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telecommunications

JOURNAL

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SIXPENCE

SUMMER 1967

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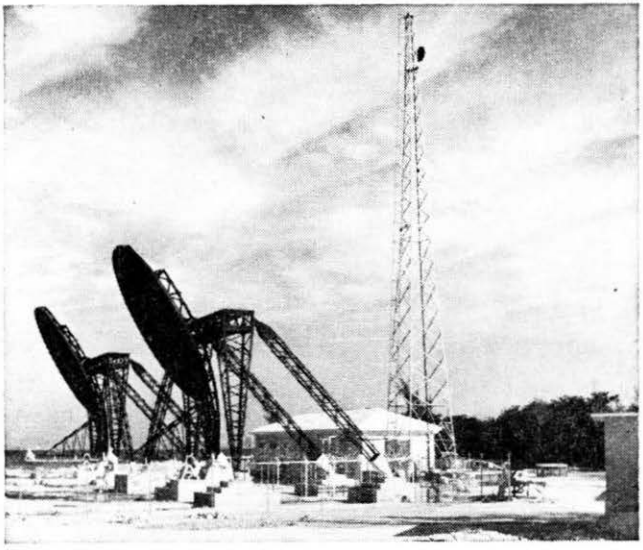

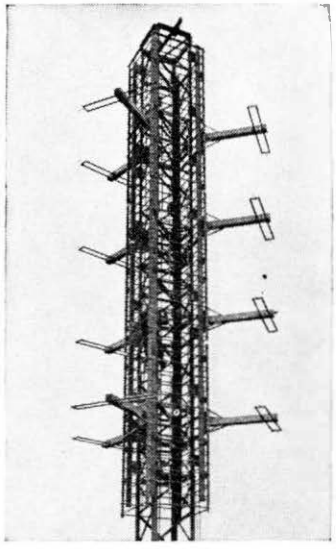

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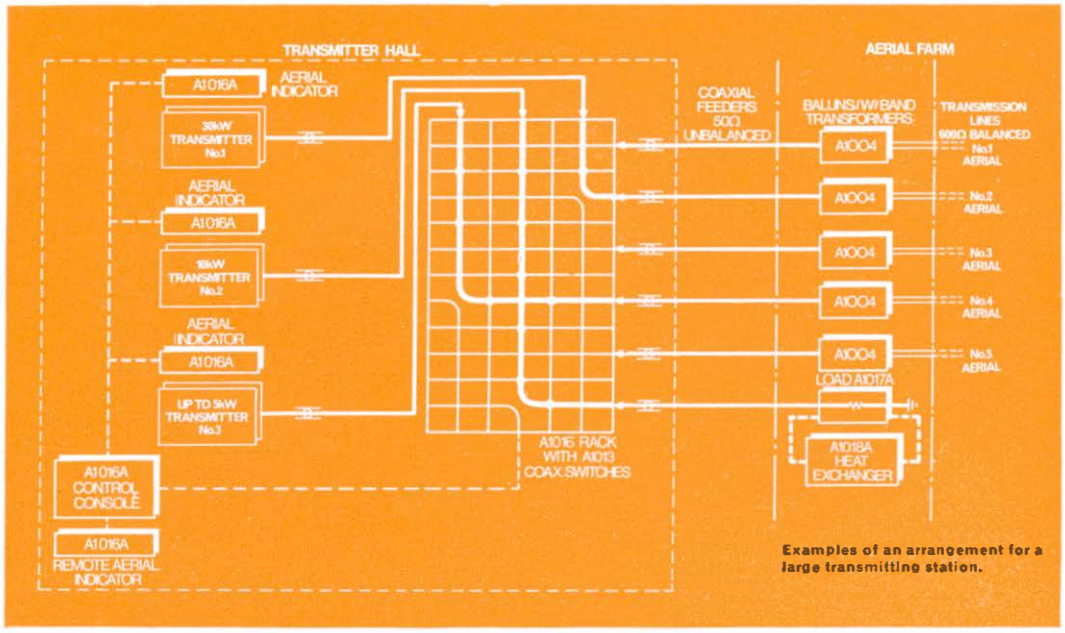
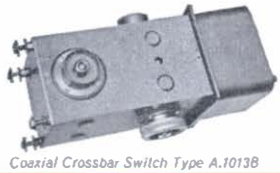
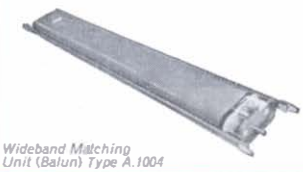
STC Telecommunications Review



Examples of an arrangement for a large transmitting station.



Coaxial Crossbar Switch Type A.1013B



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5kW Wideband Aerial Matching Transformer Type A.1003

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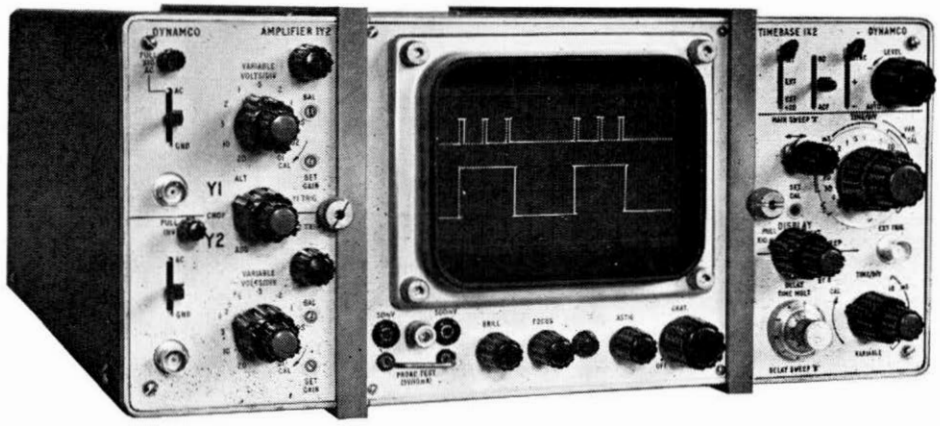
71 SERIES OSCILLOSCOPES



The 71 Series portable Transistorised Oscilloscope features plug-in X and Y modules and 10cm x 6cm display. The Display Unit (7100) contains a short mesh-screened c.r.t. operating at 10kV for high writing speeds.

VERTICAL DEFLECTION

1Y1—30MHz Single Channel
10mV/div. d.c.—30MHz
1mV/div. 10Hz—5MHz
Signal delay

1Y2—30MHz Dual Channel
10mV/div. d.c.—30MHz Channel 1 and 2
1mV/div. 10Hz—5MHz Channel 1
Signal delay

1Y7—15MHz Single Channel
50mV/div. d.c.—15MHz
5mV/div. 5Hz—1MHz

HORIZONTAL DEFLECTION

1X1—Wide Range Time Base
Sweep Range 0.2μs/div—5 sec/div.
Magnifier X10 for 20ns/div.
All normal trigger modes plus Single Shot

1X2—Sweep Delay Time Base
Main Sweep 0.2μs/div.—0.5 sec/div.
Delay Range 10μs through 0.5 sec
Bright-up 'strobe'

1X6— General Purpose Time Base
Sweep Range 0.2μs/div.—0.5sec/div.
Magnifier X5 for 40ns/div.

Typical size and weight of a 71 Series Oscilloscope is Height 6.5", Width 13.8", Depth 16.3", Weight 28½lb.

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REX

THE REED ELECTRONIC EXCHANGE

No. 18 system

packs more lines into less space— AND LEAVES ROOM FOR UNLIMITED EXPANSION

REX in a nutshell

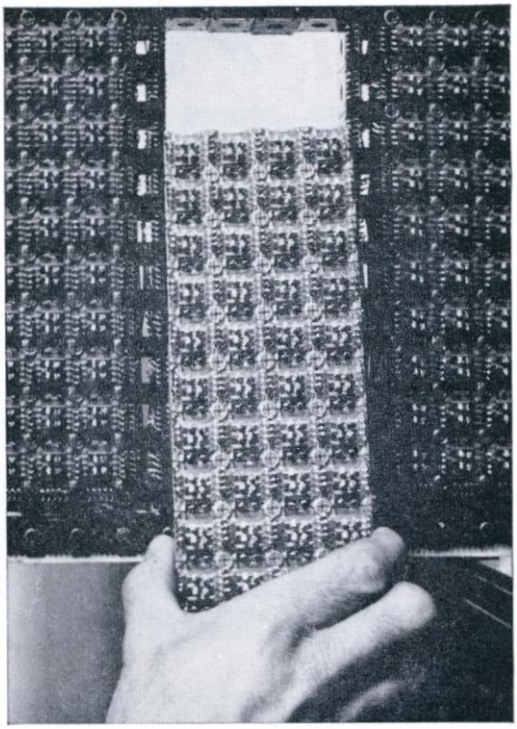
By providing electronic common control of reed relay spatial switching, the REX system offers an extremely compact and reliable solution to both the switching and control problems of modern exchange design. The REX exchange has been developed by AEI to integrate smoothly with existing automatic networks: its exceptional flexibility ensures full growth capacity for both services and traffic . . .

Wider range—more accessibility

An entirely new Reed & Electronic Modular Apparatus practice (REMA) has been designed by AEI engineers to provide completely compatible mounting of reed relays and electronic circuit components. Combined with a new sliding-frame mounting system, the REMA practice allows more than 20,000 lines of REX switching equipment to be accommodated in the space normally required by a 10,000 line electro-mechanical exchange. In existing buildings this means more space for future expansion: in new exchanges it makes possible great savings in construction and installation costs. And because the REX subscriber's line circuit can tolerate substantially wider line conditions, a REX exchange will serve an area much larger than that of a conventional exchange, with significant reductions in line plant investment.

Designed for expansion

The basic design allows for all future switching requirements, including abbreviated dialling and subscriber's automatic transfer, together with all current standard features such as data for automatic message accounting. A



stored programme control is provided to expedite inclusion of these and any other special facilities that may be required during the life of the exchange with virtually no redundancy of initial apparatus.

Minimum maintenance

The high-speed electronic control system is programmed to give complete automatic self-checking and self-reporting of fault conditions and at the same time, routes calls away from areas of faulty equipment. A 3,000 (ultimately 7,000) line prototype reed electronic exchange supplied to the BPO at Leighton Buzzard,* has been designed for completely unattended operation and reports all servicing requirements to a remote maintenance control centre.

Maximum service security has been ensured by exhaustive circuit design and testing during the development period and by replication of important items of equipment. The control area is sub-divided into independently switched functional units thus ensuring continued operation in the face of faults. Thanks to the REMA system every part of the REX exchange is accessible for inspection or servicing.

* *Developed in conjunction with the BPO under the auspices of the Joint Electronic Research Committee.*

SOPHISTICATED ELECTRONICS— BUILDING BLOCK SIMPLICITY!

The REX switching element

The basis of the REX system is the reed-relay switching element. It contains only nine different piece parts, compared with 200 in a bi-motional selector, and its very simplicity makes it uniquely reliable. There's nothing to wear out and it is sealed completely against dust and atmospheric pollution.

The REX switching matrix

Switching matrices can be built up in any form simply by clipping reed-relay crosspoints together. Thus unlimited provision for the growth of lines and links is built into the REX system.

The REX switching unit

Basic switching arrays are built up out of matrices and are arranged in parallel to form a REX switching unit. Typically, a 1,000-line four-section unit would serve a community with an average calling rate of 150 call seconds per line in the busy hour; other calling rates can be accommodated by varying the number of sections.

The multi-unit REX exchange

Switching and linking arrangements are provided for all sections of each unit so that complete crosspoint path interconnection is made between all lines of the REX exchange. The special linking pattern adopted can cater for all traffic patterns whilst retaining simplicity of control.

REX electronic control

The REX electronic control has three main areas of activity:
Scanners and Registers: To determine the source and final destination of a call.
Markers and Interrogators: Concerned with interrogating the state of crosspoint paths and marking these paths through the switching sub-units.
Common Control: Processes the necessary call setting data in accordance with instruction from the stored programme control so that the calls are routed with maximum utilisation of the switching networks.

Information for administrations

The AEI REX Information Service is one of the most comprehensive programmes ever offered. In addition to brochures and full technical data, AEI will gladly arrange for their lecture team to visit the engineering staff of interested administrations to provide an introductory course on basic REX principles. Later, key personnel would receive full training both at AEI's UK factories and on-site during installation. Training schools staffed and maintained by AEI are also under consideration for territories where reed electronic exchanges are proposed as standard.

