is one which allows propagation conditions to the areas of interest such that a value of signal strength can be maintained which will give the required picture quality. The field strength received at any particular place will be dependent upon the topographical profile to the transmitting station site. It is not intended to go into detail about the method used to predict the field strength throughout the region. However, the methods in use require details of the topography of the region, and the accuracy of the prediction is dependent on the accuracy of this data and interpretation of the effect of obstructions in the transmission path. It must, therefore, be expected that some inaccuracy will result. An inspection of the profiles in Fig. 2 will show the rugged nature of the terrain and the difficulty in making predictions accurately.

To an experienced eye, it was evident that an optimum site would most probably be located on the Bellenden Ker Range, due to the fact that it was centrally located in the region and that there were two peaks, namely Mt Bartle-Frere and Bellenden Ker, approximately 1525 m above sea level. These two peaks were selected for detailed investigation and profiles were drawn from the main centres of population in the region. From an analysis of these profiles, it was evident that Bellenden Ker was the best site available and that Mt. Bartle-Frere, although generally satisfactory, would give obstructed transmission into the southern portion of Cairns, increasing the probability of "ghosting" due to multi-path transmission.

It was then necessary to investigate the establishment costs of each site. At this stage it was found that the eastern slope of the Bellenden Ker Range was a National Park, and, although the proposed site was not in the Park, the only practicable access would be through the Park. It was also evident that the construction of a road in such steeply sloping mountain country would be very expensive, maintenance would be costly, and that it would seriously deface the National Park. The responsible authority, the Queensland Forestry Department, very properly refused permission for an access road through the Park. Consideration was then given to Mt. Bartle-Frere as road access appeared practicable from the Atherton Tableland to the west at an elevation of approximately 600 m which could result in a decrease in the cost of road construction. It was considered that the problem of the propagation path into Cairns could be solved by the use of a low-powered translator suitably located in Cairns. An investigation of this proposed access road revealed that it would be exceedingly difficult and expensive to construct due to the complex geology of the mountain caused by its volcanic history.

Consideration was given to multiple station solutions. However, it became evident that this would be expensive and only partially effective. More importantly, there would be a problem in the allocation of frequencies which would not cause mutual interference and which would allow some channels for future developments. When all these factors were considered, the multiple station solution could not be sustained; so that, after considerable effort had been applied to this problem, a viable solution had not yet been obtained.

These detailed investigations had taken a considerable time and it was clear that much more time would elapse before a satisfactory site could be selected and a working service provided. Accordingly, it was decided to establish an interim service for the city of Cairns, using the existing radio communications centre there. The Commercial company agreed to join us in this venture and a low-powered service with an effective radiated power (ERP) of about 6kW commenced operation on both channels in 1966.

Light aircraft and helicopters were used during the survey to investigate possible sites and access problems, and during these operations it was apparent that communications between aircraft and the ground control were unsatisfactory, which was not surprising as those channels are also in the VHF band. At this time jet aircraft were being introduced for civil use and the Cairns Airport was being upgraded. It was clear that the proximity of high mountains to the Cairns Airport was a hazard which would require the upgrading of navigational aids and air-ground communications. It was also evident that Bellenden Ker, with an unobstructed "line of sight" to the Cairns Airport

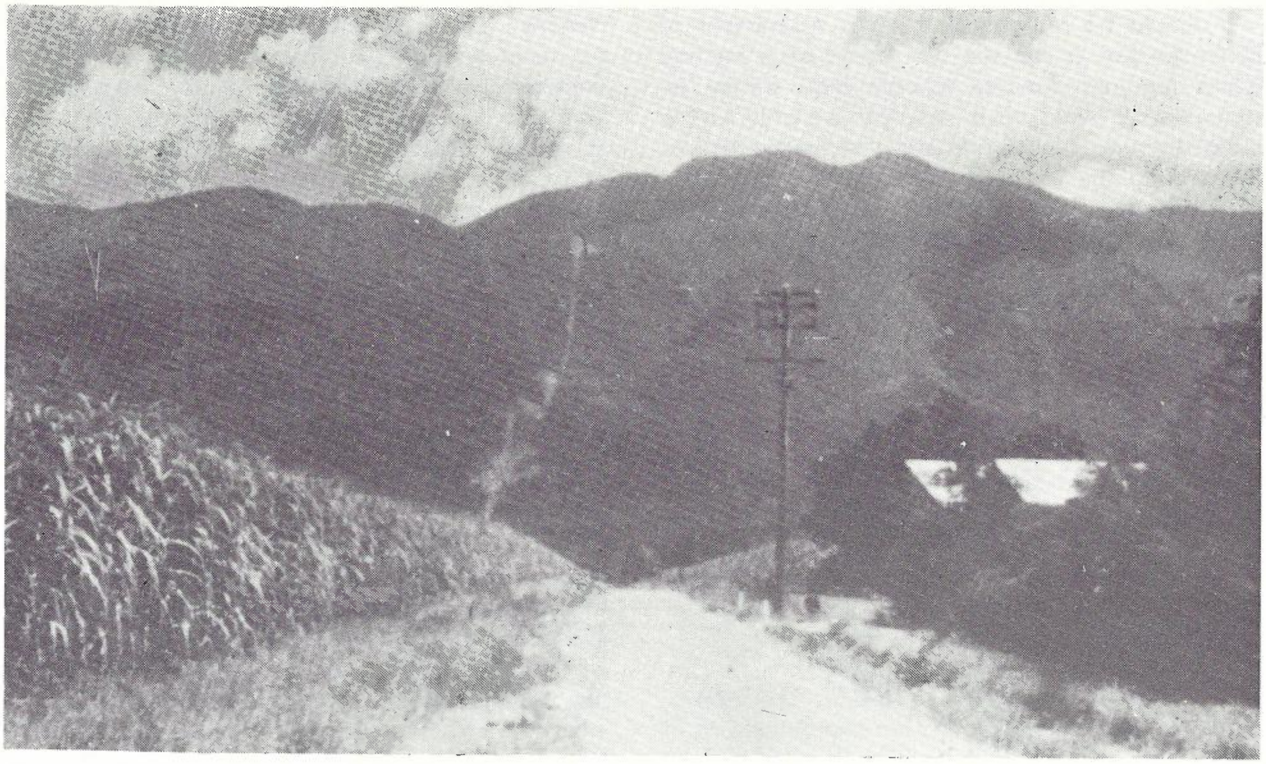


Fig. 3—Bellenden Ker Range, Showing Clearing Towards Top Site.

and its commanding view over all other obstructions, would be ideal for siting these facilities. This matter was discussed with the Department of Transport and an agreement was reached on the need to accommodate such services.

At this time, the Australian Post Office, in its general communications role, was proceeding with the introduction of Subscriber Trunk Dialling, and it was apparent that a considerable increase in trunk channels would be required between Cairns and the other towns in the region. These could be provided by coaxial cable systems, but, if a site at Bellenden Ker were available, considerable economies would be made by using microwave radio equipment. It was also evident that other services in the VHF band could be improved by location on this site.

All these factors caused a reconsideration of Bellenden Ker as a site and an attempt was made to find a way to develop it without affecting the National Park. It was evident that our need to serve the public interest in the provision of television services with conservation of the frequency spectrum was in conflict with the responsibility of another authority to serve the Public Interest by conserving the environment. As neither need could be said to have primacy over the other, some compromise was required between them. The decision was then made to investigate the feasibility of constructing a cableway across the National Park so that only a few points would be affected and minimal clearing would be required. A feasibility study was carried out by the Australian Government Departments of Housing and Construction, and Services and Property and it was established that a cableway could be constructed with long spans over the Park; this would require the location of a small number of trestles in the Park at a cost which would allow the project to proceed.

Negotiations were re-opened with the Forestry Department, who were the guardians of the National Park. The officers of this Department took their responsibilities for conservation seriously and had to be assured of the lack of a suitable alternative solution, and that the proposed cableway would not cause damage to the National Park. Ultimately, it was agreed that the proposal to locate the television station on Bellenden Ker with access by cableway could be agreed to by the responsible authorities and that they would each be able to discharge their specific responsibilities to the community.

It should be recognised that the assessment of Bellenden Ker as the site was based on a method which required accurate topographical survey information. It was known that the available survey information was inaccurate and that the method of interpreting the effect of it required a good deal of judgment. Bellenden Ker was chosen with a knowledge of the probable imperfections from a transmission viewpoint, but with the surety that it was the best site available and that those imperfections in the service which would be provided could be corrected at some future time by the use of translators. The steeply sloping eastern face of the Bellenden Ker Range is shown in Fig. 3, which gives some indication of the rugged terrain typical of the region. It also shows the clearing made through the Park for the construction of the cableway. This clearing is now overgrown and is not visible at any distance.

System Design

This required that a transmitting station be constructed with access by cablecar. The station building was to house television transmitters for a National and Commercial service which were to be remotely controlled from the radio communications terminal at Cairns. The remote control system was also to cater for the operation of the 2 kW sound broadcasting stations at Atherton, Mossman and Gordonvale. In addition, the television station building would house microwave terminal equipment for the vision links, a repeater on the microwave system from Cairns to Atherton, air-ground communication systems for the Department of Transport and communication equipment for other services. A general outline of the radio and television facilities for the whole Cairns area, based on this concept, is shown in Fig. 4.

ACCESS CABLEWAY

General

The site finally chosen for the station was just south of Centre Peak in the Bellenden Ker Range. The cableway bottom station was located some 2 km west of the Bruce Highway and about 50 km south of Cairns. Climatic conditions in the area are severe; the average annual rainfall is approximately 4000 mm on the coastal plain and exceeds this in certain

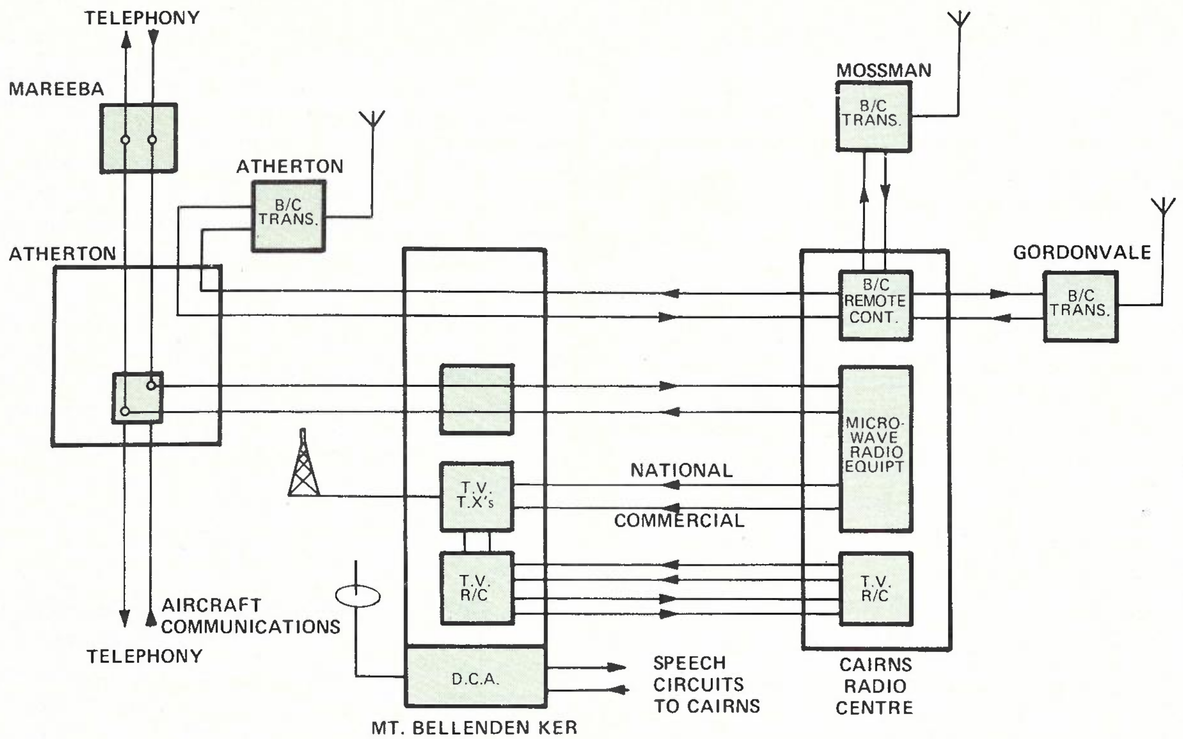


Fig. 4 — Communications Facilities Planned for the Area.

elevated areas on the mountain ranges. Cloud cover on the peak is about 50% for more than half of the year and about 25% for the remainder. Although the general area enjoys a hot wet tropical climate, temperatures on the mountain top site frequently do not exceed 5°C for days on end, even in the summer months. The lower slopes are covered with dense tropical rainforest, while in higher areas the vegetation, although different in nature, still forms a thick cover. These conditions contributed in no small measure to the difficulties of the project.