Please write for full details

Public Telephone Systems
Department (Electronic)
Telecommunications Group
Associated Electrical Industries Limited
Woolwich, London SE18.
Tel: Woolwich 2020

AEI TELECOMMUNICATIONS

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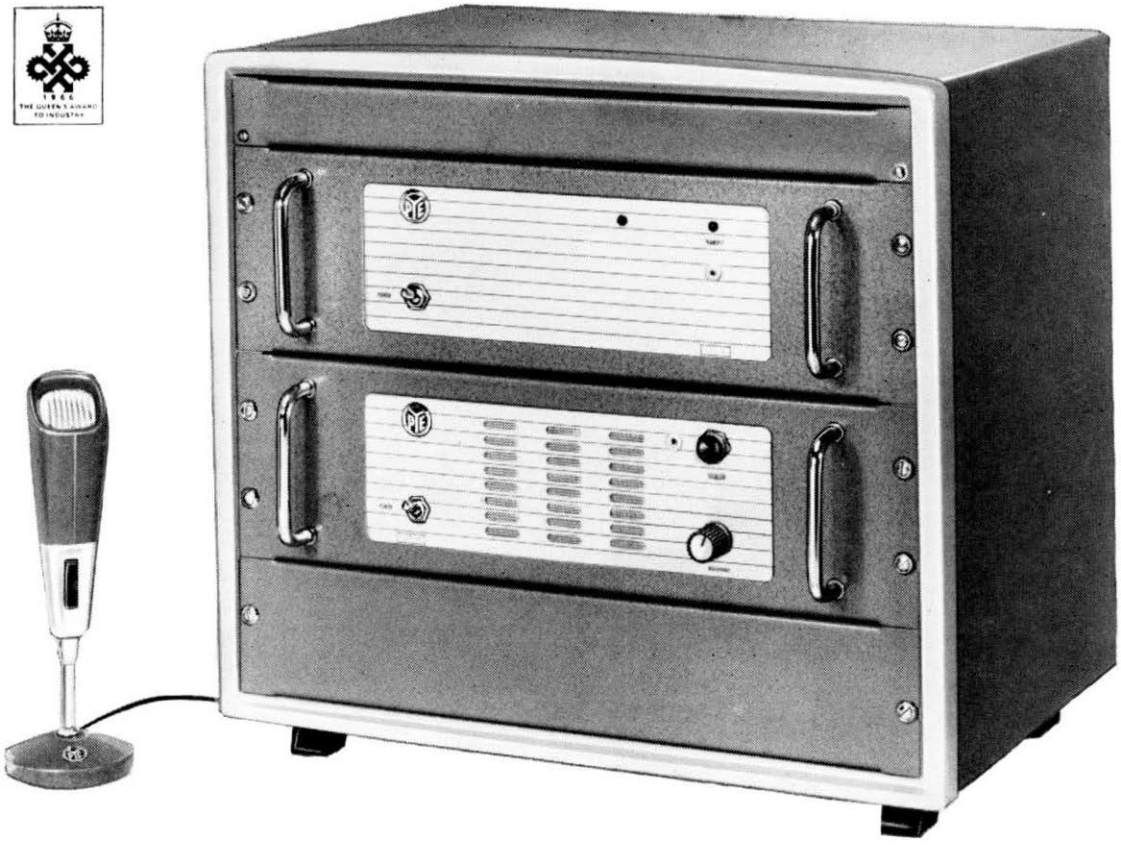

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Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

CONTENTS

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Vol. 19 Summer 1967 No. 2

STOP THAT ACCIDENT!

LAST year more than 33,000 members of the Post Office staff were injured on duty—eight of them fatally. Nearly 11,000 of these accidents resulted in sick leave. The total cost to the Post Office was about £3 million and—even more important in the long-term—a loss of efficiency and productivity.

In the Engineering Department alone there were some 9,800 accidents costing the Post Office about £1 million. Each year some 500 engineers fall from a ladder or a pole; 750 sustain eye injuries; 3,000 hurt themselves lifting equipment; and about 100 are injured slipping off vehicle steps.

These sobering facts—highlighted by the recent appearance of a new safety newspaper for the Engineering labour force throughout the country—emphasise the growing need for every possible measure to be taken to reduce the accident rate.

Obviously, every individual has a personal responsibility to guard against accidents. But the main responsibility falls on management. Only a strong lead from management at all levels can ensure that the message of safety is put across to the staff and properly understood.

In the Post Office, management is tackling the problem with increasing vigour and there are signs that the accident rate is slowly decreasing as a result. More safety officers are being appointed; some 500 joint committees have been set up throughout the country to discuss ways of making both management and staff more safety conscious and to adopt every possible precaution against accidents happening. Training courses are playing their part in driving home the message that a job done efficiently is a job done safely. At every level staff are being encouraged to take a personal interest in safety and accident investigation techniques are being improved to find out more about the cause of accidents. As an additional spur, a section is now being included in the annual reports on some supervising grades asking for an appraisal of a man's attitude to safety and his success in ensuring that those who work with and under him adopt correct safety procedures.

In the end it is at the supervisory level perhaps that the most effective means of stopping accidents can be found.

THE MPs WHO ASKED THE QUESTIONS . . .


Mr. Ian Mikardo


Mr. M. Alison


Mr. R. Brown


Mr. Neil Carmichael


Sir Henry D'Avigdor-Goldsmid

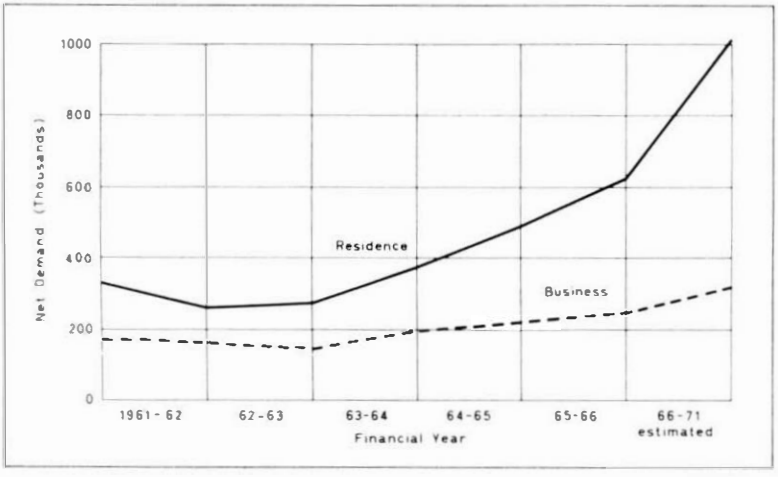

Mr. B. Floud

The Post Office emerged with considerable credit from the searching inquiries of the Select Committee on Nationalised Industries. The Committee of 18 Members of Parliament found much to praise in the way the telecommunications services are planned and operated

More Bouquets Than Brickbats

CONTRARY to the impression most people gathered from the newspapers, the recent Select Committee on Nationalised Industries' report on the Post Office congratulated more than it criticised. There were more bouquets than brickbats.

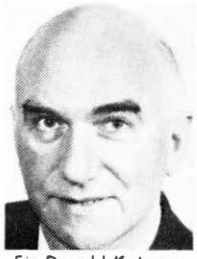
The long and detailed report—particularly timely in view of the imminent change of status from a Government Department to a nationalised corporation—emphasises two important facts which are often overlooked. First, many of the present faults in services were inherited from the past but are now being put right. And second, the telephone service, although capital-intensive and generally profitable, faces such a rapidly expanding demand that it is physically impossible at present to meet it satisfactorily.



This graph shows the rapid growth in demand for telephones in recent years. "The demand for and the use of the telephone will not end until the telephone is a standard piece of equipment of most households," says the Report.

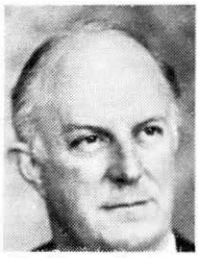

Mr. D. Griffiths


Mr. J. Horner


Sir Donald Kaberry


Col. C. Lancaster


Mr. R. Lewis


Sir Fitzroy Maclean


Mr. C. Norwood


Mr. T. Park


Mr. A. Palmer


Mr. H. Randall


Mr. N. Ridley


Mr. D. Webster

In the chapters dealing with telecommunications, the Report points out that at one time these services were largely limited to providing telephones for use by business and a small sector of the public, supplemented by a telegram service. Today, the Post Office was beginning to equip itself with the tools to provide a broader range of services which took account of the varied needs of the community for the rapid transfer of information of all kinds. Such new services as telex, Datel and television links were designed to meet the requirements of business, industrial, scientific and administrative functions in a way that simple telephones and telegrams never could.

Telex and data transmission services were still on a small scale compared with the telephone . . . but, coupled with the move towards automatic telephone services and integrated international services, "may be the beginnings of a breakthrough in telecommunications in which the Post Office will be able to reach out to every business and household and provide them with far more varied and extended methods of communication than those at present available."

During the Committee's investigations, the Engineer-in-Chief described how he envisaged that eventually there will be a single communication lead into every household carrying telephone services, sound radio and television (the Post Office is at present costing such a system in a new town and hopes soon to carry out a field experiment). Commenting on this, the Report says: "These are visions for the future and not part of the Post Office of the 1960s which only provides the ordinary telephone to a minority of the population. But your Committee applauds the readiness of the Post Office to think in such terms and to prepare to pioneer new means of telecommunications"

. . . AND HE GAVE MOST OF THE ANSWERS


Sir Ronald German, Director General until Sept. 1966. The Report thanks him for his patience and for the "clarity and frankness of his evidence."

The Report goes on to say that nowhere is the breakthrough into a new era in telecommunications more apparent than in the development of the telephone system. "The service appears to be experiencing the beginnings of a surge forward in demand for and use of telephones that will not end . . . until the telephone is a standard piece of equipment of most households.

"International comparisons of telephone penetration and calling rates show the potential for more widespread and intensive use of the telephone. Because of the speed and ease of telephone communications . . . such developments will be to the economic and social benefit of the nation. Although it must primarily be concerned with meeting actual demand, the Post Office must,

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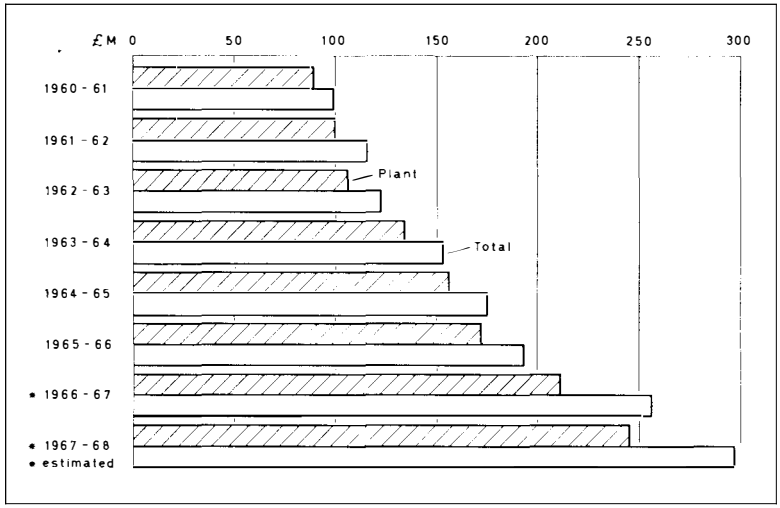


This graph illustrates how the money the Post Office has spent on telecommunications has more than doubled over the past six years.

therefore, not be content with accepting the present degree of telephone usage.

"The central problem . . . and one that should condition all the Post Office's thinking, is how fast will this development come about. Although, due to the current economic situation, there may be a temporary easing off of the growth in demand for telephones, there is little evidence to suggest a permanent slackening in growth rates. The telephone systems in a number of other countries are still growing faster than that in the United Kingdom, although in most of these the scope for increases, because of lower penetration, is greater. Furthermore, demand for the telephone appears to be increasing, particularly among poorer sections of the community and among younger people. Once the telephone becomes regarded as a necessary piece of equipment in working class homes, as it has been for some time in most middle class homes, a large rise in demand seems inevitable."

The Report criticises the Post Office for inaccurately forecasting demand and use of the telephone, although the Committee accepted that five year forecasts must necessarily be speculative.

However, the Report welcomes the improvements which have been made more recently and the detailed knowledge the Post Office is now obtaining about local developments and expected demand. It also welcomes the evidence that "the Post Office is making a more systematic attempt to collect and analyse the information needed to prepare accurate estimates. It welcomes the action that Post Office and industry are taking to improve the flow of essential equipment; the arrangements being made by the Post Office to speed the supply of new exchange equipment (including the use of mobile exchanges and the installation of temporary equipment to relieve heavy pressure); and the wider adoption of standardised buildings and industrial building techniques to speed planning and implementation of the building programme. The Committee saw no reason why the Post Office should not have similar powers to other nationalised industries for acquisition of land and hoped that "the necessary powers will be given to the Post Office in new legislation."

STIMULATING DEMAND

"The physical problems the Post Office has encountered in meeting expanding demand have high-lighted a fundamental problem in the management of telecommunications", the Report continues. "Ideally, there should be no shortage of equipment and the manufacturers should have enough capacity to meet not only unstimulated demand but also any extra demand that could be stimulated by advertising. Under these circumstances, growth and plant availability could be closely matched by controlled selling. This is out of the question at present . . . but in the long term the Committee believe that the Post Office should, in the interests of both themselves and the nation, stimulate the use of the telephone as energetically as possible."

In a chapter dealing with finances, the Report says that the shortage of capital in the 1950s meant that reinforcement of the system and the replacement of older equipment had taken place more slowly than was desirable. "As a result, when demand arose for an expansion of the telephone system at the beginning of the 1960s the

The Select Committee, which was set up at the beginning of the 1965-66 session of Parliament, consisted of 18 Members of Parliament under the chairmanship of Mr. Ian Mikardo, MP.

•

Oral evidence was taken at 22 meetings. Post Office witnesses gave evidence on 17 occasions and at all but one of these the main task of explaining the problems of his Department fell to Sir Ronald German, the former Director General of the Post Office who retired in September, 1966.

•

The other principal Post Office witnesses were Mr. A. Wolstencroft (now Managing Director: Posts), Mr. A. W. C. Ryland (now Managing Director: Telecommunications); and Mr. D. A. Barron (until recently Engineer-in-Chief).

•

Oral evidence was given by a number of other witnesses; including representatives of the Staff Sides of the Departmental Whitley Council and the Post Office Engineering, Factories and Supplies Departmental Whitley Council.

•

More than 90 memorandum of written evidence were furnished to the Committee.

•

During their inquiries, members of the Committee visited a number of Post Office installations to examine problems and methods at first hand.

•

A sub-Committee of four members visited the United States and reported back on the Bell Telephone System so that the British Post Office's telecommunications services could be compared with those of another highly-developed administration.

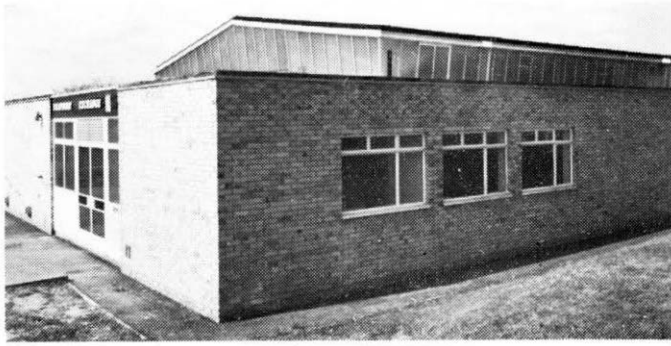
•

The Select Committee Report is a 238-page document obtainable from Her Majesty's Stationery Office (price 16s. 6d.).