In accordance with normal practice all civil engineering work associated with the project was carried out by the Australian Government Department of Housing and Construction (AGDHC). This included the bottom station access road and the transmitter building as well as the cableway itself. The AGDHC enlisted the aid of a consulting engineer in the design and specification of the cableway and a contract was ultimately let in April 1970 for the construction of the cableway bottom station and transmitter building on the mountain. The successful tenderer was McNamee Industries of Sydney, in association with the Austrian firm of Waagner-Biro, who provided the expertise necessary for the cableway itself.

Design

The cableway is described as a bicable to and fro system and consists of a track rope with a separate haul rope, all supported on nine steel towers on the eastern face of the mountain, rising from an RL of 90 m at the bottom station to 1550 m at the top. A profile of the cableway is shown in Fig. 5.

The steel wire track rope is 36 mm diameter, weighs 29.5 tonnes, and is manufactured and erected in one continuous length of some 5.3 km. As such, it is the longest cableway of its type in the world. The track rope is anchored at the top station by a number of turns around a large wood-rimmed concrete bollard, and is tensioned at the bottom station by a counterweight of 18 tonnes supported on a 27 m steel tower. The rope is supported at each intermediate tower on steel saddles with bronze lining inserts, which allow it to slide over the saddles as the catenaries change with temperature and movement of the cableway vehicles. The rope is kept well greased to assist this movement and as a corrosion preventative measure. The intermediate towers vary in height from 11 to 41 m, depending on span and location. Two of the spans are over 1.2 km long and the height of the track rope above the ground reaches 190 m in some places. Fig. 6 shows a typical cableway tower, looking up along the track.

The cableway carriage rides on the track rope and is moved to and fro between the top and bottom stations by a hauling rope. This is a steel wire rope 22 mm diameter, weighing 14.2 tonnes, and is in one continuous length of approximate 10 km. It is supported at each tower on rubber

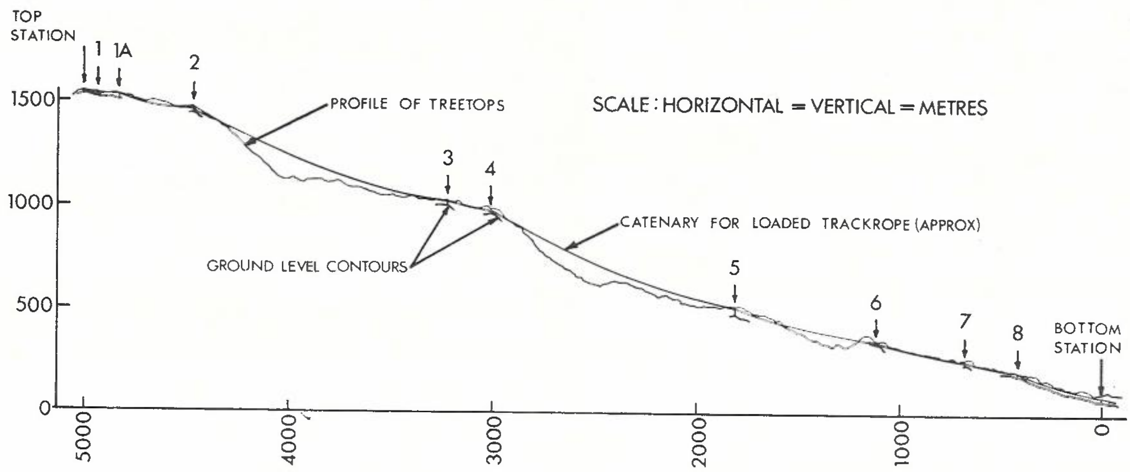


Fig. 5 — Profile of the Bellenden Ker Cableway.

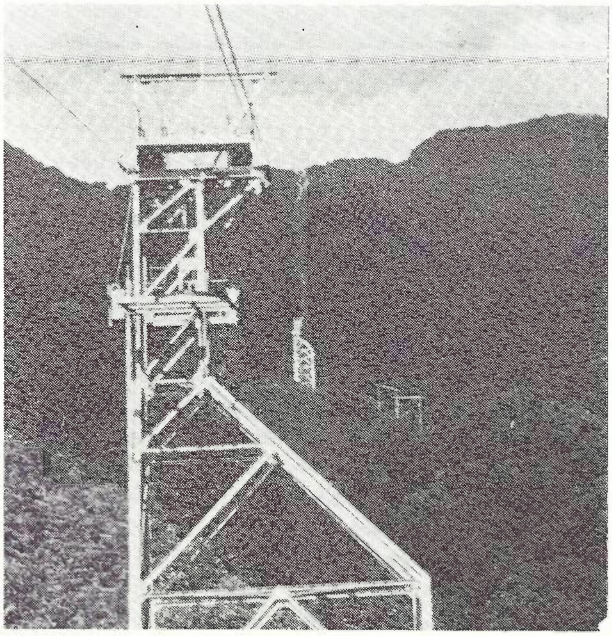


Fig. 6 — Typical Cableway Tower.

lined sheaves; this is necessary to insulate the haul rope so that it may be used for signalling purposes. The rope is driven by a large sheave 2 metres in diameter, known as the bull wheel, which in turn is directly driven by two hydraulic motors, powered by a pump from a 150 kw electric motor. The haul rope has one end attached to the cableway carriage, passes up over all the towers on sheaves on the northern side, around a counterweight carriage at the top station, down again on the return or southern side of the towers, around the bull wheel and is attached to the cableway carriage again, forming a continuous loop. The counterweight at the top station tensions the haul rope and is on a moveable carriage to allow for acceleration surges and sudden tension changes as the carriage passes over the towers.

The cableway carriage is a wheeled vehicle which rides on the track rope and carries a hanger from which various loads can be suspended, depending on the mode of operation:

- With the "deluxe" passenger cabin attached it can carry a net load of some 800 kg. This is the normal mode now employed for transport of maintenance staff and equipment to the top station. Fig. 7 shows this cabin departing from the botton station.
- With a construction cabin attached the net load is 900 kg. This was the mode mostly used for installation work at the top station and as such could transport 10 to 12 staff per trip.
- With no cabin attached and an auxiliary carriage on the track rope a net load of 1000 kg could be carried, with maximum dimensions of approximately 10 m long, 3 m high and 1.5 m wide.

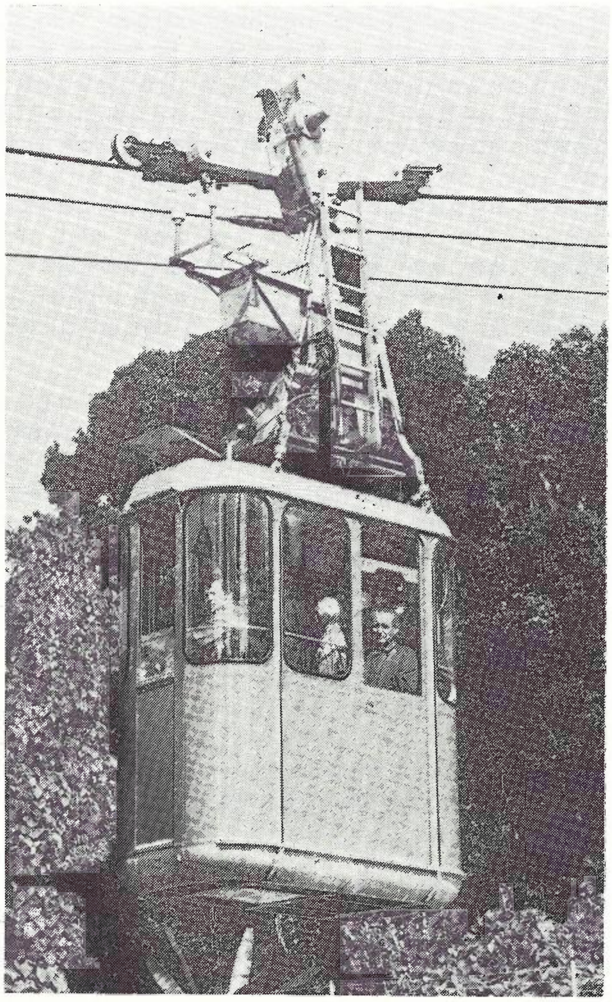


Fig. 7 — Cableway Passenger Cabin.

The speed of travel is 5 m/sec, giving a trip time of about 20 minutes when operating normally with a cabin attached.

Controls

The normal operation of the cableway is controlled by an operator in the passenger cabin, who has only to press buttons such as "Start" and "Up" or "Down" as required. Thereafter an electronic programmed controller provides all necessary signals to the drive system to ensure a complete trip in the required direction, including reduced speed over towers and controlled deceleration and final stop at the terminal station. This is done by continuously monitoring the carriage position throughout the trip and generating the necessary control signals at a number of points as selected in the programme. Operation of the cableway can also be carried out from a control panel in the top station or the main control console in the bottom station. Manual control of the drive system can be exercised from any of these control points should the programmer become faulty.

All drive and programme control equipment is installed in the bottom station; there is also an emergency diesel engine and hydraulic pump which can operate the system at reduced speed under the manual control of an operator in the bottom station. This could be used, for example, in the event of a prolonged interruption of the primary AC power supply.

Communication between passengers in the cabin and the top and bottom stations is provided by a telephone circuit which operates by induction on the electrically insulated haul rope. This system is also used to provide VF control and monitor signals between the cabin and top station control panels and the bottom station equipment. In addition, FM transceivers have been provided for emergency communications between the passenger cabin, the top and bottom stations and the radio control centre in Cairns.

Safety Provisions

The basic safety of a cableway such as this is, of course, dependent on the initial specification and design of the system, which must be coupled with meticulous manufacture of critical components and careful installation of the whole system. The Austrian firm of Waagner-Biro, a company with many years of experience in the construction of cableways in Europe, provided the design and manufacturing competence, while field supervision by the AGDHC ensured that the required standard of local manufacture and on-site construction work was maintained.

A large number of design safety features such as multiple fail-safe braking systems, limit switches, overspeed protection and similar measures are incorporated in the system to ensure the maximum possible security. The communications, signalling and programme controller systems are, of course, operated from batteries.

An auxiliary self-propelled emergency car capable of travelling along the track rope is provided in the bottom station for rescue purposes or for inspection of the installation, for example, after a cyclone. In this context it is relevant to point out that the cableway system is designed to be operational in wind velocities of up to 80 km/hr, and to safely withstand a wind velocity of 225 km/hr.

Construction

It can be appreciated that a project of this magnitude, the first of its kind in Australia, was made even more difficult by the climatic and topographical conditions in the area.

Before any construction work could commence, it was necessary to clear a swathe along the cableway track from bottom to top of the mountain. The width of this had been strictly limited to 6 m by the Queensland Conservator of Forests, and clearing a track 6 m wide and 5 km long in a straight line over ridges and gorges was one of the many difficult tasks in the project. Part of this cleared track is shown in Fig. 8.