Post Office was ill-equipped and ill-prepared to meet it." Since 1961 the Post Office had no difficulty obtaining money for telecommunications capital expenditure . . . the telecommunications service continued to be under-capitalised, but now it was primarily because of practical difficulties in getting equipment fast enough.

So long as it suffered from the pre-1961 restrictions imposed from outside, the Post Office could not be held fully accountable for shortcomings in the telecommunications services. Now that these restrictions had been eased, the solution to its problems lay in its own hands—in co-operation with the telecommunications manufacturing industry.

"The Committee believes that the Post Office has now adopted the right approach for planning investment programmes and welcomes the discretion given to Telephone Managers to plan the deployment of capital within their areas, subject



The Report welcomes the wider adoption of standardisation and industrialised techniques to speed building. This standard telephone exchange—at Laindon, Essex—is the new K1 Mk 4 type and cost only £16,250 to build.

to priorities and standards laid down by Headquarters. The Committee also endorses the priority the Post Office is now giving to maintaining and improving the telephone service for existing subscribers rather than to extending services to new subscribers and "realises that the Post Office has been under considerable pressure—not least from Members of Parliament—to take the opposite view. But we believe that the Post Office's priorities are correct."

QUALITY OF SERVICE

On quality of service, the Report says the public has reason not to be satisfied. The number of calls which fail because of congestion and plant defects was higher than the maximum the Post Office considered economically tolerable. The quality of service of dialled trunk calls was particularly low, comparing unfavourably with that in the United States.

The incidence of non-effective calls was particularly high in London and the South-East. This was one of the main consequences of shortage of plant in those areas where traffic had risen more rapidly than the Post Office had forecast. In other parts of the country the quality of service did not fall much, if at all, short of the desired standards.

The quality of the operator services, measured in the time it takes to answer a call, also varied from area to area and was "in the majority of exchanges considerably worse than the standard aimed at". There had been improvements in recent years, however, and these the Committee welcomed.

The Committee also welcomed the emphasis now being placed on the assistance that operators

OVER

can give to the public. "However good the automatic service may become—and it cannot be 100 per cent reliable—an efficient and courteous operator service will always be required in cases of difficulty and for special types of call. In particular, high standards should be required in the directory enquiry service . . . As the use of the telephone becomes more widespread the demand for this service will inevitably increase . . . The Post Office is showing a proper concern to improve the speed of service on directory enquiries . . . (The Committee) also welcomes the proposal to publish more helpful directories and to earn revenue from advertising but . . . regret that this was not done before."

The Committee found that the quality of the fault repair service appeared to be generally satisfactory, comparing reasonably with that in the United States, and welcomed the action being taken to improve the service still further.

"Improved quality of services in future must require greater attention to be paid to maintenance of equipment, including the replacement of older plant," adds the Report. "The main remedy must be the provision of more plant and operating staff. The shortage of equipment will not, however, be eliminated for a number of years. In the meantime, the best prospects of improved quality of service comes from technical developments."

VANDALISM

Commenting on vandalism, the Report thinks the Post Office was too trusting in installing lighter equipment in telephone kiosks and welcomes the extra precautions now being taken. The long-term solution might be to put more kiosks, at least in urban areas, into more public places, where there was more chance of supervision, and to encourage the use of metred telephones in shops and cafes.

The Report welcomes the steps being taken to reduce vandalism by providing less vulnerable kiosks. This is the Kiosk No. 8, containing toughened glass and a number of other anti-vandal devices.

Praise For Productivity

THE Select Committee Report pays o tribute to both management and staff in achieving improvements in productivity.

The Post Office had a good record in telecommunications productivity. Without the benefits secured in 1960-65 a total engineering, clerical and operating staff of 206,000 instead of 167,000 would have been needed. "Again, but for these productivity improvements," a further 80,000 people would be needed in 1970-71 to cope with the increase in business.

Telsta, a new labour-saving machine for erecting aerial cables. The increasing use of such machines to improve productivity is warmly welcomed by the Select Committee.

"Apart from increasing economies from the enlarging scale of operations and the advantages gained from automation, the use of computers and other technical innovations, the most significant gains in productivity have resulted from improved manning arrangements in the engineering field. The Committee welcomes particularly the fact that the unions concerned have co-operated fully in bringing these about."

The Committee appreciated the unions' desire to share in some of the benefits that flow from increased productivity but emphasise that a large measure of the benefits should "continue to accrue to the consumer by being passed on in the form of lower costs and so keep down tariffs."

PREPARING THE WAY AHEAD

As a White Paper was published outlining the shape of the Post Office of the future, the first steps were being taken to lay the foundations for 1969 and on

★

WHEN the Post Office becomes a public corporation (probably in the Spring of 1969) it will be headed by a single, small, largely executive board . . . but, if the two businesses—posts and telecommunications—are to develop successfully in their different ways and seize their different opportunities, they must be managed separately within this framework.

Announcing this decision, the White Paper *Reorganisation of the Post Office* says that the managerial structure of the corporation should provide for this arrangement at all levels—national, regional and local. A fundamental examination was now being carried out to see what changes are called for to fit it into the future needs of the Post Office. Where appropriate, changes will be implemented before vesting day.

The White Paper reveals that the Corporation will be known as "The Post Office" and that the Crown and Royal Cypher will continue to be used. The title "Royal Mail" will also continue and the Sovereign's head will still be included in the design of stamps and postal orders.

The Bill establishing the new Corporation will be introduced in the 1967-68 Session of Parliament and members of the Board will be appointed as soon as possible after the Bill becomes law (possibly in the summer of 1968). Vesting day will follow as quickly as possible after that. The Government's objective would be to create an authority which will develop the most efficient services possible, at the lowest charges consistent with sound financial policies; carry on the Post Office tradition of service to the public; and develop relations with its staff in a forward looking and progressive way.

The new Corporation will have the same sort of financial obligations as other nationalised industries, says the White Paper. It will be expected to pay its way with sufficient margin between income and expenditure to make suitable allocations to reserves. The Minister who bears responsibility for the new Corporation will settle financial targets with the Corporation to provide a stimulus to efficiency and to ensure that it generates an appropriate proportion of its own capital requirements.

"Parliament and public have a right to expect guarantees that the Corporation will be responsive to the social and business needs of users and sensitive to their opinion," adds the White Paper. "For this reason the Government attach great importance to the arrangements to be made for user consultation.

Users' Interests

"The keystone of the consultative structure will be a national Users' Council . . . with a secretariat independent of the Corporation . . . arrangements will be made to ensure that there is effective consultative machinery below national level . . . the Council will represent the interests of all users. It will be able to make recommendations about the services. It will consider proposals put to it by the Corporation and any complaints from individual users." The Corporation will consult the Council on all major proposals affecting its main services insofar as they affect users, and the Users' Council will have access to the Minister if it disagrees with the Corporation.

The Corporation will have statutory power to fix charges for its services and facilities and the conditions on which they are provided. It will also have power to manufacture anything used in connection with the running of the services; to form subsidiaries and to engage in joint undertakings with other organisations.

The Government do not intend the new Corporation to have a wider monopoly in inland telecommunications than it has at present. The position of private networks operated outside the monopoly will not be affected and the monopoly will not extend to broadcast transmissions from radio stations direct to the public. However, the Government have decided that, subject to certain limitations, the monopoly should extend to overseas telecommunications. "They have reached this conclusion," says the White Paper, "because, with the rapid technological developments that are taking place in this field, overseas and inland telecommunications systems are becoming increasingly integrated from the operational point of view. For example, the International Subscriber Dialling and national Subscriber Trunk Dialling networks

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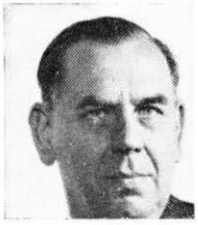
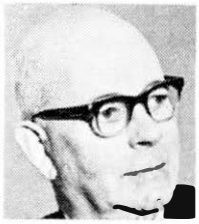
THE FIRST MOVES IN MANAGEMENT


Mr. Ryland


Mr. Wolstencroft


Mr. Merriman


Mr. Harnden


Mr. Weaver


Mr. Baillie

THE first move in bringing Post Office management structure into line with future needs was made when the Postmaster General recently announced changes in organisation and titles of senior management.

Mr. A. W. C. Ryland (formerly Deputy Director General, Telecommunications) becomes Managing Director: Telecommunications; and Mr. A. Wolstencroft (formerly Deputy Director General, Posts) becomes Managing Director: Posts.

A new post—that of Senior Director of Telecommunications—has been created and the title of Engineer-in-Chief disappears to be replaced by a Senior Director of Engineering. The titles of Deputy Engineer-in-Chief and Assistant Engineers-in-Chief are changed to Director of Engineering and Deputy Directors of Engineering respectively. Under the new arrangement, the Senior Director of Engineering is responsible to the Managing Directors for engineering matters and the Senior Director of Telecommunications is responsible to the Managing Director: Telecommunications for all non-engineering aspects of both inland and overseas telecommunications.

Announcing the changes in Parliament on March 15, the Postmaster General, Mr. Edward Short, said that these changes will be followed by others affecting the Post Office from top to bottom. The guiding principle will be to give each of the two businesses—telecommunications and posts—its own supporting services and at the same time to avoid costly and unnecessary duplication. The present all-purpose regional organisations will be split into separate postal and telecommunications regions.

"These changes will begin the process of creating a more dynamic, coherent and purposeful management structure," Mr. Short added. "They will speed the drive to give better service and improved productivity."

The PMG stressed that the re-organisation was not a reflection on Post Office engineers. "They are a very talented group of people and are among the best in the world," he said. "In a growing industry like telecommunications, with its dependence on technological advance, the place of the engineers in the Post Office is assured and will undoubtedly grow. But it must be made clear that they are part of an organisation which is responsible to the Managing Directors and, through them, to me."

The new Senior Director of Engineering is Mr. J. H. H. Merriman (formerly Deputy Engineer-in-Chief). Mr. A. B. Harnden, formerly Director, London Telecommunications Region, becomes the first Senior Director of Telecommunications. He is succeeded as Director, LTR by Mr. E. W. Weaver, formerly Deputy Director, LTR. Mr. J. Baillie (formerly Finance Officer in the same region) becomes Deputy Director, LTR.

are interdependent to the point where, to the user, they are virtually one system."

Staff Affairs

The White Paper says the Government have reluctantly decided that it will not be practicable to offer the staff an option to choose either to transfer to the Corporation or remain in the Civil Service. Nevertheless, the Post Office is prepared to consider sympathetically ways of moving individuals into the Savings Department, the residual Ministry or other Government Departments where there are suitable vacancies. The transfer of existing staff to the Corporation will present a unique problem because of the number involved and because most are providing essential services. Consultations were already taking place with staff associations but many issues had still to be discussed.

The Government have, however, already given undertakings on four issues.

First, between now and vesting day all Post Office staff will continue to be Civil Servants and treated as such.

Second, negotiations on conditions of service will begin as soon as the Corporation has been established.

Third, subject to manpower needs and fitness and efficiency, the Corporation will give a high degree of security of tenure and there will be no arbitrary system of hire and fire. ("There is no reason for transferred staff to feel insecure—especially as the total manpower demands of the Corporation are likely to increase," says the White Paper.)

Fourth, existing Civil Servants will be entitled to opt to have the superannuation benefits they

would have enjoyed had they not been transferred and all reckonable service before transfer will be counted as reckonable service for the purpose of the Corporation's arrangements.

Scope for More Initiative

The White Paper emphasises that managers at all levels will have a greater degree of personal responsibility and that "this greater scope for initiative and the most stringent requirements in assessing performance . . . will be widely welcomed within the Post Office.

"Without detriment to the responsibilities of managers to manage, the Government will expect the Corporation to promote the most constructive relationships between management and staff. The new Corporation will not be taking over an industry marked by bad industrial relations; on the contrary, a fine tradition of co-operation and consultation between management and staff has been built up in the Post Office . . . the Bill will impose on the Corporation a duty to consult with the staff associations on setting up machinery at all appropriate levels for negotiation and arbitration and for the promotion and encouragement of measures affecting the efficiency of the services and the safety, health, training and welfare of the staff . . . the change in status presents an opportunity for developments in industrial democracy within the Corporation leading both to increasing the contribution of the staff to the efficient running of the services and to increasing the satisfaction of the staff with their conditions and place in the organisation.

" . . . The Government intention is that the two sides, in discussions before vesting day, should review their arrangements and approach to ensure that any weakness is removed. This will be in the public interest and advantageous to management and staff.

"If the contribution of the staff is to be fully effective, some rationalisation of the structure of staff representation, accompanied by a reduction in the number of associations from the present 20 would be helpful both in streamlining and speeding joint machinery and in adaptation to the new organisation. The changes associated with the transformation may assist this process.

"The services which the new Corporation will take over have an exciting future," the White Paper concludes. "The technologies on which they draw are advancing at unprecedented speed and economic and social progress will continually create new openings for their exploitation. The changes are being made to meet this challenge. They will provide a context in which the spirit of service which has inspired the Post Office in the past can be carried forward successfully into the future."

A BRIGHT FUTURE

* * *

TELECOMMUNICATIONS is an expanding industry with a bright future in spite of the present temporary downturn in growth rate, says the recently-published White Paper outlining the Post Office's prospects for 1967-68.

The Government's economic measures of July, 1966, had resulted in a lower growth rate in inland telephone traffic, especially trunk calls, says the White Paper. This trend was likely to continue into 1967-68. Nevertheless, inland trunk calls were expected to grow by about 10 per cent in 1967-68, local calls by seven per cent and inland telex calls by 21 per cent.

International traffic continued extremely buoyant. Telephone calls to the rest of Europe, more than half of them dialled by subscribers themselves, increased by 20 per cent in 1966-67 and this rate is expected to be maintained. Inter-Continental traffic was expanding even more rapidly—by about 23 per cent a year.

The White Paper makes the following points:—

Telephone Service

This is generally good but not everywhere as good as the Post Office would like, due mainly to congestion (especially in the trunk service where traffic has almost trebled since STD was introduced) and late deliveries of equipment. Improvement in quality of service is a first priority. Clearing congestion is a formidable task and likely to be a continuing problem in 1967-68.

Trunk Network

Some 9,000 circuits (a 16 per cent growth) will be added in the coming year. A further 65,000 shorter-distance junction circuits (11 per cent growth) will be provided. These will be more than enough to meet the expected rise in

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traffic and help to reduce the backlog and relieve congestion.

Telephone Exchanges

The big bottleneck in meeting demand is the telephone exchange situation. Some 120 new exchanges and 515 extensions are expected to be completed during the year and contractors will start installing equipment for 150 new exchanges and for extending about 410 existing exchanges in 1967-68. However, many delivery dates for exchange equipment are lagging. Until contractors step up their output the position will remain less than satisfactory.

Local Lines

Sufficient lines to meet expected longer-term growth are planned to be added to local networks connecting subscribers' premises with telephone exchanges.

Subscribers' Circuits

Orders for about 1,200,000 connections are expected to be met in 1967-68—840,000 by new provision and 360,000 by taking over existing installations. The net increase will be 485,000, bringing the total connections by March, 1968, to 7,295,000 compared with 6,810,000 on 1 April, 1967. By the end of 1967 the total number of telephones, including extensions, will be more than 12 million—an increase of 750,000 compared with the total at the end of 1966. Speed of provision of service continues to improve. By the end of 1966 about 57 per cent of all exchange connections were completed within two weeks.

Waiting List

At the end of December, 1966, this was 122,000 of which 106,000 were waiting for exchange equipment, 9,000 for lines to an exchange and 7,000 for both equipment and lines. Another 98,000 applications for service were being negotiated or met. "Inevitably, the situation depends on the amount and incidence of demand in relation to local availability of plant," says the White Paper. "No dramatic change in the total waiting list can be expected until the exchange equipment position improves."

Electronic Exchanges

Three more small-to-medium size electronic exchanges will come into service in 1967 and another 30 in 1968. After that, the number will build up rapidly. Electronic exchanges are already being ordered exclusively for all small-to-medium sizes. A production model of a large electronic exchange and electronic equipment for extending existing electro-mechanical exchanges are about to go on field trial.

Automatisation

More than a third of the remaining 240 manual exchanges will be converted to automatic working and trunk dialling facilities will be extended to a further 10 per cent of subscribers in 1967-68. By March, 1968, more than 97 per cent of customers will have automatic service and some 80 per cent will be able to dial their own trunk calls.

Telex

It is expected that there will be more than 19,000 lines by the beginning of 1967-68 and that over 3,000 will be added in the year.

Buildings

Work is expected to begin on 200 new telephone exchange buildings and on 20 new engineering centres and workshops.

Overseas Telephone Service

About 450 additional circuits will be required in the overseas network in 1967-68 to carry increased traffic. Over trans-Atlantic cables capacity is being stepped up by the use of the Time Assignment and Speech Interpolation (TASI) equipment which enables more calls to be made simultaneously over a given number of circuits. International subscriber dialling will be extended to Austria, Denmark, Italy, Norway and Sweden.

Satellite Communications

A new satellite earth station is being provided at Goonhilly, including a second aerial which will work to a new stationary satellite to be launched over the Atlantic in 1968. The new satellite will allow simultaneous telephone communication to be set up with countries in North and South America, the West Indies and Africa. It will also handle television programmes. The present aerial will be given additional equipment enabling it to operate to another new stationary satellite over the Indian Ocean and provide communication by satellite to Australia, India, Pakistan, Ceylon, Japan and the Far East generally. Goonhilly will then become a focal point for satellite communication with direct access to almost the whole of the world.

Finance

The fall in the return of capital for telecommunications (an estimated 7.2 per cent in 1967-68 compared with an estimated 7.6 per cent in 1966-67) was disturbing. General stimulation of demand for service and of traffic as a way of improving financial performance was impracticable so long as shortage of equipment persists. But the scope for selective stimulation was being urgently examined. The finances of the services were also being thoroughly scrutinised.

"The introduction of a new organisational structure and the intensification of productivity improvement programmes and the continuing application of new practices and methods and better management techniques are part of this process," the White Paper concludes. "Once this has been done, the problem of achieving a sound relationship between prices and costs will be tackled."

Re-Organisation

"The right kind of organisation is vital to the future well-being of the Post Office . . . and the first steps towards a fundamental re-organisation will be taken in 1967-68," says the White Paper. "At the same time special attention is being paid to productivity. The planned investment in new equipment and so on and the new pattern of organisation will contribute to improved efficiency. So will the application of the many technical projects now being studied and developed. Complementing all this, the Post Office is now about to intensify its productivity improvement programmes . . . to keep down costs and to make the best use of manpower."

★

A National Data Processing Service Plan

The Post Office plans to set up a national data processing service, based on an interlinked network of computers in major cities, for use by private firms.

Introducing a Bill in Parliament to give the Post Office the necessary powers, the Postmaster General, Mr. Edward Short, said that such a service would be an important extension of Post Office activities.

"Computer usage in this country is much less than it should be," said Mr. Short, "The Post Office has about £4 million worth of computer equipment already installed and working. By 1971 we aim to have 20 large modern computers in operation up and down the country . . . There is, therefore, a firm base on which to build a national data processing service capable of meeting a wide variety of customer needs.

"I am sure this new service would meet a widespread need, especially among the smaller businesses and organisations which are unlikely to be able to justify computers of their own."

The Postmaster General emphasised that the Post Office would not have, or seek, a monopoly of data processing facilities and would offer its services on a wholly commercial basis.

The Bill announcing the plan had received its second reading and was due to go before a Committee of the House of Commons as the *Journal* went to press.

★ We hope to publish a full account of the plan in the Autumn issue of the *Journal*.

. . . AND A NEW TRANSIT NETWORK

The Post Office has placed orders for the first five of 36 new telephone switching centres to be set up during the next five years in a new transit network which will widen the scope of the Subscriber Trunk Dialling system. The orders, which total more than £1.8 million, are for complete crossbar equipment for transit switching centres at Birmingham, Leeds, Reading, Leicester and Manchester.

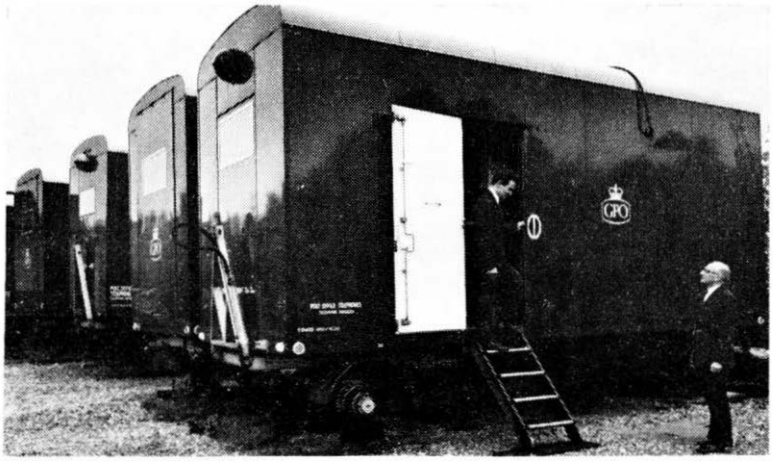
The plan to install the 36 special exchanges (at a cost of about £6.5 million) is part of the Post Office drive to cope more effectively with ever-increasing trunk traffic. The switching centres will be linked by a new high-speed network of trunk lines so that subscribers on even the smallest and most remote exchanges can dial most, if not all, their numbers. The new transit system should be in operation throughout the country by the end of 1972. It should produce savings of several million pounds a year in the cost of providing operator services and give all subscribers full access to a quicker STD service.

★ The *Journal* hopes to publish an article describing the new transit network in the near future.

Mobile Exchanges Make Their Mark

The Post Office's fleet of mobile non-director exchanges is to be increased. They will continue to play a big part in providing telephone service in areas where manual exchanges are exhausted or where equipment at automatic exchanges is already fully in use

By S. WRIGHT



An MNDX site in the Home Counties. Each MNDX is a self-contained unit mounted in a trailer-caravan and can provide service for up to 400 lines. The latest versions of MNDX can give full STD facilities.

THE Post Office will shortly be receiving 50 more mobile-non-director exchanges (MNDXs). They will be added to the existing fleet of 117 throughout the country as part of the sustained drive to provide telephone service for customers who would otherwise have to wait much longer until permanent equipment can be installed.

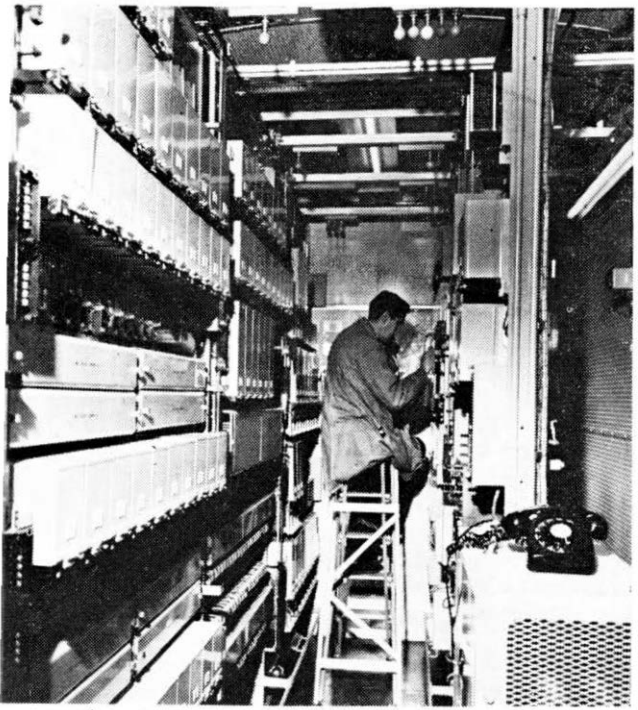
These new mobile exchanges, designed and developed by Post Office engineers, were introduced in 1963 to relieve automatic exchanges where all the equipment was already in use or to extend the last few years life of a manual exchange where it would be wasteful or impracticable to provide additional manual equipment.

Each MNDX-self-contained unit mounted in a trailer caravan—can provide service for up to 400 lines and later versions provide full STD facilities. Special tandem units, of which there are at present 23 in operation—can be used to link two or more MNDXs or provide tandem switching facilities for other purposes, for example, traffic between unattended automatic exchanges.

At the same time, new transportable racks, designed as 200-line units and intended to supplement automatic equipment at existing exchanges, were also introduced. Subscribers' calling equipments and multiple only are provided. The equipment is grafted on to an existing exchange to make use of the available intermediate switching capacity.

The new mobile exchanges and transportable racks have together made an important contribution towards enabling service to be given where demand has exceeded the capacity of the existing exchange equipment particularly in South East England. By the autumn of 1965, the territory then known as Home Counties (now split into the Eastern Region and South Eastern Region) contained about one third of the national equipment waiting list and for this reason received a major share of the national production of MNDXs and transportable racks—about 60 per cent of the former and 30 per cent of the latter.

The two regions have now received almost all the transportable racks they need but more MNDXs are required. Use of this expedient equipment is likely to reach a peak during the autumn of 1967, when the number of MNDXs and racks in service is expected to provide a total of 60,000 multiple.



A maintenance engineer tests the equipment inside a typical 400-line MNDX.

Even more dramatic is the impact of the new equipment on individual areas where rapid growth has resulted in an acute shortage of exchange equipment. In the Canterbury Area, for example, the equipment waiting list in the autumn of 1966, would have risen to about 10,000 had MNDXs and transportable racks not been brought into use.

The use of composite racks is the simplest means of providing interim relief at an exhausted automatic exchange if conditions are suitable. Accommodation must be available to house the racks without prejudice to the next normal equipment extension. Full utilisation of a rack requires the use of two spare levels of the penultimate rank of switches so that the number of spare levels limits the number of racks that can be used. Finally, there must be adequate traffic capacity to accept the traffic generated by the additional customers connected to the rack.

This last limitation has not proved a serious impediment in practice and need not do so as long as use of the racks is limited to residential customers with a low calling rate.

At an exchange where growth of business connections is substantial, very careful husbandry of the normal exchange equipment particularly uniselectors is necessary in the period before the racks are introduced. Each rack requires 20 uniselectors in the normal exchange equipment to which the 200 calling equipments of the rack are connected by way of the rack line finders. These uniselectors must be reserved together with sufficient equipment to meet expected business growth. This may mean restricting residential growth at an early stage. To neglect this precaution may lead to a situation in which it is possible to offer service to residential but not to business applicants—which is clearly unacceptable—or the rack must be used to serve business applicants, thus limiting its capacity for connections to a fraction of the designed figure of 200.

One reason for introducing MNDXs was to relieve manual exhanges which had reached the point of exhaustion before conversion to automatic working was possible. In the old Home Counties Region they have been found effective in this role although, in the event, only a small number have been so used because of the overwhelming demand for relieving exhausted automatic exchanges.

Typical use of MNDX equipment to relieve an exhausted manual exchange is in an area served by a CB 10 exchange where conversion to automatic had been delayed by site difficulties. No further manual extension was practicable so relief was provided by MNDX equipment. Four MNDX units and one tandem unit have so far been provided, being located at the rear of the Head Post Office which houses the manual exchange.