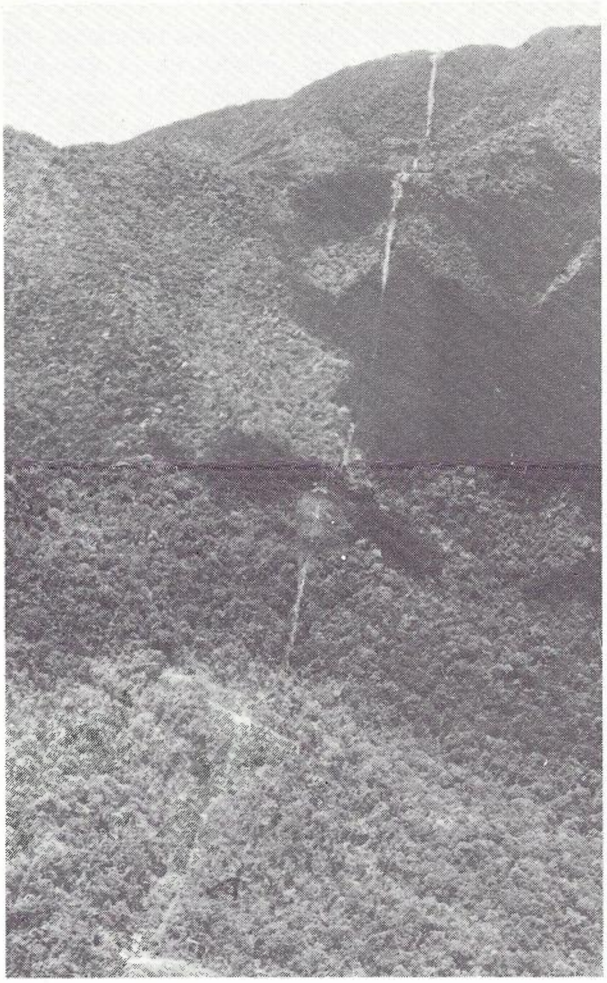


Fig. 8—Cleared Cableway Track to Top Site.

The actual construction work relied almost entirely on the use of helicopters for transporting men and material to all of the tower sites and to the top station on the mountain. All of the material for the cableway and the transmitter building was carried in this way. In addition the helicopters were used as "flying cranes" for a large proportion of the rigging work, and it is a tribute to the skill of the pilots and riggers that the work was completed without any major accident. A total of some 2000 flights were made during the course of construction, using up to three helicopters during the peak periods, and it is doubtful if the project could have been completed at all in any other way.

The cableway towers, although relatively simple to erect, required considerable care in placement, since the track rope saddles at the top had to lie within ± 20 mm of a defined straight line along the cableway. In a track length of some 5 km, this necessitated precise surveying and positioning.

Hauling the track rope from the bottom to the top of the mountain was without doubt the most difficult task in the construction. This was done by first flying a number of drums of small diameter wire rope to various locations on the mountain, laying and joining these lengths by hand and using this rope and a winch at the top station to haul a larger wire rope into position. This was in turn used to finally haul the 36 mm track rope. Although the principle sounds elegantly simple, constraints such as ensuring that the 5 km of track rope was always kept under tension and not allowed to rotate, along with the very limited amount of clearing permitted along the track in the National Park, made the job both difficult and prolonged.

When the cableway was completed it was subjected to a searching inspection and test by the head of the Austrian Government Department responsible for licencing such installations in Europe, and certified as to safety and quality of construction.

Operation

The facility was made available to the APO for equipment and personnel transport in May 1972. For contractural reasons it was operated by the AGDHC during the first 12 months, during which time it was in use at least 6 days per week for the APO or by the AGDHC in site clearing work and the completion of certain building construction work. As would be expected with such a complex and unfamiliar facility, there were the usual initial operational problems, but in general these were not serious and were gradually resolved and eliminated during subsequent operation.

TELEVISION FACILITIES

Building

The top station transmitter building was designed in Queensland to suit all the known requirements of the site and equipment. Because of the difficulties and cost of material transport to the top station, a normal reinforced concrete building as used in other areas was not suitable. Instead of this a steel framed building using prefabricated insulated units for walls and pre-treated steel ribbed panels as external cladding was designed by the APO. The roof was of conventional steel decking, while the floors were constructed of steel decking topped with concrete. This method of floor construction meant that all holes for ducting and ventilation had to be detailed in advance so that suitable steel framing could be provided in the construction. Since the transmitter types had not been finally determined during the building design and documentation stage some educated guesses were necessary for such details. The layout of the building floors is shown in Fig. 9.

Because of the weather conditions at the site, namely up to 100% relative humidity and a large proportion of the time in fog and cloud, it was necessary to provide special treatment for the transmitter cooling air. With the two national and two commercial transmitters operating, an air change of 170 cubic metres per minute is required. The initial air intake is through a large bank of fibreglass filter panels, which remove most of the airborne droplets and fog. Behind these filters is a basement plenum chamber where hot exhaust air from the transmitters can be mixed with the inlet air. This mixture is warmed and dehumidified as a result and is then circulated through a secondary filter bank to the transmitter air blowers and returned by ducting to the plenum chamber where it can be either mixed with the incoming air as previously described or vented under the building. This process is controlled by a thermostat in the transmitter air inlets which operates control motors and vanes in the return air duct to vent the hot air instead of mixing it with inlet air. The design of the system is such that failure of a control motor will vent the return air thus ensuring that such a failure will not lead to transmitter overheating. When the transmitters are not operating small radiant heaters in the bottom of the inlet air ducts dehumidify any convected air and prevent condensation within the transmitter cabinets. This simple system has proven very satisfactory in practice and corrosion problems in the transmitters are expected to be minimal.

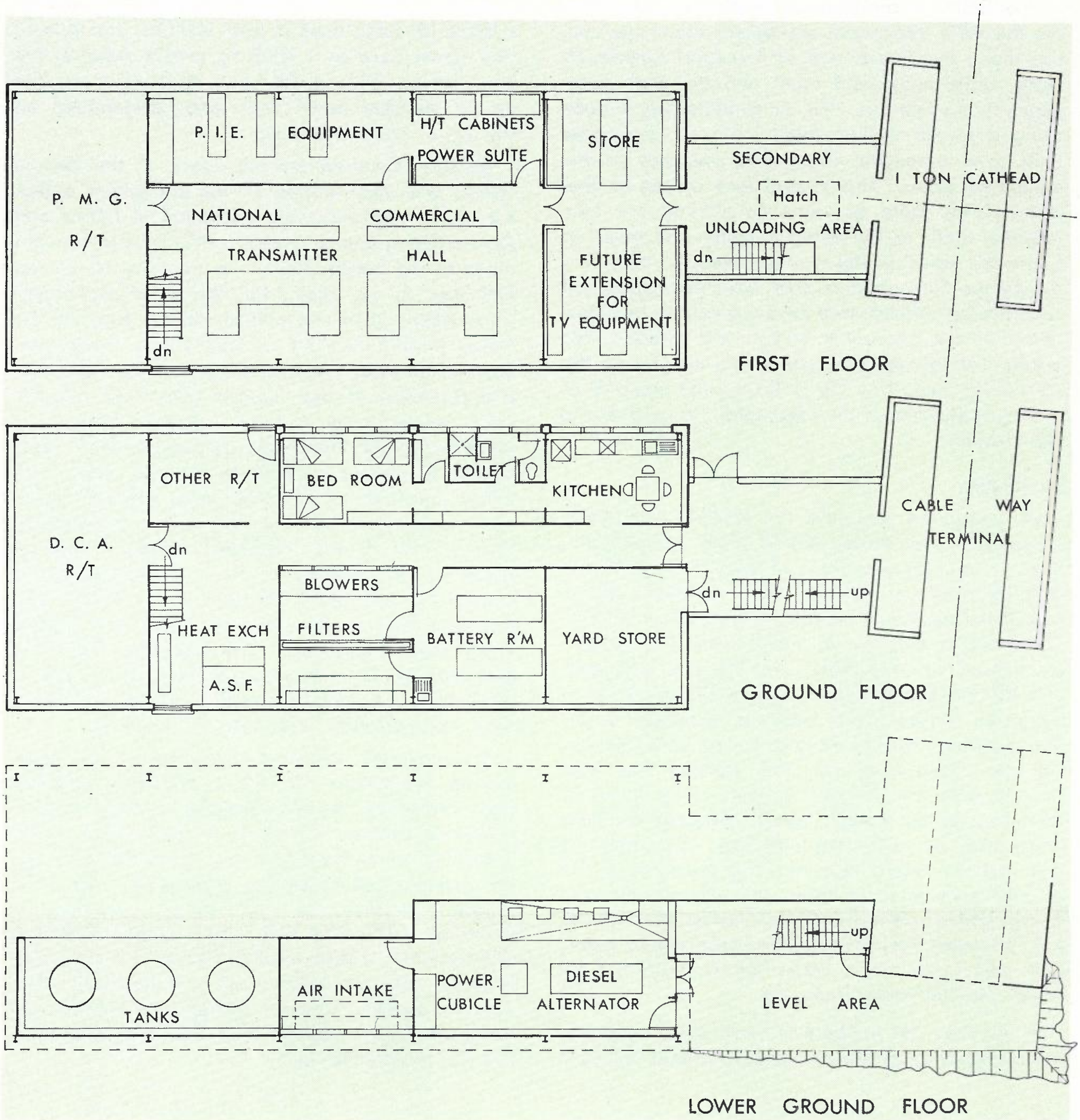


Fig. 9 — Floor Layout of Top Station Transmitter Building.

The only air conditioned areas in the building are the APO microwave equipment room, the control room, the Department of Transport (previously DCA), radio equipment room and the staff emergency living quarters. All air conditioning is done using duplicate wall-mounted room air conditioner units with automatic changeover facilities in the equipment areas. This system was chosen so that maintenance could be done on site by our own technical staff, or by taking a faulty unit down to Cairns for repair. In this way the necessity of having to arrange for specialist staff from commercial air conditioning maintenance organisations to be transported to the transmitter station was avoided. The wisdom of this decision was borne out during the installation period by the difficulty and expense of getting tradesmen of any description to work at the top station.

Installation

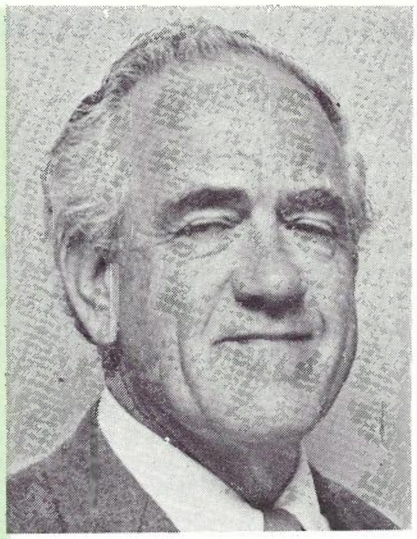
As would be expected the location and mode of access to the station led to some unique problems in the physical task of transporting all the required items to the site. The cableway design had been based on a maximum net load of 1000kg, which was determined by the heaviest packed item of transmitting equipment and the heaviest items of a dismantled emergency engine alternator; these were the engine block and the alternator rotor. This maximum load could only be carried by removing the construction car and slinging the load directly from the carriage hanger, using an auxiliary carriage and hanger where necessary for long items such as tower leg members. Operation in this manner was time-consuming because of the difficulties involved in lifting and slinging the load at the bottom station and then removing it at the top, and was restricted to the large tower members and large heavy crates which could not be fitted into the construction car.

A number of mechanical aids were essential throughout the transportation period; these included a mobile crane at the bottom station, a hydraulic scissors lift table used at both stations, and a front end loader used as a 1000 kg mobile crane at the top station. This loader was itself taken to the top in stripped down form and reassembled on site by a motor mechanic.

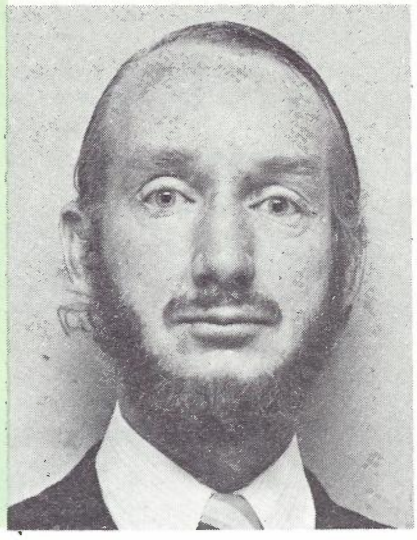
Because enclosed storage space at the bottom station was very limited all the equipment except the tower steelwork was stockpiled in Cairns and each morning one or more truckloads were brought down to the bottom station for transport to the top that day. In all, about 150 tonnes of equipment were taken up in this manner; since many of the crates were bulky but not particularly heavy the payload on most trips was far below the maximum and hundreds of trips spread over many months were necessary for material transport alone. At times during the installation programme there were almost 30 people working on the top station site which meant that three trips were necessary each morning and each afternoon for personnel transport. During most of the installation phase a core of about 10 staff worked 12 hours a day, starting in Cairns at 7 am and finishing back there at 7 pm; this was done on five days per week and usually every second Saturday. The cableway itself was operating for 10 to 12 hours per day, seven days a week since maintenance was done during the weekends when the APO staff were not working.

In accordance with normal practice, all the transmitting equipment for the commercial company was installed by the APO. Despite the logistics difficulties of material transport, all installation work, including the microwave links, transmitting tower and antenna and transmitters themselves, was completed in time to allow half power operation by Christmas 1972, less than eight months after the cableway was made available to us. Full power operation was not commenced until February 1973 after the existing Channel Diplexer for the interim service had been shifted from Cairns to Bellenden Ker and re-installed there.

A. B. POULSON graduated as an Engineer through the Cadet Engineer training scheme in 1949. After some years of general engineering experience he joined the Radio Section in the Queensland Administration and became Divisional Engineer, Broadcasting, in 1956. He subsequently became Divisional Engineer, Television, and was responsible for the implementation of the Television installation programme from its inception until 1969, during which period this project was planned. He is at present Superintending Engineer, Regional Operations Branch.



P. J. REED joined the APO in 1956 as a Cadet Engineer and graduated as a Bachelor of Electrical Engineering from the University of Queensland in 1960. After a year in the Radio Section he spent sixteen months in the Materials Division being responsible for the Materials Testing Laboratory. Following this he returned to the Radio Section and was involved in several areas before joining the Television Division in 1963. During the next ten years he was responsible for the planning and installation of most of the high-power television transmitting stations in Queensland. In 1973 Mr. Reed transferred to the Metropolitan Operations Branch, where his present position is Acting Engineer Class 3, Switching and Transmission, City Operations Section in Brisbane.



A Centenary for Monsieur Baudot

D. L. SHAW, B.E., M.I.E. Aust.

You have probably used the unit 'baud' when describing telegraph speed or modulation rate, but have you ever wondered as to the origin of the name of the unit?

The name of the unit honors the work of the French engineer Emile Baudot who invented a printing telegraph system in 1874.

In today's environment of rapid technological progress it is interesting to reflect on the work of pioneers who achieved impressive results using purely electro mechanical devices in the nineteenth century.

Baudot's system was a combination of his own inventions and the works of earlier pioneers. It used:

(a) Certain printing details of Hughes instrument, developed in 1855

(b) The distributor arrangements invented by Bernard Meyer in 1871, which was used in a Morse Multiplex system

(c) The 5 unit code which was suggested by Gauss and Weber in 1833.

The first Baudot receiver was produced in 1874 and in the following year the invention was accepted by the French administration and after further development work it was adopted in 1877. Thereafter its use in France was extensive and to some extent it was adopted in other countries.

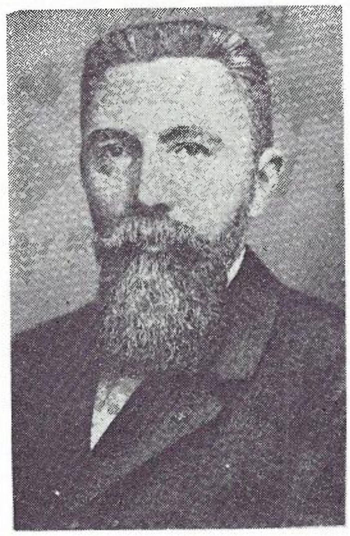


Fig. 1 — Emile Baudot.

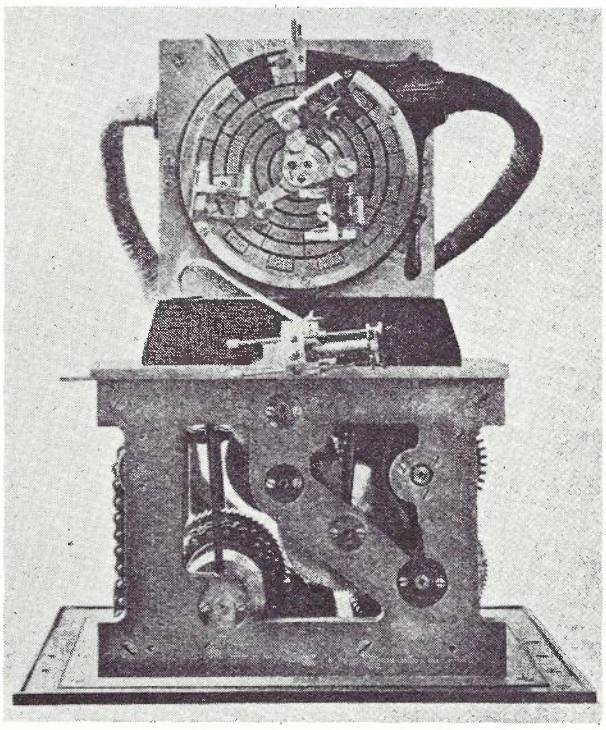


Fig. 2 — Weight-Driven Baudot Distributor

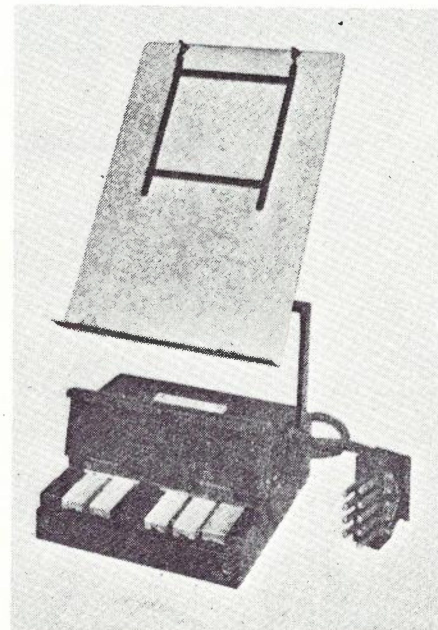


Fig. 3 — Baudot Keyboard

It was the first commercial system to make use of the 5 unit code and it incorporated a simple and elegant receiver for converting 5 unit signals directly into printed characters. The success of the Baudot system demonstrated the pre-eminence of the 5 unit code for printing telegraphy and provided the basis from which was evolved the modern teleprinter.

The time division multiplexing of 2 to 6 channels was achieved by using a segmented 'commutator' ring which was swept by the rotating distributor brush arm. Synchronization between the brush arm at the sending and receiving station was achieved by sending a correcting pulse to the line once per revolution of the brush arm. The brush arm at the corrected station was set to run at 0.25 to 0.5 rpm faster than that at the correcting station. Depending on the time of arrival of the correcting pulse the 'corrected' brush arm was mechanically retarded to maintain the phase relation between the two stations.

The earlier distributors were driven by heavy weights acting through a clockwork mechanism. At a later date a phonic motor, driven from a vibrator, was employed to drive the distributor and this was later replaced by an electric motor fitted with a refined form of centrifugal friction governor.

The Baudot keyboard had five keys similar to those of a piano. Code elements 1, 2 & 3 were transmitted by keys 1, 2 & 3 which were operated by the first three fingers of the right hand. Code elements 4 & 5 were transmitted by keys 4 & 5 which were operated by the first two fingers of the left hand. The keyboard was so arranged that when any key was depressed it was mechanically locked until the distributor brush had passed over the five segments of the distributor connected to the keyboard and thus had transmitted the signal. The keys were then unlocked in readiness for the transmission of the next character. The electro magnet which removed the lock from the depressed keys produced an audible click or 'cadence signal' as an indication to the operator that the next combination of keys should be depressed for the transmission of the next character. Note that the operator did the coding action. The manipulation of a Baudot keyboard called for a high degree of operating skill since a definite, unvarying, rythmic speed of signalling was necessary as 180 characters per minute was the normal speed employed.

Some Baudot equipment was used in Australia in about the early 1920s.

Emile Baudot was born at Magneux France in 1845 and died at Sceaux in 1903. He was an Officer of the French Telegraph Service.

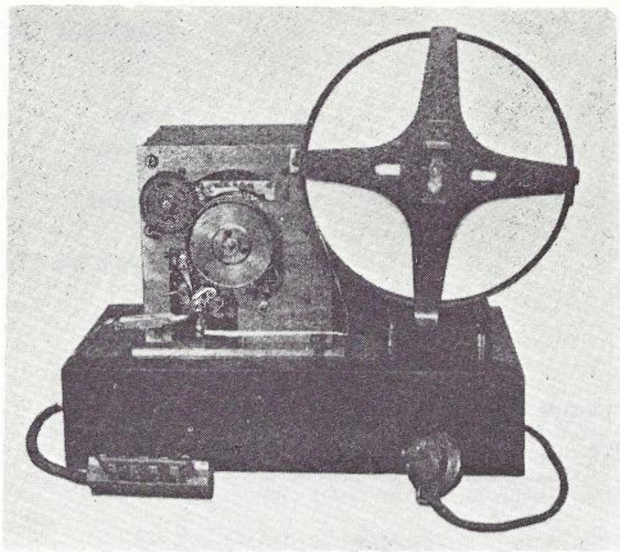


Fig. 4 — Baudot Receiver

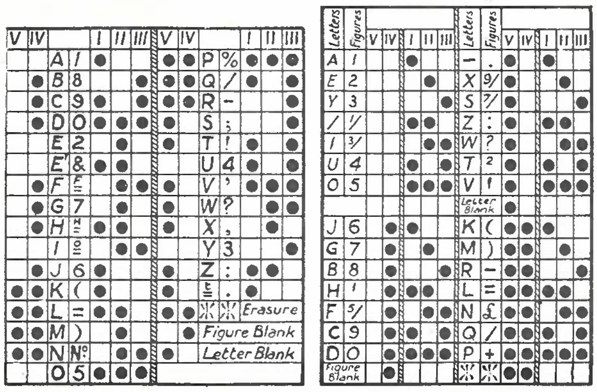


Fig. 5 — The Baudot Code and Manipulation Tables

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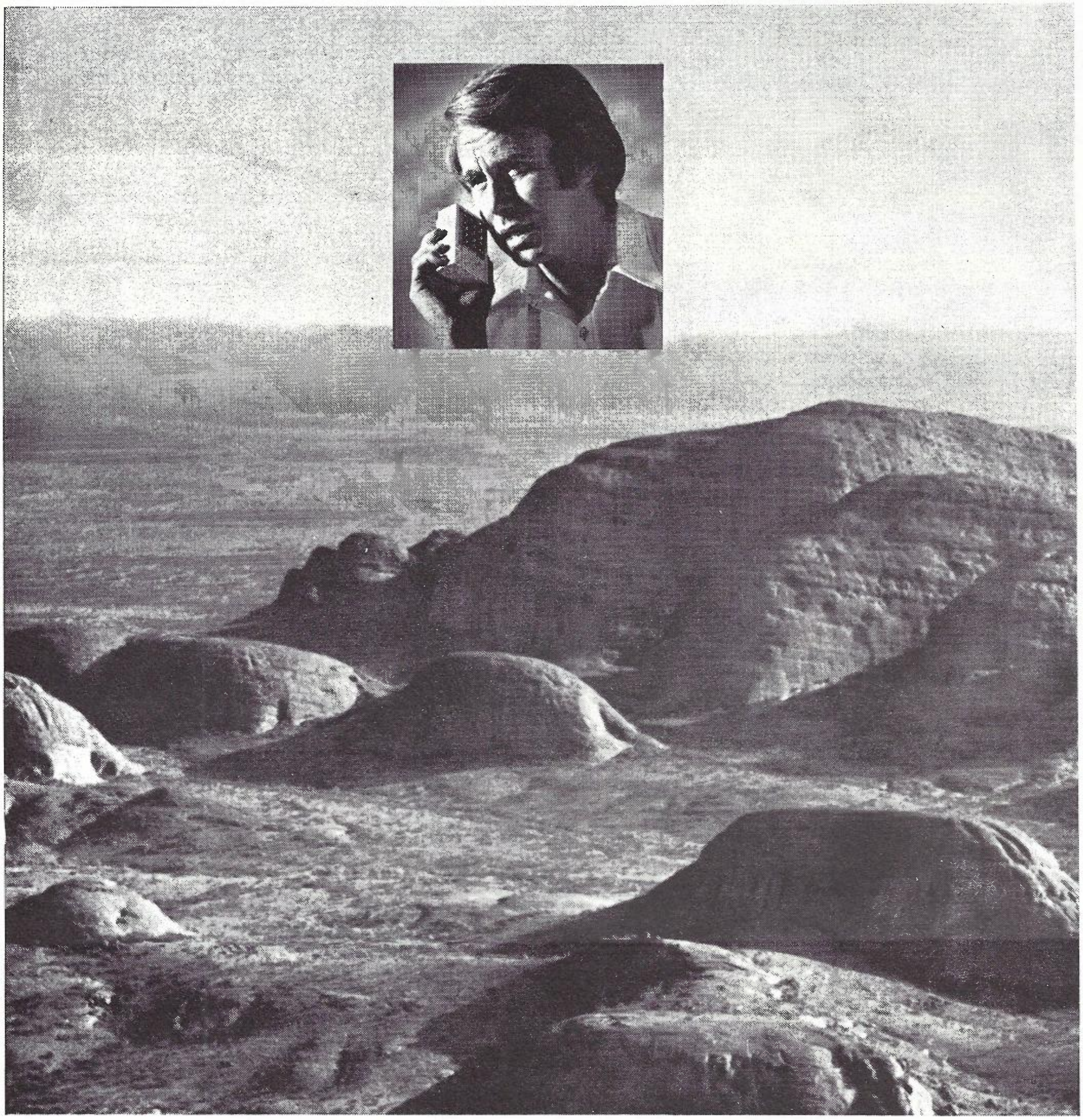