The exchange is not expected to be converted until 1970. For this reason it is planned to increase the capacity of the relief exchange, if necessary to eight MNDX and two tandem units to meet growth until then. Used in this fashion, the MNDX equipment functions as a remote non-director exchange with its own name and numbering range. Normal parent manual or automanual board services are required and if these have to be provided by the manual exchange the effectiveness of the relief is much reduced. A more satisfactory scheme

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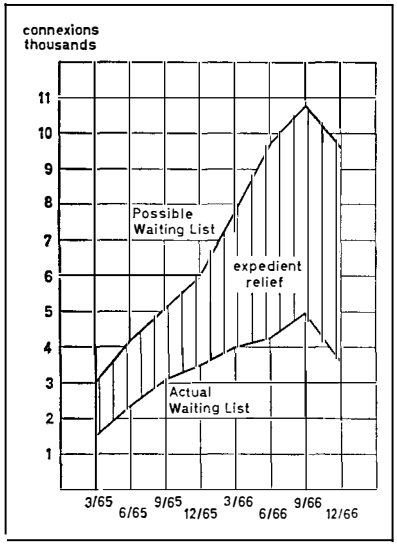
is possible if parent manual board traffic can be handled elsewhere, or direct dialling provided to a neighbouring automatic exchange, or exchanges, with a strong community of interest.

More than 60 per cent of the MNDX equipment in service in the Eastern and South Eastern Regions has been used to provide relief for exhausted automatic exchanges until a normal extension can be brought into service. Normally, this type of relief is provided where the use of racks is impracticable. In a few instances, mixed relief using both racks and MNDX equipment is in service. This has provided an apt solution where the growth of business connections posed a problem—the racks accommodating residential growth while the mobiles, with their more adequate traffic capacity, cope with business growth.

As a rule, the MNDX is used to establish a relief non-director exchange sharing the same automanual parent and linked to the relieved exchange by a junction route permitting interdialling. The relief exchange has, of course, a separate identity and numbering range. This has the disadvantage that on provision of the normal extension the connections served by the MNDX suffer a change of telephone number. In a few instances it has been found possible to integrate the MNDX equipment with the normal equipment at the relieved exchange and avoid the difficulties inherent in the establishment of a relief exchange with a separate identity



This graph shows the effect which MNDXs have had on the waiting list in the Canterbury Area.

One of the main considerations in deciding on the feasibility of MNDX relief, whether for a manual or an automatic exchange, is the existence of a suitable site. The site must be physically capable of accommodating the required number of caravan trailers, each of which is 13 feet high and 22 feet long and weighs seven tons. It must also be so located in relation to the local cable network that new customers can be connected without inordinate expense in cabling. Most often MNDXs are set up on concrete or other hard surfaced sites as close as possible to the relieved exchange. Occasionally, when an exchange is scheduled for conversion a new site is already available and CL cabling has been or will be provided in the normal way.

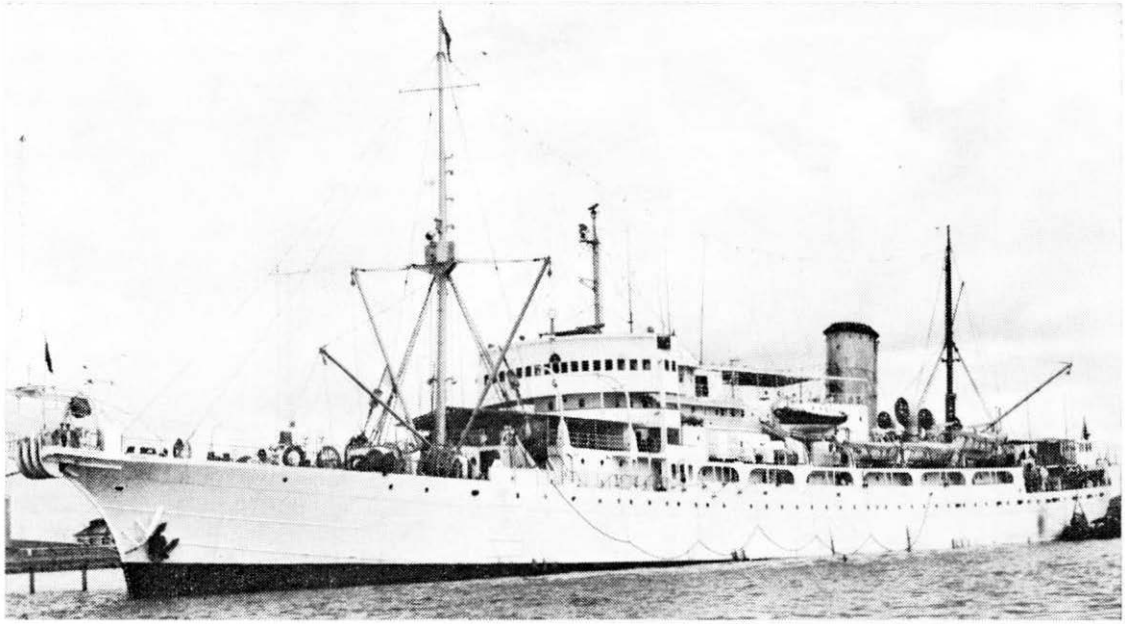
The essential feature of the MNDX is that it is mobile, and of the rack that it is transportable. Repeated use of the same unit in different locations is necessary to secure both an effective service and a reasonable return on the considerable capital invested in expedient equipment. Planning poses intricate problems both in the initial deployment of the units and in the all-too-frequent changes necessitated by changing circumstances. Once a unit is in service it cannot be released until the customers connected to it can be transferred to normal equipment. Any delay to, say, a contract exchange extension would prejudice the release of expedient equipment and disrupt a carefully planned sequence of re-use at a number of other exchanges.

The removal in due course of the present backlog in exchange equipment provision will together with new planning techniques, alter the scope for the use of mobile exchanges, but they are expected to have a permanent place in the system as a means of catering for sudden unforseen growths, giving service in new towns and housing estates, and assisting in the conversion and replacement of exchanges. Larger and more flexible mobile exchanges using electronic switching equipment are now being planned.

THE AUTHOR

MR. S. WRIGHT *joined the Traffic Staff of the Post Office at Manchester in 1935. He has seen service in the Aberdeen and Belfast Telephone Areas and in ITD and is at present Senior Assistant Telecommunications Controller at South Eastern Regional Headquarters.*

SEACOM IN SERVICE

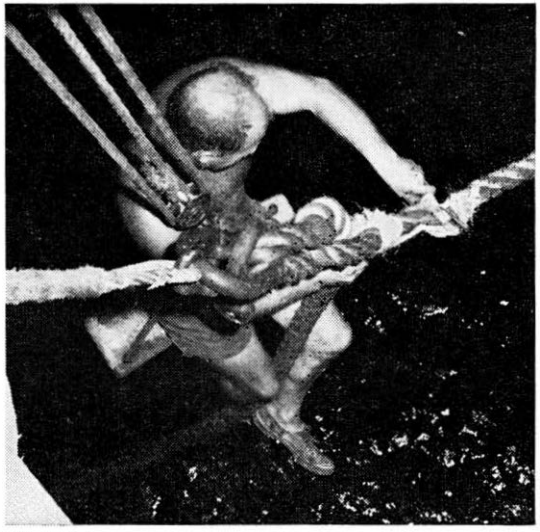


The Post Office cable ship, HMTS Monarch, *which laid more than 1,000 nautical miles of SEACOM. Here she is seen off Singapore, awaiting the arrival of the Cable and Wireless Ltd's* Mercury *before setting out to lay the link between Jesselton and Singapore. Below: A seaman on* Monarch *cuts the holding bridle before slipping the final splice of the Jesselton-Singapore section.*

IN the early hours of Thursday, 30 March, the recorded voice of the Queen flashed over 23,000 miles of submarine cable from London to Hong Kong.

SEACOM (the South East Asia Commonwealth Cable)—third link in the Commonwealth Cable system which spans the Atlantic and Pacific Oceans, the Tasman Sea and the Coral and China Seas, was officially open.

SEACOM, a 7,000 nautical mile cable linking Australia with Singapore by way of New Guinea, Guam, Hong Kong and North Borneo, took three years to complete. The first stage—between Singapore and Hong Kong—came into service in March, 1965, and the second—from Hong Kong to Guam—in August, 1966. The final joint and splice on the third stage between Guam, Madang and Cairns (Australia) was made by the Post Office Cable ship HMTS *Monarch* in January, 1967.



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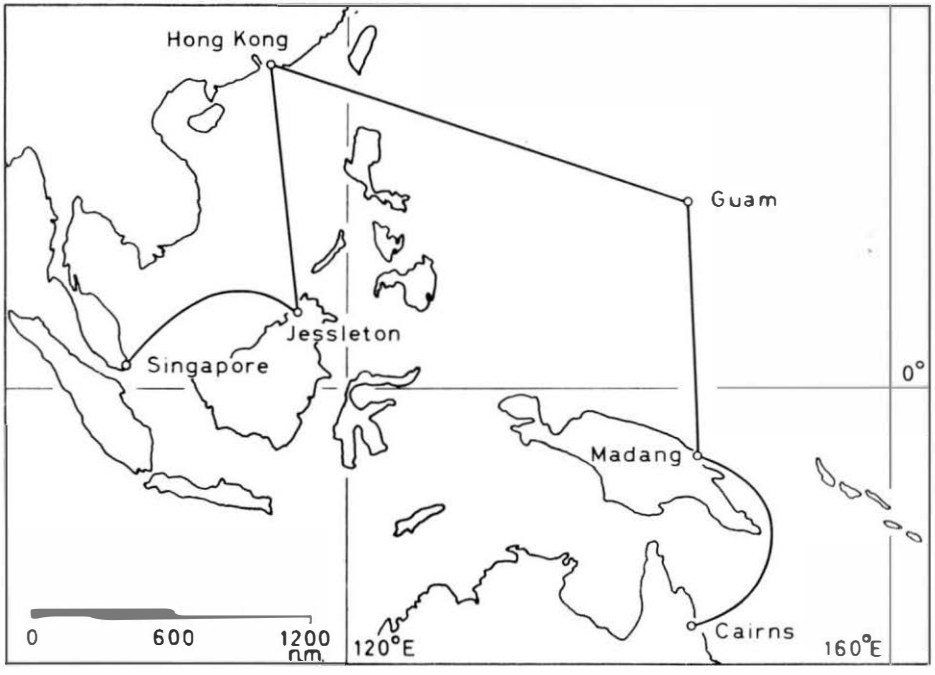
The Australian Postmaster General, Mr. A. S. Hulme, in Sydney, talks to the PMGs of other Commonwealth countries during the opening ceremony.

This latest link in the Commonwealth Cable Scheme is connected to the COMPAC (Commonwealth Pacific) Cable running between Australia and Canada by way of New Zealand, Hawaii and Fiji. COMPAC, in turn, is linked to the CANTAT (Trans-Atlantic) Cable by way of the trans-Canada microwave system. Thus, for the first time, Britain is directly connected by telephone with most of the Commonwealth countries over Commonwealth links.

"This cable route is an entirely Common-



The map shows the route of the SEACOM cable, the 7,000 - mile link between Australia and Singapore.

The Acting Prime Minister of Singapore, in Singapore, talks to his opposite numbers in other Commonwealth countries.

wealth venture," said the Postmaster General, Mr. Edward Short, during the SEACOM opening ceremony. "Good communications must inevitably bring members of the Commonwealth closer to one another and anything which strengthens Commonwealth links is good not only for the Commonwealth but also the whole world. The amazing efficiency of this new link is a tribute to the engineers who designed and built it and an important advance in telecommunications across the world."

SEACOM provides a capacity of 80 telephone circuits between Singapore and Guam and 160 between Guam and Cairns. It incorporates 356 submerged repeaters and was laid by Monarch *(on loan to Cable and Wireless Ltd) and the Cable and Wireless fleet* Mercury, Enterprise *and* Recorder. Monarch *laid 1066 nautical miles and 64 repeaters. Part of the cable crosses the Mariana Trench, the deepest-known submarine chasm in the world. At this spot* SEACOM *lies in a depth of 4,900 fathoms (about 5.6 miles).*

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MORE NORTH SEA CABLES

FOUR new submarine cables linking Britain with Belgium, the Netherlands, West Germany and Scandinavia have been recommended by the North Sea Cable Conference meeting in London recently.

The proposed new cables are of a new design and each has a capacity of 1,140 telephone circuits—more than double the capacity of any submarine cable system anywhere in the world. The new cable system has been designed and developed by engineers at the Post Office Research Station, Dollis Hill.

The first of the new cables—to West Germany—is expected to be in service before the end of 1970 and the others are planned to follow at yearly intervals.

The seven countries represented at the Conference were Britain, Belgium, the Netherlands, West Germany, Denmark, Sweden and Norway.

The *Journal* proposes to publish a fuller article describing the new system as soon as possible after all the administrations concerned have confirmed the recommendations.

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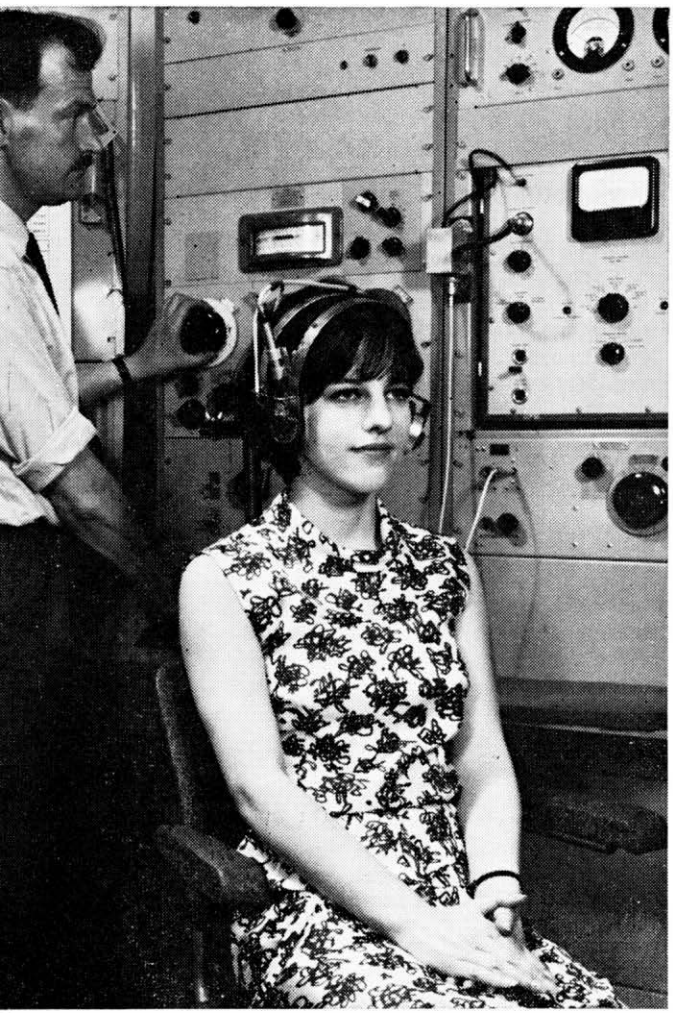
Lincompex (Linked Compressor and Expander) equipment is soon to be introduced on radiotelephone circuits between London and India, Ceylon, Kenya, Nigeria, South Africa and a number of other overseas terminals.

The Lincompex system (see the Summer, 1965, issue of the *Journal*) improves the quality and efficiency of radiotelephone circuits, eliminating variations in speech volume and timbre caused by fading and suppressing radio noise. The equipment was designed and developed by Post Office engineers.

Human Factors In Telephony

By E. W. AYERS, BSc. (Eng) MIEE
and F. E. WILLIAMS, MSc. (Eng) FIEE

The Post Office has set up a special committee to study the effects of human factors on the telephone system. In their experiments, the study teams carry out a wide ranging series of tests designed to find out the users' difficulties and to suggest ways of overcoming them



Assistant Executive Engineer E. G. T. Johnson measures the acoustic impedance of the ears of Drawing Office Assistant, Miss M. Bird.

HUMAN Factors Engineering is concerned with the interaction of human beings with their environment, especially the complex man-made environment of this technological age. The varied services provided by the Post Office are a part of this environment and, if they are to be of maximum benefit to the community, regard to possible human factors problems must be given at all stages from planning a service to its daily operation.

The interchange of information between man and machine—for example, obtaining the required number on an automatic telephone system—is a classic begetter of human factors problems. In the early days of the telephone the subscriber was scarcely aware of the machine. All he had to do was ask the operator for the number he wanted and wait while she got it for him.

As the telephone network grows, however, its complexity increases and gives rise to questions to which the answers demand close co-operation between communications experts and human factors specialists.

In recent years the growth in human factors problems on which the Post Office needs advice and assistance from specialists, or where existing knowledge is inadequate, has been such that a central Human Factors Research Committee has been set up.

Under the chairmanship of the Director of Research, the Committee has a wide representation drawn from administrative, operational and engineering interests inside the Post Office. Its functions are to promote a general awareness of the importance of human factors throughout the system, to make specialist advice available where needed, to initiate basic studies in areas where ignorance exists and to co-ordinate activities to avoid overlapping. The Committee does not carry out re-

Technical Officer R. Else measures with a microphone the speech sound pressure around the head of Mrs. P. Edmond, an Assistant Factory Technician.

search work directly but serves rather as a clearing house ensuring that the problems are passed on to those most expert to deal with them.

Studies relating to specific applications are undertaken by teams already concerned with other aspects of the activity or service, and much of the subjective testing (laboratory experimentation using human subjects) is carried out at the Post Office Research Station at Dollis Hill. Here teams of research engineers and scientists have conducted experiments on many aspects of the communication of speech by way of telephone links, on the subjective effects of signal distortion on the quality of television pictures and on the causes of subscribers' dialling errors to name but a few of the many fields explored.

Help in the relevant specialised fields of applied psychology, physiology and ergonomics is available from the Applied Psychology Research Unit of the Medical Research Council at Cambridge. The Deputy Director of this unit, Dr. R. Conrad, acts as honorary consultant to the Post Office. Besides giving expert advice on a wide range of problems, Dr. Conrad has also carried out a major research investigation, in co-operation with the Postal Mechanisation Branch, into problems arising from the development of keyboard-operated letter-sorting machines.

This investigation centered on the design of codes and coding procedures suitable for sorting letters and included research leading to the design of an actual keyboard. Subjective tests were carried out with staff and union co-operation in sorting offices at Liverpool and Norwich, and studies were also made of the effect on the operator of the duration of operating spells on the letter-sorting machine.

Dr. Conrad has also given advice on ergonomics problems arising in the design of such items as cordless switchboards, engineering test desks and turntable filing systems and has carried out subjective tests at Cambridge, using local volunteers as subjects, to find the best keyboard arrangement for a push-button telephone.

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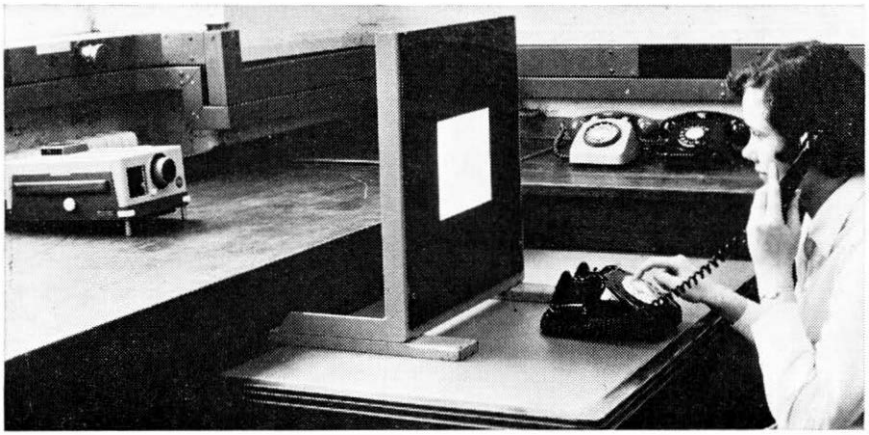
Miss Yvonne Gordon, of the Speech Test crew, takes part in a sound articulation comparison of different telephone instruments.



Assistant Experimental Officer Miss Janet Stammers, taking part in a dialling experiment. The number to be dialled is projected on the screen in front of her.

How are these subjective tests carried out and what are the pitfalls? A typical example is the series of experiments performed at Dollis Hill to ascertain which features of the telephone dial affect the subscriber's liability to make dialling errors.

When the 700-type telephone was introduced, a change was made in the display of the letters and numerals around the dial. Other changes which might also be relevant were that the whole dial was mounted at 30 degrees to the horizontal instead of at 40 degrees, and that the finger plate was made of thick coloured PVC sheet instead of thin stainless steel. The simple questions posed by the administration were: "Do subscribers make more dialling errors on the new telephone than they did on the old; and if so, why?

In a laboratory experiment of this kind the first requirement is a large number of willing subjects, covering a wide range of ages and occupations and preferably with no specialised knowledge of the items under test. The Dollis Hill establishment totals about 1,300 and includes a large number of different Post Office grades. Most of them will happily come along to the laboratory for a half-hour (say, once a year) to take part in a simple test which can often be arranged to look like a game.

To compare different telephonedials, eachsubject clearly has to be persuaded to dial several telephone numbers on each dial and the time he takes to do it and the errors he makes have to be recorded. If the subject knows that the main objective of the test is accuracy he will be very careful and make no errors. It is necessary, therefore, to devise a more realistic situation in which the subject concentrates on some other aspect and the dialling becomes only an incidental part of the procedure.

Obviously, he will gain experience as the test proceeds and his performance on the test items will be coloured by the order in which they are presented to him. Some seven-figure telephone numbers are easier to dial than others and the list of numbers he is asked to dial will also have a bearing on the errors he makes. It is necessary, therefore, to design a completely balanced experiment in which each test item appears the same number of times in each order of presentation and in which each list of telephone numbers is dialled the same number of times on each item. This design of experiment is most suitable for comparing either two or four slightly differing test items.

After experimenting with various ways of stressing the subject, the simplest and most effective method was found to consist in making the subject remember the number he was to dial. Initially, a seven-digit London telephone number was displayed by back-projection on a small screen. The subject was allowed to study this as long as he wished but the instant he started to dial, the display was switched off.

To obtain statistically-stable results it was found necessary in each experiment to use not fewer than 120 subjects, each of whom was asked to dial ten seven-digit numbers on each test telephone. These figures indicate the size and cost of human factors experiments. In

these particular experiments the spread of the results was such that it was only by including a large number of observations that meaningful results were obtained. Telephone dials, being fairly cheap mechanical devices, vary in smoothness and 'feel' and this could easily bias the comparisons. As a further precaution, therefore, several examples of each dial were used in rotation in the tests.

These dialling tests have led to the firm conclusion, deducible from the first experiments and explicitly confirmed in later tests, that the only significant change in the dial of the Telephone 706 was the introduction of the outside number ring, with the omission of the letters and numbers from the finger holes. The other factors—angle of mounting and material and colour of the finger plate—were shown not to be significant. But it was confirmed that the outside number ring was responsible for a greater number of dialling errors.

In the first comparisons, in 1962, the ratio of errors on the new and the old telephone sets was approximately two to one. However, in successive experiments carried out in 1963-1965 to diagnose the precise reason for the difference, a gradual decrease in this ratio was observed. A fresh batch of subjects had been used for each experiment and the only explanation for the decline was seen to be the increasing familiarity of the public with the new dial. In 1962 many of the subjects were meeting the new dial for the first time. By 1964-5 it had become as familiar as the old one.

These dialling tests illustrated a major difficulty in conducting any human factors experiment in which something new and unfamiliar is compared with an established and familiar item. Unless a protracted period of learning is allowed on the new item, comparison can be misleading.

An example of an experiment designed to allow for a learning effect is that carried out to assess the probable performance of a dial which has a novel type of finger plate with open-ended spokes instead of finger holes. A small group of subjects repeatedly dialled blocks of numbers alternately on the standard and on the experimental dial. After each day's session the average dialling times for the two were compared. As the experiment proceeded, the times become progressively shorter but the standard dial continued to maintain its superiority over the experimental dial.

In the Dollis Hill laboratory, a panel of viewers assess the effects of distortion of a TV picture.

With the expansion of the Post Office services and the spread of mechanisation and automation, the study of human factors problems arising in the interface between user and machine will become increasingly important. There is a natural tendency for such studies to be undertaken rather late in the day—usually after the user has complained of difficulty rather than before the item is put into service. The difficulties encountered with the 700-type telephone dial are an example of this, but the designers might reasonably have expected that the introduction of the outside number ring, with its larger letters and numerals, would have made the dial easier and not harder to use correctly.

Nevertheless, much can be learned from subjective experiments and the establishment of the Human Factors Research Committee has made it easier for Departments with problems to gain access to expert advice. Here the Post Office is particularly fortunate in being able to draw upon the experience of the Medical Research Council's experts at the Applied Psychology Research Unit at Cambridge. In the field of telephony a third international symposium has recently been held at which information on human factors problems has been freely interchanged between administrations.

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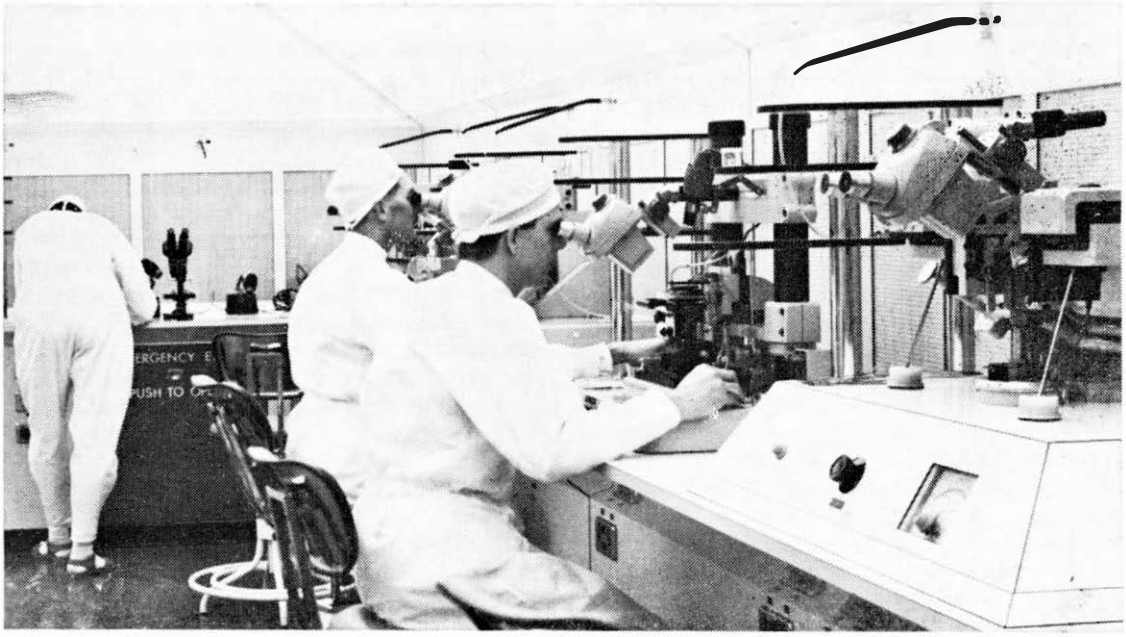
At the end of March, 1967, the number of combined television and sound radio licences in Britain and Northern Ireland was 14,267,271.