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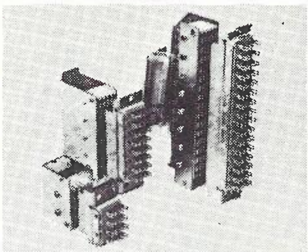
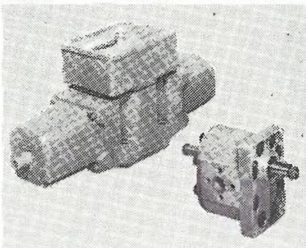
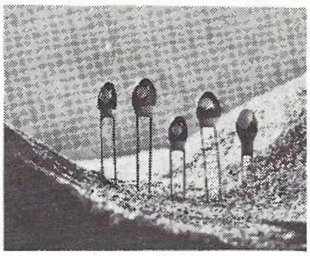


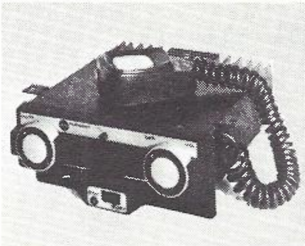
Plessey knife and fork connectors are part of the wide range of multi-circuit connectors marketed by Plessey Australia, Components Division. They are available in standard 20, 40 and 80 way sizes.



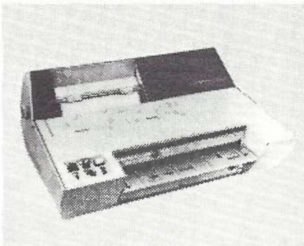
Internationally recognised "RACINE" hydraulic pumps and valves are sold and serviced throughout Australia by Plessey Australia, Telecommunications Division, Meadowbank, NSW.



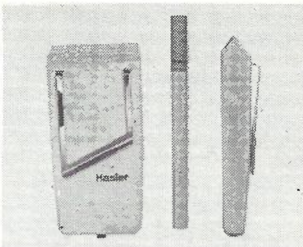
These NEC solid tantalum capacitors are designed for decoupling, by-pass, blocking and filtering applications in both professional and domestic electronic equipment. They are but one of the extensive range of professional components available from Plessey Australia, Components Division.



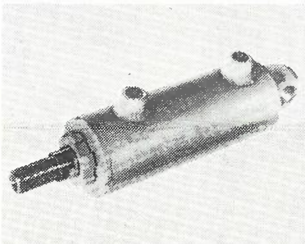
Illustrated is the MRT 40 mobile 2-way radio system with an SC 201 Decoder fitted. Developed by Plessey Australia Electronics System, Richmond, Victoria, the system employs a method of selective calling whereby each operator receives only those messages specifically directed to him.



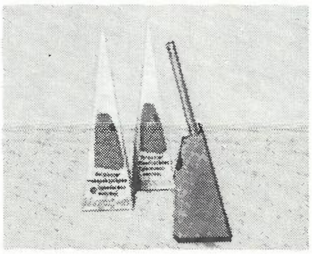
Marketed by Plessey Communication Systems, the Facsimile Remote Copier is a desk-top copier capable of transmitting and receiving over public or private telephone lines, printed, written or graphic material within minutes.



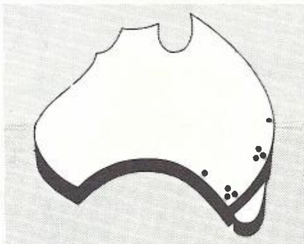
This radio paging miniature receiver uses the most advanced electronic circuitry to maximise efficiency in the location of staff. This inductive loop system is available from Plessey Communication Systems.



Designed and manufactured locally, Plessey hydraulic cylinders and presses are available for a variety of industrial and mobile applications. The cylinder illustrated is just one of the wide range available from Plessey Australia, Telecommunications Division, Meadowbank, NSW.



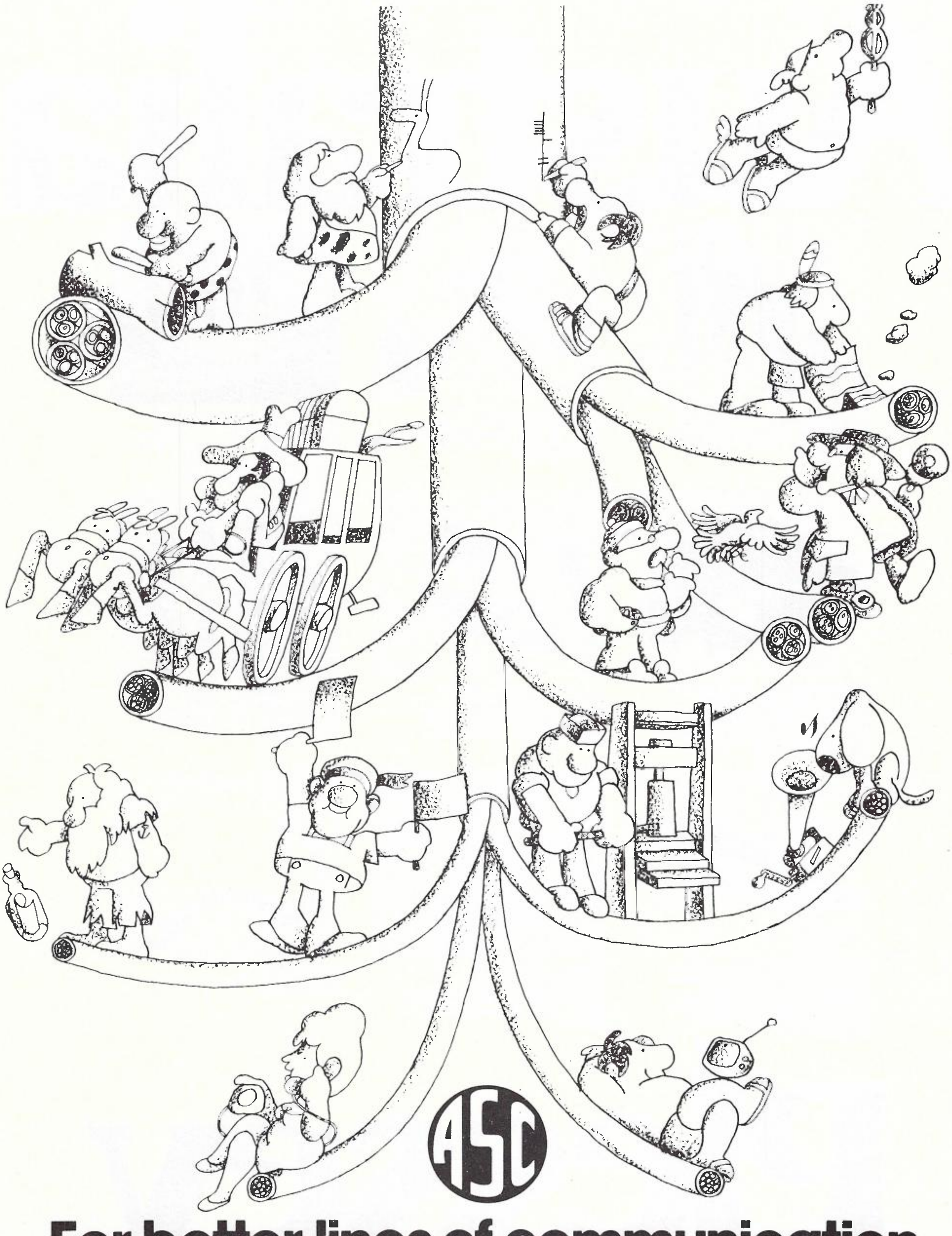
Marketed by Plessey Australia, Components Division the 'Magispark' is a compact electronic gas lighter providing a continuous spark suitable for use in kitchens, on boats, caravans and for outdoor stoves and gas barbecues.



Number of plants: 8
Factory capacity: 1 million sq. ft.
Employees: 4,000

Plessey

APP70/R1



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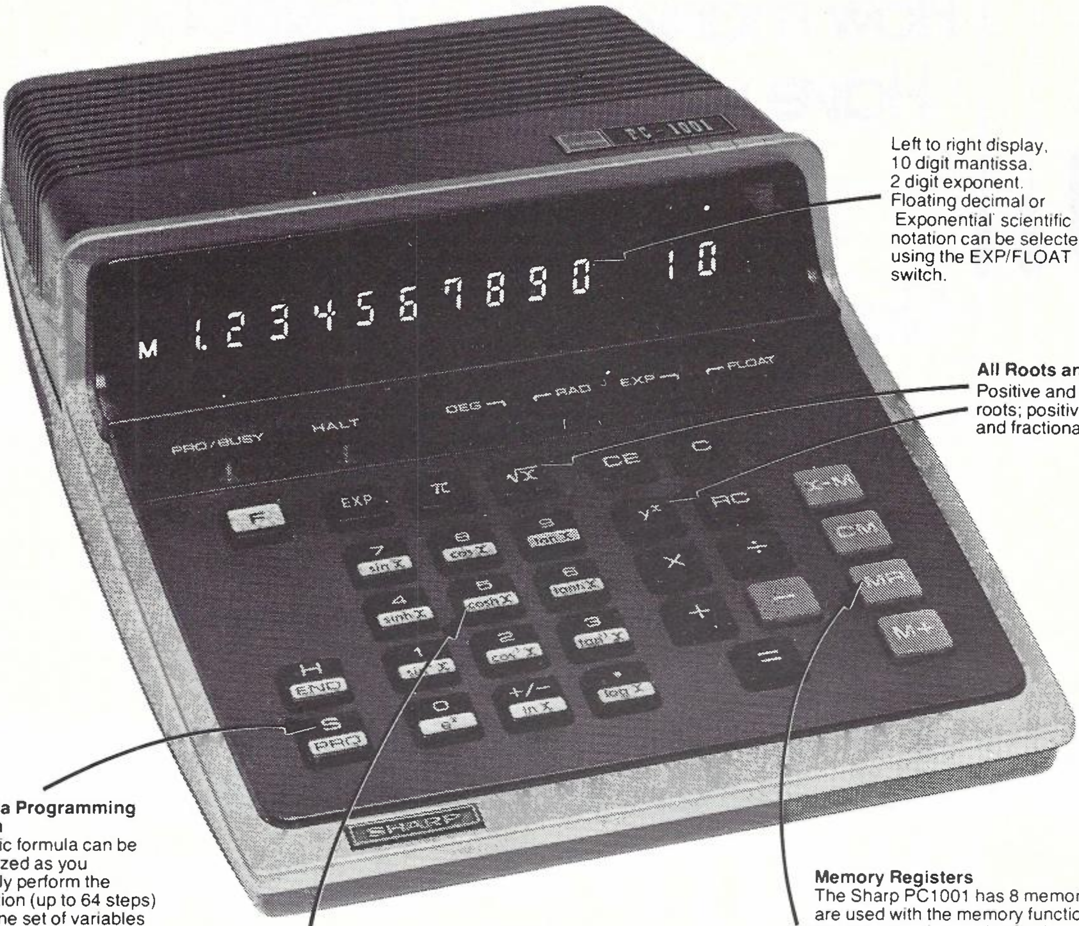
Austral Standard Cables Pty. Ltd., makers of Australia's telephone cables. Incorporating Bly's Industries, suppliers of telephone cords and cordage
Head Office: 325 Collins St., Melbourne, Vic. Works: Maidstone and Clayton, Vic. Liverpool, N.S.W. and Hornby, Christchurch, N.Z. Laboratories: Maidstone, Vic.



Left to right display, 10 digit mantissa, 2 digit exponent. Floating decimal or 'Exponential' scientific notation can be selected using the EXP/FLOAT switch.

All Roots and Powers
Positive and negative roots; positive, negative and fractional powers.

Formula Programming System
Scientific formula can be memorized as you manually perform the calculation (up to 64 steps) using one set of variables [F][S] starts the programme: [H] is a 'halt' instruction in the programme memory; [F][H] ends the programme.

15 Hard Wire Functions include —
Trigonometric functions: Sin x, cos x, tan x; Sin^{-1} x, cos^{-1} x, tan^{-1}; Sinh x, cosh x, tanh x. Logarithmic Functions: ln x (natural) log x (common) are all calculated by depressing [F][0] – [9] keys. Answers can be in degrees or radians by using the DEG. RAD switch.

Memory Registers
The Sharp PC1001 has 8 memories which are used with the memory function keys and a memory register selection key thus
[0] key No. 0 memory
[2] key No. 2 memory

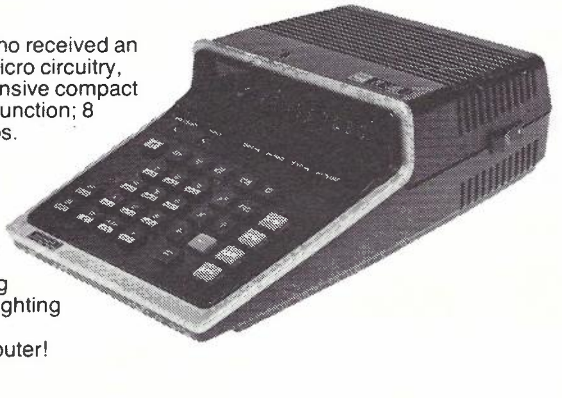
MORE THAN A CALCULATOR– A MINI-COMPUTER

Sharp Electronics, the same people who received an award from the Apollo Moon project for micro circuitry, introduce their new PC1001 — an inexpensive compact calculator with 14 registers: 3 working; 3 function; 8 memory — fully programmable to 64 steps.

The Sharp PC1001 has 15 hard wire functions, employs algebraic logic, gives instant reciprocals, can automatically override the floating decimal switch and gives you choice of input and output.

The Sharp PC1001 is ideal for any technical or scientific application including electrical and chemical engineering, draughting and surveying.

It's little wonder they call it a mini computer!



SHARP

ELECTRONIC CALCULATOR PC1001

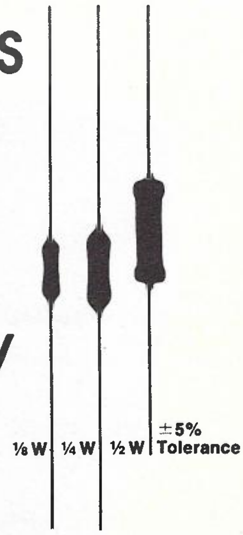
SHARP CORPORATION of AUSTRALIA:
N.S.W. 519 5522; VIC. 419 1077; QLD. 44 7311; S.A. 42 6241; W.A. 25 9544; A.C.T. 95 3911; TAS. Hobart 34 6711, Launceston 22 391.

How many styles of resistors Have you been buying?

SIX?

Now you need stock only

ONE Style!



IRC TYPE RG¼
±2% TOLERANCE
METAL GLAZE RESISTOR
½ WATT (at 70°C Ambient)

Body Length 0.25"
Diameter .090"

Small enough to replace many ⅛ watt resistors but with a high stability ½ watt rating, the RG¼ is manufactured in tolerances of ±2% and ±5%.

A calculation of the cost of using ⅛W, ¼W and ½W resistors in both 5% and 2% tolerances will show you can make a dramatic saving by switching to RG¼ 2% tolerance.

That is why we have made the decision to stock the full range of E-24 values in 2% tolerance.

Apart from the question of economy, what other resistor gives you so many benefits?

***Rugged:**	Moulded jacket gives protection from roughest handling.
***Lower Temperature Coefficient:**	Less than 200 ppm/°C (.02% per °C).
***Superior Stability:**	At ¼ watt rating Mil. load life is better than 1%. At ½ watt, better than 1.5%.
***Lower Surface Temperature:**	Body temperature rise at ½ watt at 70°C amb. is only 40°C.
***Permanent Colour Bands:**	Acrylic colours remain bright and clear after years of service.
***Leads Solder Fast:**	Exclusive IRC tin-lead alloy plating process results in first class solderability even after years of storage.

Manufactured in Australia by:
IRH COMPONENTS DIVISION
NATRONICS PTY. LIMITED
The Crescent, Kingsgrove, N.S.W. 2208

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IRH COMPONENTS DIVISION
P.O. BOX 71, KINGSGROVE, N.S.W. 2208
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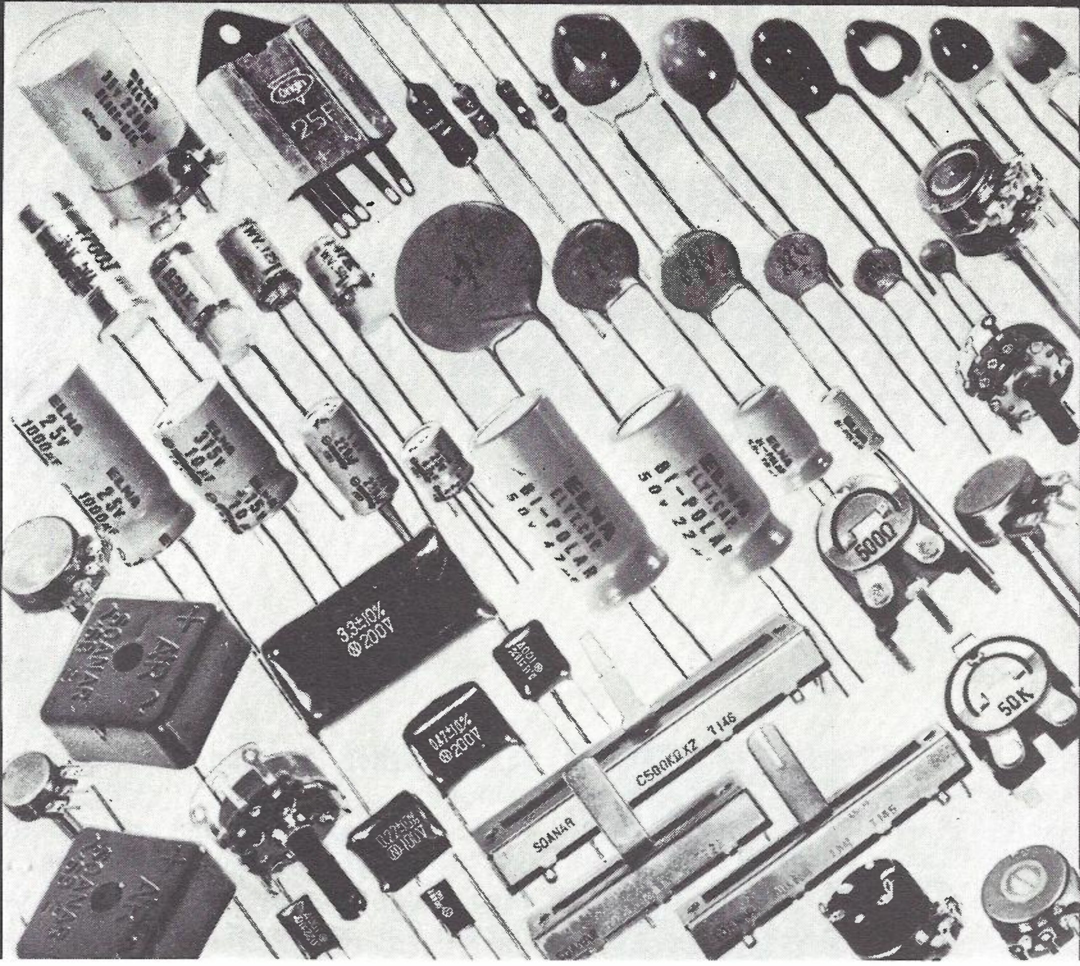
MG.4/74

There's nothing passive about our components



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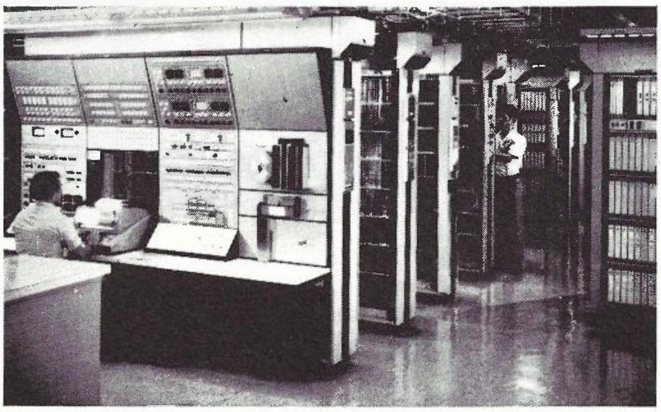


Flexible and ready for growth.

That's No. 1 EAX, a central office system that can be expanded up to 45,000 lines.

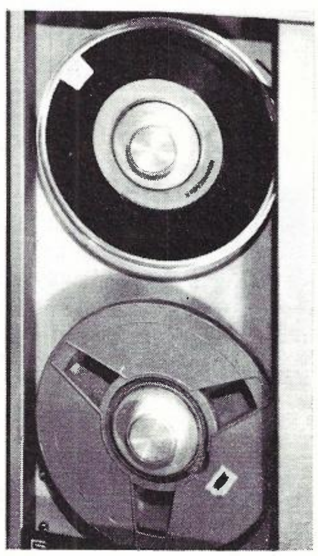
We've taken advantage of the latest developments in integrated circuits and computer logic to design a system that sets a completely new standard for local and local tandem exchanges.

For example, our stored program technique lets you keep up with changing customer requirements by inserting new instructions through a teletypewriter that can be built-in or located remotely.

No hardware or wiring changes are needed.

This lets you do things like changing dial to touch calling simply by typing a class-of-service marker into the computer memory. (The No. 1 EAX can handle both types of subscriber calls simultaneously.)

The No. 1 EAX also lets you offer your customers direct-distance dialing. The automatic message accounting system can be located right at the exchange or the information can be routed to a centralized toll ticketing or TSPS facility.



Both LAMA and CAMA toll ticketing systems can be installed as part of a No. 1 EAX system. The LAMA unit will handle up to 45,000 lines and store up to 1,000 completed calls on just nine feet of tape.

From GTE.
-the-art exchange.

And, LAMA records trunk number, called number, calling number, start and completion time, date, rate, and class of call for automatic billing systems.

In the No. 1 EAX, dual computer and data processing systems are on line simultaneously to give maximum security against malfunction.

In addition, a computerized diagnostic program constantly monitors the operation of these systems and all subsystems.

The No. 1 EAX can handle subscriber loops with total external resistance of up to 2250 ohms at 50 Volts. That means that fewer long line adapters are needed.

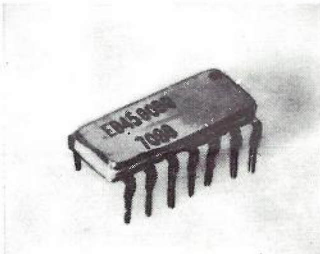
Expansion is also a simple matter.

You can add lines just by adding modules to the existing system.