MAKING TRANSISTORS AT DOLLIS HILL

One of the many little-known and very specialised tasks carried out at the Post Office Research Station is making the highly-reliable transistors for the latest submarine cable repeaters

By A. G. HARE, BSc. (Eng), C.Eng, MIEE
and A. W. SEARLS, C.Eng, MIEE

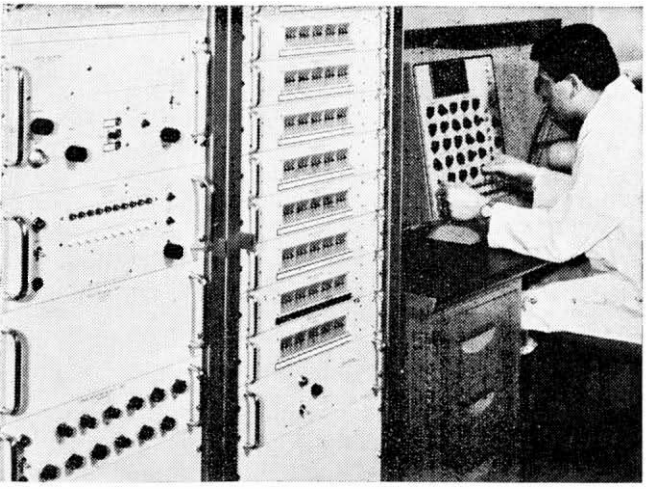


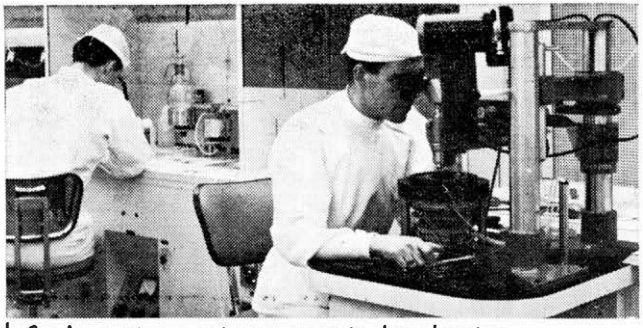
Operators at work in the special clean room where the air is continuously filtered.

IN the go-ahead Post Office telecommunications industry it is not unusual to find a group of engineers designing and manufacturing tools and equipment when there are no suitable items available to meet their immediate needs.

This, in fact, is the story behind the setting up of a unit for transistor manufacture at the Post Office Research Station, Dollis Hill. Transistors were needed for repeater use in several new submarine cable systems. No commercially available transistors were able to meet the very stringent target specification set for performance, so continuing the 'do-it-yourself' policy which proved successful in the development of thermionic valves for repeater use, the Engineering Department decided to make the devices themselves.

The task given to the production unit was to manufacture a transistor with a high order of 'built-in' reliability, specified in terms of permissible limits of performance. The opera-





Left: An engineer using automatic data logging equipment to measure transistors.
Above: In the photolithography section.

tional excellence of the product had to be assured with a high degree of confidence because the new types of deep water amplifiers would be required to work effectively for at least 20 years. Premature failure would mean serious financial loss.

To manufacture a transistor with potential reliability of this order, maximum control over all aspects of manufacture was essential, not only in processing, but also over materials, components, equipment and—vitally—the operators carrying out the work. Comprehensive records and a system of continuous scrutiny had to be established. A recipe was therefore compiled for all production processes, right from the purchase and preparation of materials and piece parts, through the many individual operations and inspections and finally to the device release.

It was necessary to keep records identifying the slice of silicon starting material and showing process conditions and deviations, together with the cumulative history of inspection and sampling. This information had to be available for action, not only during production, but also later, when the comprehensive electrical measurements were studied in conjunction with a 'case history' and an individual photographic record, to enable quality assessment to be made on each finished device. The system of product control planned in this way is working effectively.

The transistor, which is of the silicon NPN type, is fabricated by planar methods in which the various regions are formed by controlled impurity diffusion processes.

Production begins with a 25 millimetre (mm) diameter slice of N-type impurity silicon crystal material of 0.15 mm thickness. The impurity content has been carefully determined and provides a suitable bulk material on one surface of which a 0.015 mm 'skin' is formed by epitaxial growth. Again the material is N-type but it has a different impurity concentration. Since it is in this layer that the active region will be developed, the concentration is chosen to give the desired transistor characteristics.

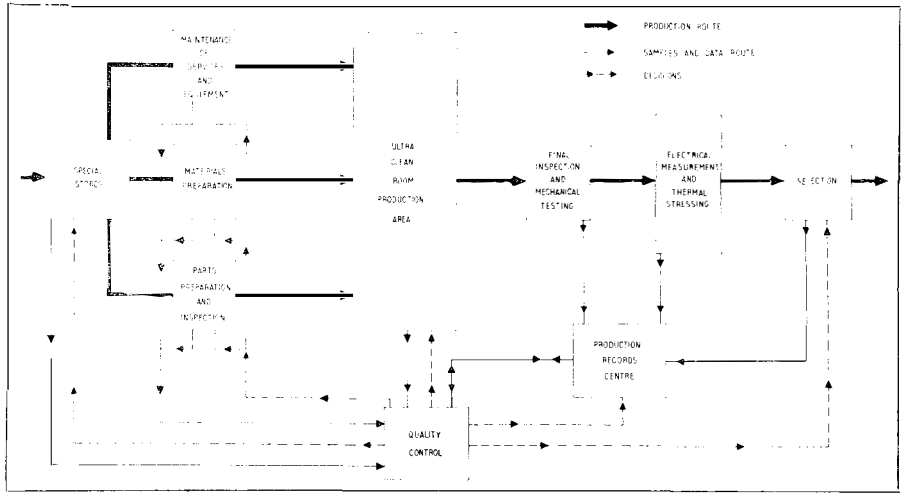
On the chemically clean and mirror-like surface of the prepared slice, a thin layer of silicon dioxide is formed. The function of this and subsequent similar treatments is twofold, firstly to provide a masking medium and secondly to isolate the active areas with a passive surface.

By means of a photolithographic and etching technique, a 20 x 20 lattice of "windows" is cut through the oxide layer to define the regions where 400 transistors will be made on the slice. Boron, a P-type impurity material, is then diffused into these regions under carefully controlled conditions in a furnace running at approximately 1100 degrees Centigrade and forms the first junction of each transistor—the "Base-Collector" junction. The slice is then passivated with a second silicon dioxide layer.

By a similar photo-etching treatment, a region of N-type impurity material, phosphorus, is diffused into new "windows" cut into the centres of the boron doped surfaces to form second junctions—the "Base-Emitter" junctions.

OVER

How the organisation has evolved. Main production route is from stores, through processing to testing and selection. All materials and parts are given separate batch identities.



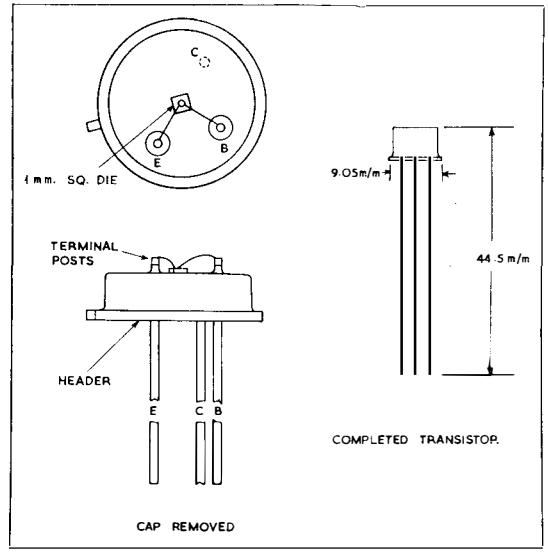
Again the surface of the slice receives passivation in the form of a silicon dioxide layer.

"Windows" are now cut simultaneously into the "Emitter" and "Base" areas to enable aluminium electrodes to be deposited under high vacuum conditions. These form the contact pads to which connecting wires are later bonded.

At this stage, sample electrical measurements are taken on selected devices on the slice. This is done by applying two very fine wire probes to associated "Emitter" and "Base" pads and monitoring the electrical characteristics of the junctions, using the back surface of the slice as the common "Collector". Inspections and measurements of this type are carried out under binocular microscopes and enable production variations to be checked and controlled.

After a high temperature treatment, to stabilise the surface of the slice, the individual 1mm. square transistor dice are detached by scribing the slice orthogonally with a diamond point and breaking the very brittle material, the method is similar to that used to "cut" glass. The dice are next bonded individually to gold plated headers using a silicon-gold eutectic brazing process. Each header has three external wires; one is directly connected to the die as a result of the braze and forms the "Collector" connection, whilst the other two wires terminate as insulated posts near the die. The "Base" and "Emitter" pads are next connected, one to each of these posts by aluminium

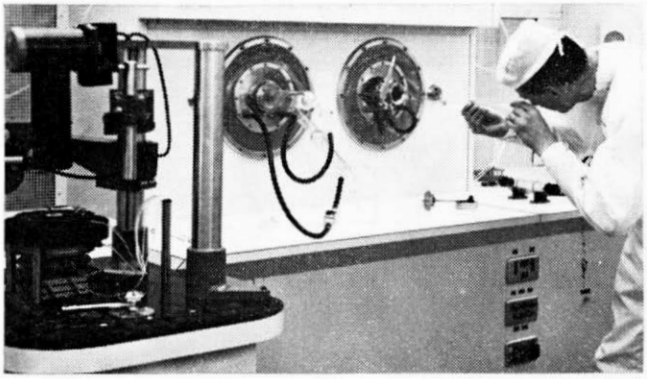
Below: The general construction of a transistor.



wire measuring .001 of an inch in diameter. This is done by a special thermocompression bonding technique developed at Dollis Hill.

The headed device is inspected and photographed under a high power microscope before being capped with a nickel can; this is welded to the header after the components have been baked in dry nitrogen gas. After a final inspection, the finished transistor is ready for its long series of electrical proving tests.

The smallness of the product, its sensitivity



An operator loads the Boron Diffusion Furnace.

to contaminants in processing and the very exacting requirements of the manufacturing technology, show clearly that it was of the utmost importance to create clinically clean working conditions in the process area. To meet this requirement, a special clean room has been constructed. Inside, the air is continuously filtered to remove even very small dust particles. Temperature and humidity are rigidly controlled. A laminar flow of the incoming clean air passes from the wall filters, over the work and then to central exhaust columns, thus ensuring that the working positions remain clean. The special nylon type clothing worn by the operators helps to contain particles shed by the human body and does not itself generate lint. Finally, air-locks to an associated changing chamber ensure minimum disturbance to the clean room conditions when staff enter or leave.

When transistor manufacture was first planned, it had been appreciated that for comparison and assessment purposes in product control, there was a vital need for electrical measurements to be made at several key points in processing. These were required also when the finished transistors were being maintained under simulated operating conditions as part of a reliability assurance programme. On each occasion, information was needed on a minimum of fifteen different electrical characteristics for each device. In order to support quantity production, the measurement system had to be automated, otherwise the staff would have been buried under a vast repetitive measurement load.

The electrical measurements required for production assessment were divided broadly into two categories, a.c. or small signal parameters and d.c. or static parameters, the latter constituting the bulk of the measurement information. To cope with the d.c. measurement problem, an automatic data logging equipment was manufactured specially for the Research Branch. The machine was required to punch out, on a five-track Elliott coded paper tape, a sequence of twelve different "words", each "word" representing a separate d.c. measurement made by the machine on each transistor being tested. The punched tape

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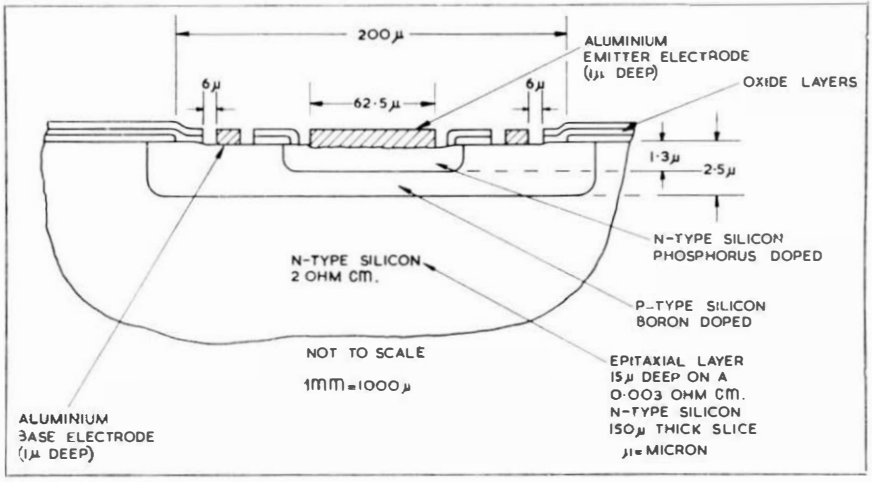


A cross-section of the active "heart" of a transistor.

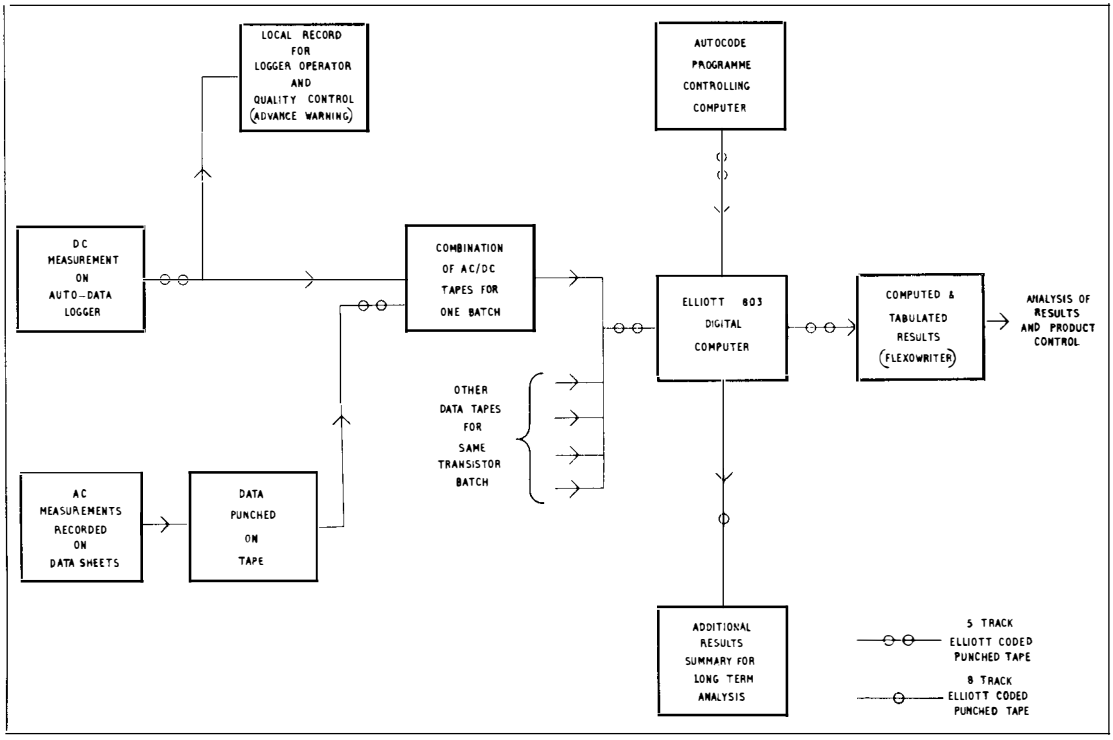
could then be joined to a second, much shorter, tape having a similarly coded record of the a.c. measurements punched out from an engineer's readings.