If it's a bigger expansion, you can grow in 200 line increments just by adding factory-wired line frames and switching matrixes.

A lot of people realize the advantage of No. 1 EAX. Right now, there are 19 installations in full operation. And that number will grow to 26 by the end of 1974.

No. 1 EAX is only part of GTE's family of electronic telephone equipment. A family that is designed to meet the needs of every size exchange.



And they all have the same basic design concept that assures high reliability and wide flexibility.

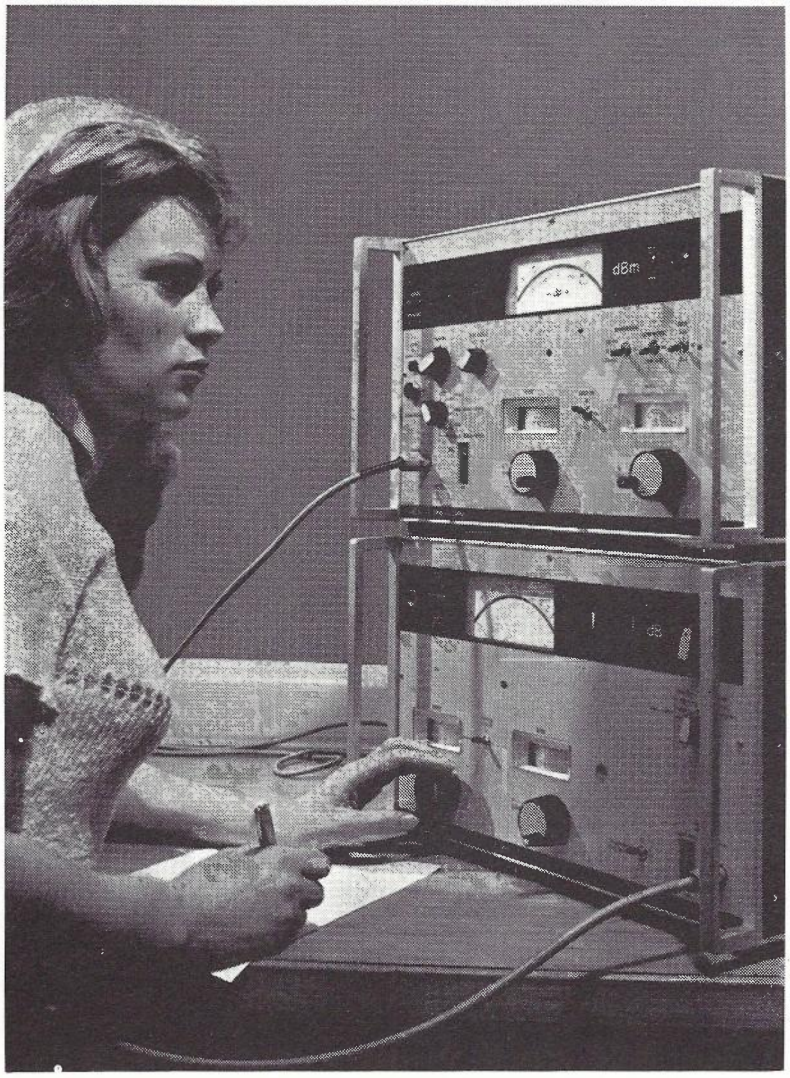
After all, what else would you expect from the people who invented automatic telephony? We established the state-of-the-art in 1891, and we're still leading it today.

GTE INTERNATIONAL

GTE International, P.O. Box 105, Gordon, NSW 2072

SIEMENS

New Level Measuring Set-up 6kHz-18.6MHz without band switching



The main application of Siemens new 18.6 MHz set-up is for selective level measure ments on carrier frequency wide-band transmission systems, either in-station or along the route

A modern measuring set for laboratory or field use must be accurate and reliable It must be solid state, portable and robust. The Siemens 18.6 MHz level measuring set-up has all these qualities It is extremely versatile and its perform ance features include

- ☐ frequency adjustment without band switching over the entire frequency range
- ☐ push-button pilot attachment for crystal-accurate CCITT-frequencies
- ☐ ease of operation
- ☐ automatic tuning system (AFC)
- ☐ balanced measurements up to 10 MHz
- ☐ single push-button automatic calibration with visual indication
- ☐ combined digital (electronic) and analogue display
- ☐ scale expansion
- ☐ excellent frequency/level accuracy/ stability – crystal spectrum control
- ☐ operation from mains or battery

Like to know more? For further details and informative technical literature, contact Siemens

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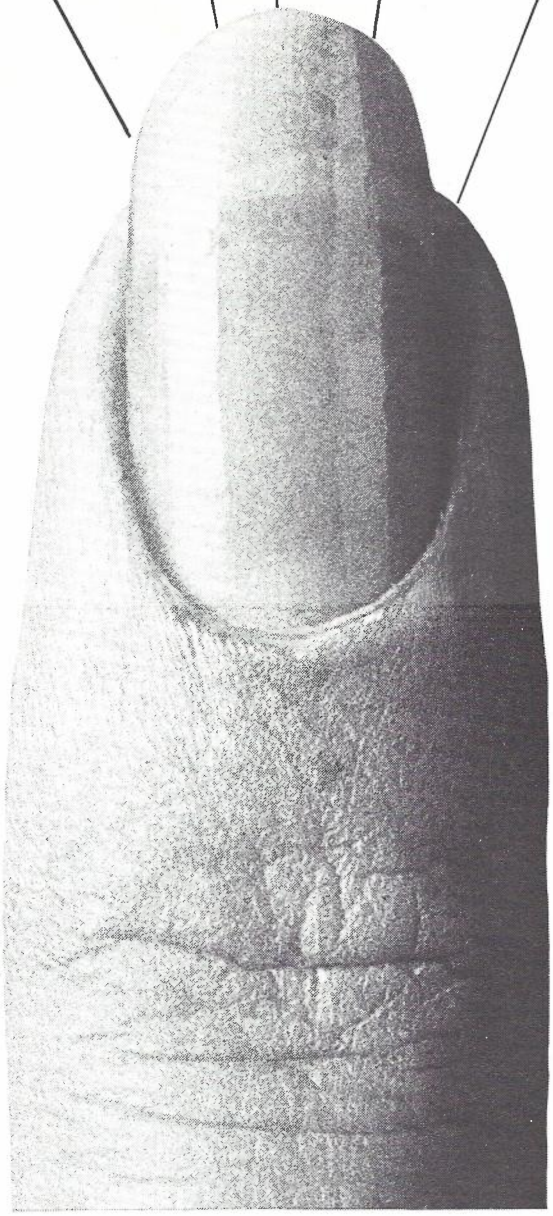
SH 6083 N

At your fingertip. Two or three telephones on one exchange line and an intercom system all in one.



The versatile GEC 740 switching telephone.

There's more to the GEC 740 switching telephone than meets the eye....

On one hand it provides independent access to a single exchange line from two telephones (1/2 system) or three telephones (1/3 system).

On the other, it is a separate intercom system–keeping exchange calls secret from internal calls. And it's all in one basic instrument–controlled by push-button switches in front of the hand-set on each 'phone. Neat, simple to use–but extremely versatile.

Dial or pushbutton versions available for all telephones.

GEC manufacture telephones for world markets: table and wall-mounting models in a number of attractive colours, loudspeaking telephones, pushbutton telephones and switching telephone systems....

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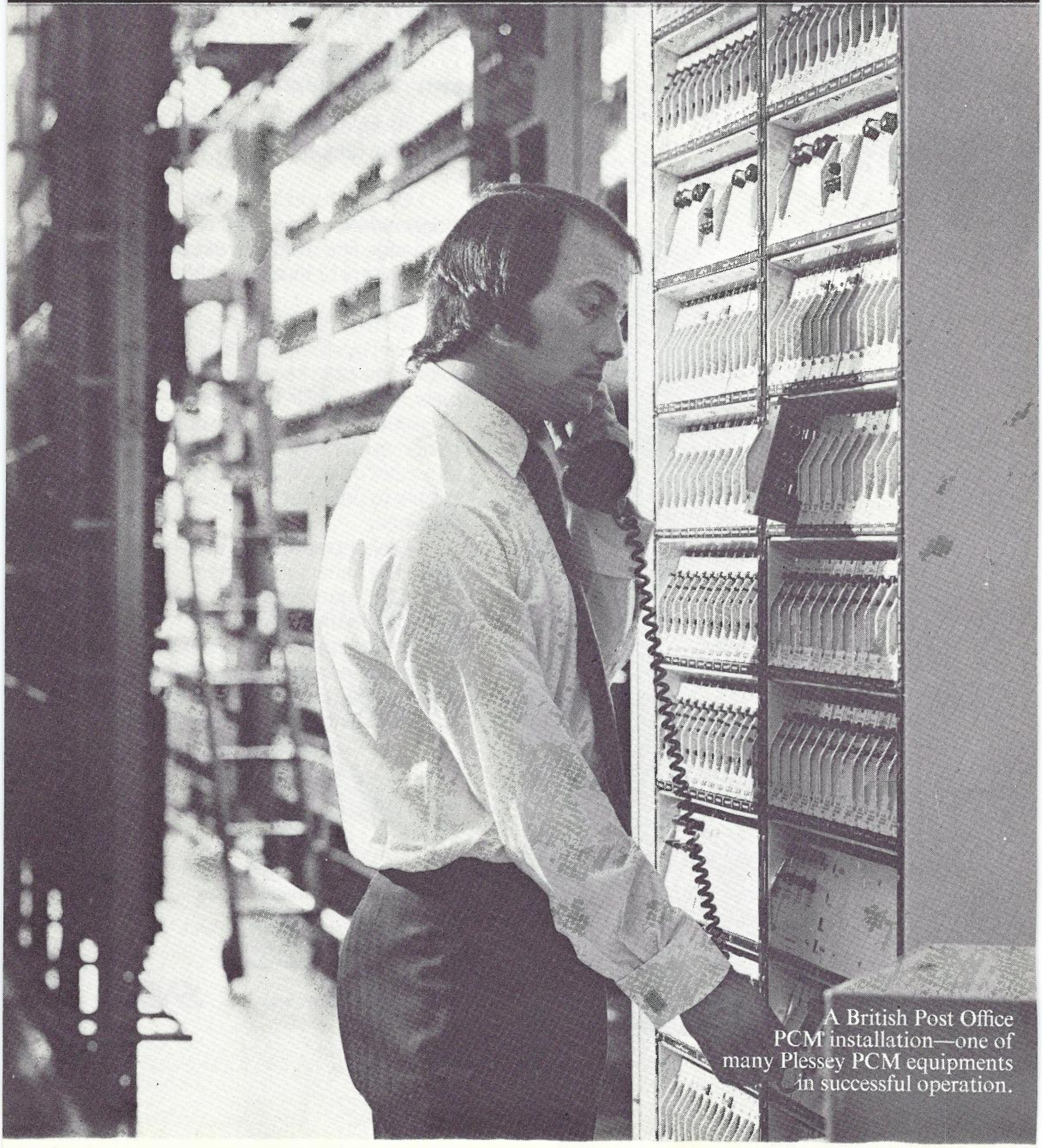
GF1

Speech quantity plus speech quality-



A British Post Office PCM installation—one of many Plessey PCM equipments in successful operation.

That's Plessey system CD30A 30-channel PCM

System CD30A is the latest advance in pulse code modulation transmission equipment, providing 30 high-grade junction telephone circuits on a single four-wire cable circuit.

Designed to the latest CEPT and CCITT recommendations, CD30A provides a versatile system suitable for use with any type of telephone exchange.

Line signal bit rate is the standard 2048 kbit/sec., providing 32 time slots per frame (30 standard speech circuits).

Regenerators spaced at intervals in the transmission path ensure that the bit stream is reconstituted—you get out what you put in.

Fault location and alarm facilities form an integral part of the system design and include remote location of faulty regenerators.

Environment: 0–50°C with 95% humidity.

Discuss your increasing traffic problems with us—the CD30A could be the answer.

For further information please write or telephone:
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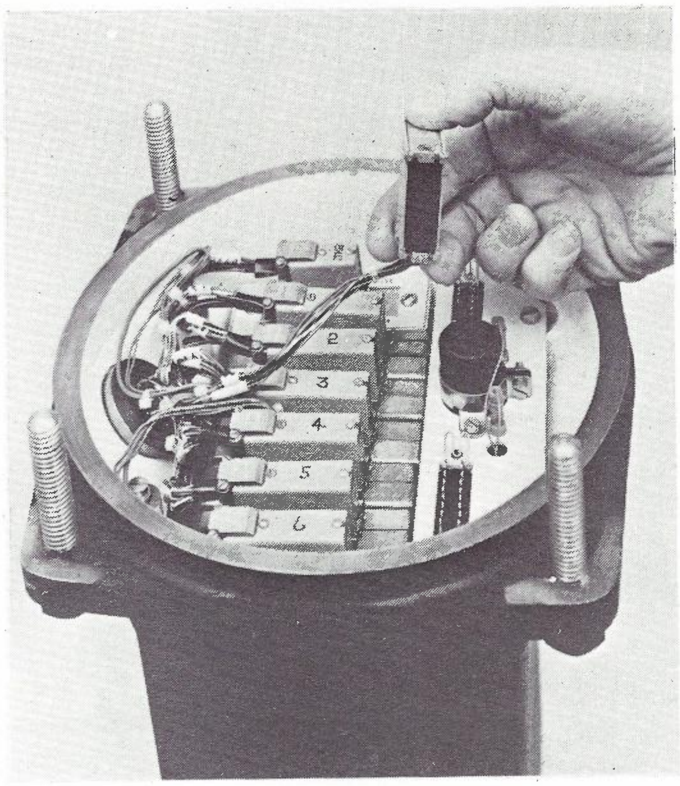
Edge Lane, Liverpool, England L7 9NW
Telephone: Liverpool (051) 228 4830.
Telex: 62267



The picture shows a regenerator assembly box containing six regenerator units together with a supervisory unit. Other boxes are available holding up to 36 regenerator units. Only those cable pairs immediately required for transmission of PCM signals are equipped with regenerators, the remaining pairs being equipped with plug-in loading coils—readily replaceable by regenerator units when additional PCM circuits are required.

PLESSEY
TELECOMMUNICATIONS

720 PTG


Any weather, any climate,
GEC take radio efficiency to extremes
Take the GEC 2GHz system.
So adaptable, it is already operating successfully in various extremes of temperature and humidity – from the arctic regions of Canada to the Swiss Alps, and from the deserts of Libya and Bahrain to the tropical conditions of Nigeria and Zambia.
The GEC 2GHz system provides high system planning flexibility with complete band coverage from 1.7 to 2.3 GHz, with a capacity of 960 telephone circuits, or one colour television channel and one sound channel. Completely semiconductored, the equipment, which is in accord with CCIR recommendations, combines high reliability with low power consumption making it particularly dependable for routes which must cross remote or difficult areas. Its modular construction, the latest example of systematic improvement to a successful and proven system, reduces field maintenance to a minimum and enables qualified maintenance engineers to work from a strategically located central depot. System-planning engineers will be pleased to show you some of the other ways in which the 2GHz system has already proved extremely successful in 18 countries.
Total telecommunications: Microwave and Line Transmission, Multiplex, V.F. Telegraphy, Data Modems, Public Exchanges, Private Telephone Systems, Telephones, Total Systems Capability.
In the Chilean High Andes
GEC
GEC Telecommunications Limited of Coventry, England.
A Management Company of The General Electric Co. Ltd. of England.
In the Nigerian Bush
In the Swiss Alps

GB6

The Telecommunications Journal of Australia

ABSTRACTS: Vol. 24, No. 3.

DODDS, H. E.: 'Quality Control and the APO Inspector'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 227.

This article and the accompanying article by J. Marchant in this issue of the Journal are part of a set of articles outlining the methods used to ensure that specified levels of quality are achieved in the purchase, installation and operation of plant comprising the telecommunications network. This article describes, in simple terms, the work of the APO Inspector responsible for quality control. A survey is given of the various techniques used to ensure, in the most efficient way, that the APO receives the specified quality in the goods purchased.

The next issue of the Journal will contain two more articles covering the application of quality control techniques to the installation and operational aspects of telecommunications plant.

DUNNE, R. P. S.: 'New Telephone Order Procedures for Metropolitan Fault Despatch Centres'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 245.

This article discusses the reasons for improving telephone order procedures in Metropolitan Operations, and describes the new system which has been introduced in Melbourne, using Fault Despatch Centres as the control point within each Operations area.

ELGIE, M. B.: ''Customphone' Development in New South Wales'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 270.

This article briefly outlines the development in NSW of the Customphone, the modern counterpart of the Non Switching Unit (NSU) facility. The initial NSU installations catered for rather simple executive-secretarial communication functions which did not require diverse switching of calls to other points; hence the term NSU became generally accepted as the name for these early types of services. As the demand for more complex arrangements has emerged, a more appropriate designation, Customphone, has been adopted for modern type units installed since 1972.

HAMILTON, D. R.: 'Operation of a Large Metropolitan Subscribers' District Centre Organisation'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 256.

This article describes the internal and external plant aspect of operating a Subscriber District Centre (SDC) organisation in the Sydney Metropolitan area. The author is the Technical Grade officer in charge of the SDC in the Newtown Engineering Operations Section, and the article refers particularly to this centre.

The management objectives for each cell in the organisation are stated and various control parameters used in assessing progress are discussed.

McCARTHY, R.: '1974 — Pitt Exchange, Scene of Major Cut-Overs in the Heart of Sydney'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 215.

Features of the Pitt Street, Sydney, telephone exchange building and of the various types of telecommunication equipment accommodated in this building are included in this survey of the historic major intensive effort needed to successfully cut over Sydney's inner city business area to crossbar equipment.

MARCHANT, J.: 'Quality Control and the Manufacturer'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 233.

This article outlines the role of Quality Control both as a management system and an integral phase of the manufacturing process, interfaced between the customer and the manufacturer's design and industrial engineering department. As well as setting out the need to obtain agreements with the customer on Acceptable Quality Levels (AQL), it indicates the techniques employed to ensure early warning of any deterioration in standards during manufacture, thus ensuring that the customer receives a product which will provide good performance with low maintenance effort at a reasonable cost.

OCKLEY, D. V.: 'Final Route Traffic Supervision'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 264.

This article describes a simple method of approximating the offered traffics, grade of service and circuit requirements on final routes at main or tandem switching points in alternatively routed networks, using a time-shared computer terminal to perform calculations. Application of the method at Melbourne ARM exchange is discussed.

POULSEN, A. B. and REED, P. J.: 'The Bellenden Ker Television Project — Part 1'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 276.

The selection of Bellenden Ker as a television transmitting site for the Cairns region of North Queensland was a decision of some moment, necessitating the construction of a passenger cableway to the top of the Bellenden Ker Range for site access. Part 1 of this article outlines the factors leading to this decision, and describes the construction and operation of the cableway. Part 2 in the next issue of the Journal will describe the equipment installed in the transmitter building, and the operation of this equipment by remote control. This was the major factor permitting the integration of all radio operations in the Cairns area into a functional Radio District.

TORKINGTON, R. M.: 'Portable Traffic Route Tester — Model Q1'; Telecomm. Journal of Aust., Vol. 24, No. 3, 1974, page 222.

The solid state Traffic Route Tester described in this series of articles is among the first of a generation of instruments using extensive micrologic for the testing of telephone exchange operation. In this article, the philosophy of the design approach is outlined, and the motivation behind the various technical decisions made during its development.

THE TELECOMMUNICATION JOURNAL OF AUSTRALIA

VOL. 24. No. 3. 1974

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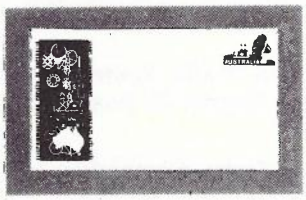
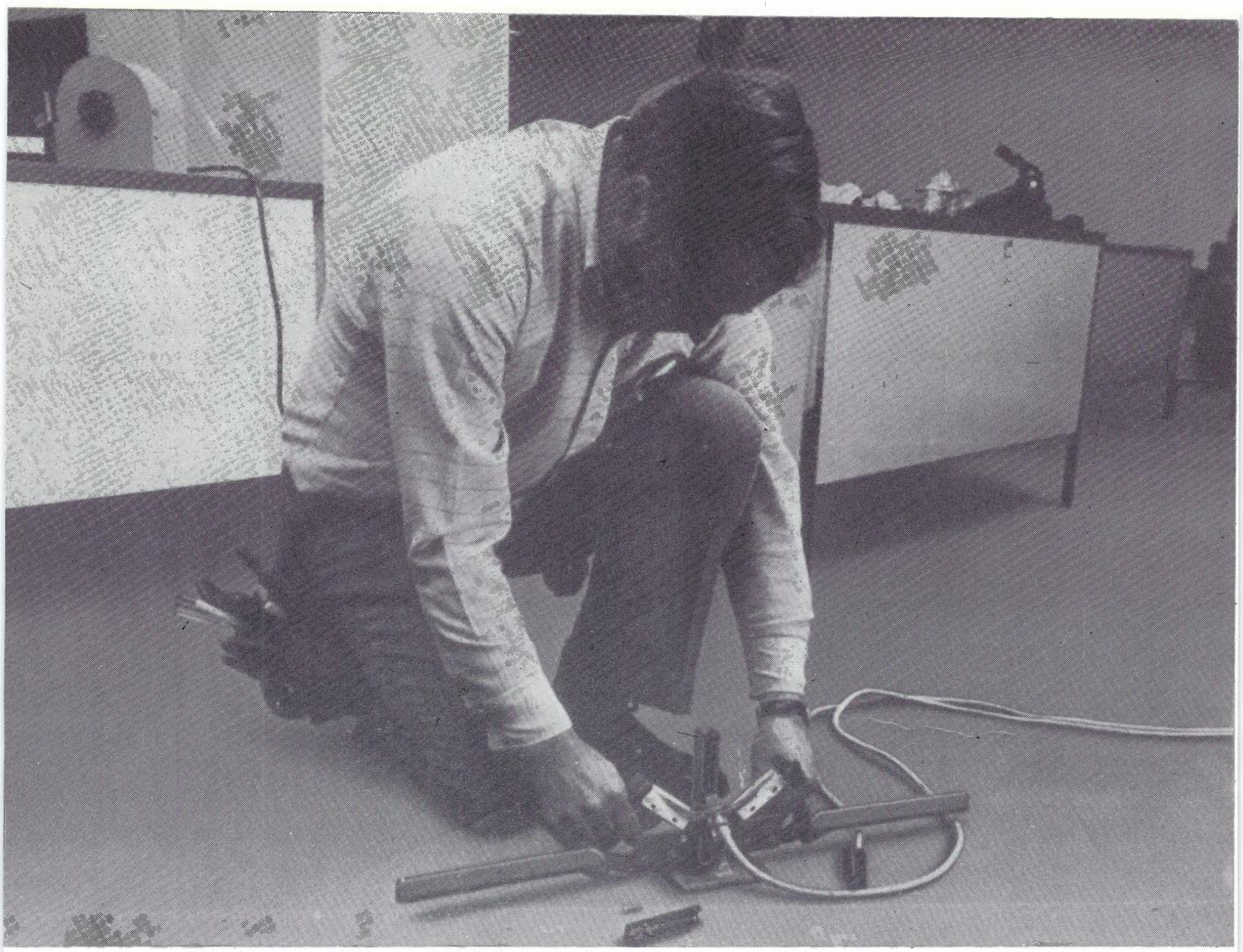


COVER
CENTENARY
COMMEMORATIVE
COVER



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Impressive? Yes—and you can do it now with the CHAMP 25-pair connector and hand tool.

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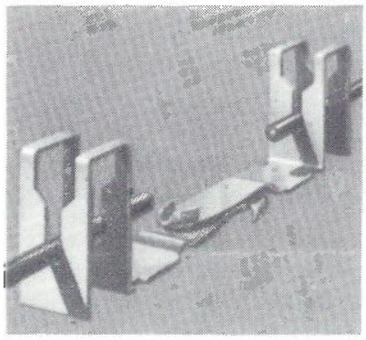

Unique displation technique provides gastight, wire-to-contact termination.

This connector is also available for use with woven or flat cable, which makes it ideal for certain installations.

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