It was arranged that a batch of up to 50 transistors could be dealt with in this way, yielding a composite continuous tape containing all the information acquired at one stage of measurement and thereby providing a basic "block" for automatic data processing. There would be similar blocks of such data accumulating with each transistor batch as measurements were made in its passage through production and testing. It was necessary to plan a flexible system for "block" comparison.

The system evolved for processing the data tapes has been designed to utilise most effectively the Elliott 803 computer at Dollis Hill. The basic blocks of measurement information associated with one batch are fed in sequence into the computer, together with a programme tape prepared in Autocode by the measurement engineer. The computer produces a "results" tape in which each separate transistor is analysed one parameter at a time; the "block" variations which show its condition at each measuring stage being computed and tabulated. Certain statistical information is also compiled by the computer, for example the mean value of a parameter for a number of devices in a "block" and the standard deviation. Information of this kind enables batch to batch changes to be observed in order to keep a check on the uniformity of the product. Additionally, the computer "looks" at the overall characteristics of each device and grades it as one of four main variants of the specification, summarising the numbers of each kind within the batch.

The machine produces also a second tape output containing a summary of information required for long term analysis of the product data. This is punched in 8-track Elliott code in order to utilise the more flexible processing capability of the computer's ancillary equipment in this mode of operation.

The measurement system has proved to be a powerful tool, the use of which has enabled



This diagram illustrates the system used for processing the transistor measurement data.

A batch of transistors being loaded into an oven for thermal stressing.

the engineers and scientists engaged on the transistor project to produce a device which they are confident will contribute to the reliability of the new generation of submarine cable systems.

Various aspects of production and measurement have been described. Careful control in manufacturing and testing transistors can virtually eliminate 'rogue' failures due to faulty materials or processing. The resulting product has a potentially long lifetime, a bonus derived from the application of silicon planar technology. Failures which then occur are likely to be due to a gradual change in which the electrical performance of the device deteriorates very slowly. This deterioration has been ascribed to diffusion processes which depend on temperature and time. Tests at Dollis Hill indicate that raising the device temperature of the order of 12 degrees Centigrade is equivalent to halving the time to failure. Thus, operation at high-temperature conveniently accelerates failure and enables life test programmes to be carried out in a short time.

After manufacture, therefore, a high proportion of good transistors receive a series of elevated temperature stresses for set periods, individual electrical characteristics being measured in the intervals. Failure criteria applied to these measurements enable data to be accumulated from which to predict the life probability of the remainder of the transistors when released for systems use.

To augment the degree of confidence obtained from this essentially destructive testing, each device selected for repeater use is given a period of operational storage, in which the electrical bias conditions of the service amplifier are simulated. The storage ovens are maintained at a temperature of 50 degrees Centigrade in order to provide a nominally fourfold acceleration above service conditions.

Currently, the transistors for deep water repeater use are stored in this manner for six months, a service equivalent of two years. The electrical characteristics, logged regularly during storage, must remain within set performance limits otherwise release is not permitted.

The combination of statistical confidence by batch testing and a six month's 'pedigree' for each individual device is, we think, a good assurance for the viability of our transistors.

THE AUTHORS

MR. A. G. HARE, BSc (Eng), C Eng, MIEE, *is a Senior Executive Engineer in Research Branch, RB Division. He joined the LTR, West Area in 1938 as a Youth-in-Training and after war service in Royal Signals was transferred to the Engineering Department. He moved to Dollis Hill in 1950 and was for some years in RS Division concerned with the development of electronic data handling equipment for other Departments. He joined the transistor project in 1963 to organise and run the electrical measurement facility for production.*

MR. A. W. SEARLS, C Eng, MIEE, *is a Senior Executive Engineer in Research Branch, RB Division, joining the Radio Branch laboratories at Dollis Hill in 1936. He spent many years developing and producing piezo-electric devices. After a period at work on very high frequency techniques he was transferred in 1961 to set up facilities for semi-conductor manufacture.*

VISUAL DESIGN FOR TELECOMMUNICATIONS

By F. H. K. HENRION
and ALAN PARKIN

The first of two articles describing the importance of visual design in telecommunications and what is being done in the Post Office to achieve the highest possible standards

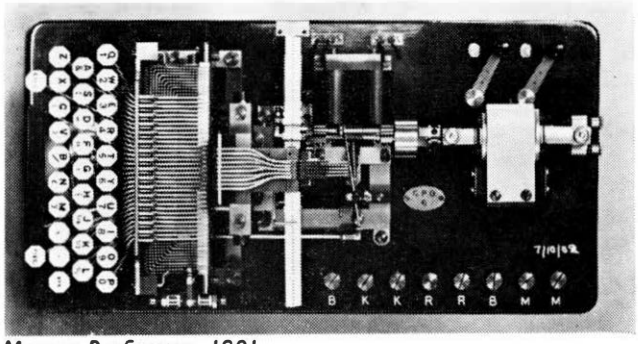
DESIGN is a very important activity in the present-day technological world. Design in the widest sense is deciding and specifying things in advance; and this covers a multitude of fields, from planning whole systems of roads or telecommunications down to detailing hardware. The next big advances in many fields of design wait not upon technical changes but upon a better understanding of the nature and use of design, particularly among those who employ, or could employ, designers.

We wish to draw attention in this, and a following article, to a relatively recent specialisation: visual design. By visual design we mean controlling the appearance of things. It cannot be isolated from mechanical and other kinds of engineering design, but it goes beyond them in considering factors which are outside the field of engineering. Visual design is particularly important at the interface between a telecommunications system and its users. It is also widely misunderstood.

Visual design is always for people: if it makes the relation between product and user easier, then it is good design. If it makes this

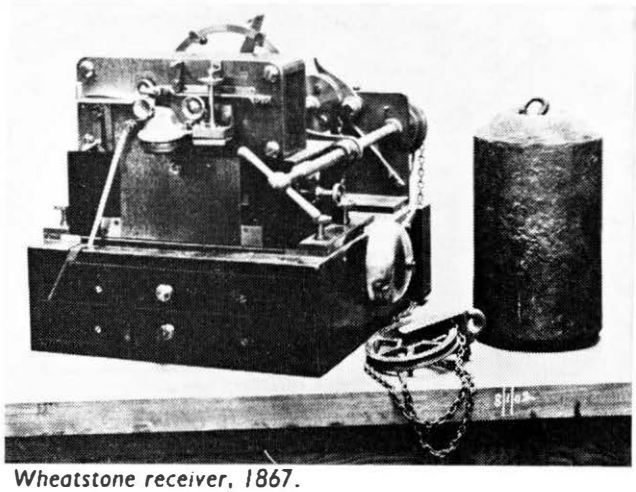
(continued on page 30)

Wheatstone's ABC telegraph, 1840.

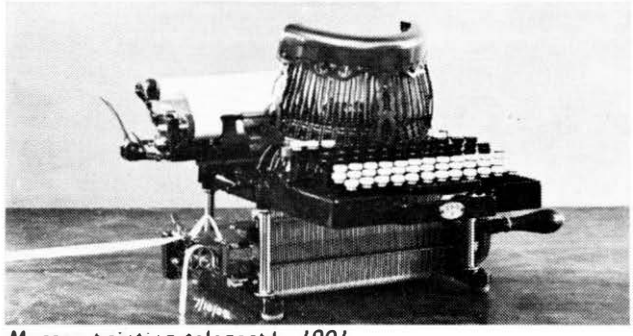


Murray Perforator, 1901

Creed teleprinter, 7 ERP.



Wheatstone receiver, 1867.



Murray printing telegraph, 1901.

Creed teleprinter, No. 15.

In the historical development of the telephone and the telegraph there is a pattern which is typical of other devices originated in the 19th century. The pattern is a technical and commercial selection, working like Darwin's natural selection towards survival of the fittest.

At first, inventions are made around a general theme, and prototypes are tried and modified. Some of these are taken up commercially and put into small-quantity production.

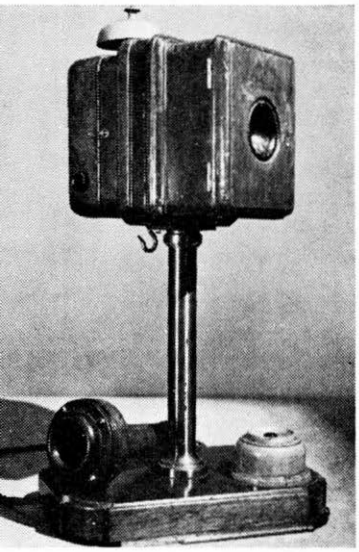
The manufacturing techniques are usually borrowed from other crafts or industries. Technical and commercial selection of the best features from different devices gradually leads to a classic form which remains stable for some time. Then, new inventions, materials, or manufacturing methods lead to radical rethinking, which again progresses to a new classic form.

The most striking change in the visual design of telegraphic equipment is the gradual separation of outside from inside. As mechanisms and circuitry became more complex, external cases became simpler. It is true that Wheatstone's ABC instrument is completely and simply cased but this owes more to horological and laboratory instrument traditions than to industrial design. The lower dial was surrounded by the 30 transmitting keys and the upper dial was for receiving. One of these instruments was still in use in North Wales in 1930.

The Wheatstone receiver also had a long career in several versions powered by weights and eventually by electric motors. The main design and construction principles are still derived from laboratory instruments.

By 1900, telegraphy design began to aim at 'typewriting at a distance'. In Murray's perforator the tape was punched longitudinally, not transversely. The printing telegraph, in use from 1902 until superseded quite recently by the Creed teleprinter, was in effect Murray's perforator folded up under a more or less standard typewriter. The Creed No. 7 instrument presents a distinctly unco-ordinated appearance.

The forthcoming No. 15 Creed (visual design by David Mellor) is a notable improvement. As well as higher speed of operation and two-colour printing, the new instrument has the transmitter in the same case as the printer and perforator. The two units and the table are clean and unified in appearance.



United Telephone Co., 1880.

Carbon transmitter, 1900.

Standard table telephone, 1914.

relationship simpler, clearer, more comfortable, or more efficient, and possibly more pleasurable to look at, then design is doing an essential job. If equipment is awkward to use, if controls are difficult to operate correctly, if labels and scales are not absolutely clear, if materials, colours and finishes are unpleasant, then design has not been properly brought in.

A persistent misconception is that visual design is 'styling', a surface cosmetic treatment to make a thing look better after the engineers have finished with it. This is simply bad design. The real work of the visual designer is to bring to bear on the particular problem in hand his overall knowledge and awareness of what is happening and, more importantly, what is going to happen in the design world. He should do this throughout the development of the job, from the very earliest stages.

Methodical research into human factors by ergonomics and other disciplines is steadily extending the amount and scope of quantitative data. But there remains the need for creative interpretation of data, which is the field of design, not research. Again, the conclusions of human factors research, like engineering requirements, usually leave several possible alternatives open. A decision has to be reached on other grounds, and here the visual designer can make a valuable contribution.

The anticipation of future user needs and attitudes is another field in which the visual designer can help. Market research and pre-testing can provide quantitative information, but only on the basis of existing design ideas. A constructive dialogue between designer and researcher can usually produce much better results by proposing, testing and modifying new design ideas.

The engineering designer and the visual designer should work together in their overlapping, but not identical, special fields. The fundamental principles are much the same for both; maximum effect from minimum resources. Both need full information of requirements and constraints, and both contribute their specialised expert knowledge and abilities. There should be no grounds for conflict or misunderstanding.

The Postmaster General commissioned Henrion Design Associates in January, 1965, as consultants 'to make a survey of all aspects of design in the Post Office with the intention of recommending ways and means of co-ordinating designs and methods of achieving the highest design standards in every field as seen by the public and staff'. The potential scope of visual design in the Post Office was unknown, both to the Post Office and to the consultants. The first task, therefore, was to investigate the

The major changes of form in telephone design have been made possible by technical advances in components. The basic pedestal arrangement persisted while a large receiver was necessary, but the mixed materials of the 1880 instrument and the elaborate turned pedestal of 1900 were developed by 1914 to a much simpler and cheaper form adapted to mass production. Dials were introduced at about this time.

The next major change, about 1929—the microphone/receiver handset—was made possible by the development of small receivers. By 1959, plastics technology provided stronger, lighter and coloured materials. The dial fingerplate was also by this date cheaper to make in plastics than in metal. The 1965 Trimphone has a radically new handset, with a single receiver/microphone insert at the earpiece and a carefully calculated acoustic channel from the mouth-piece. It uses a small tone caller, an illuminated dial and the whole instrument is light and compact.

existing situation. A pilot survey was made and the main conclusions were that:

1. Some particular items were of high standard.
2. Co-ordination between items was lacking, especially on the industrial design side.
3. The identification and other 'corporate image' aspects of Post Office design were too diverse and, in many cases, not entirely appropriate.
4. Procedures for managing design needed fundamental reconstruction.

The detailed survey began in January, 1966, and is still continuing. A co-ordinate indexing system was specially developed for storing and retrieving the information gathered.

The basic idea of co-ordinate indexing is to use whatever terms naturally occur in a field of information as 'keywords', rather than setting up categories in advance. Each physical item in the library—whether book, report, specially-printed card, photograph or even telephone or other piece of equipment—is then given a number, shelved and described by a small number of 'keywords'. Each 'keyword' has an index card, filed alphabetically, and that index card carries the number of every item

(continued on page 33)

The first standard handset telephone, 1929.

The telephone No. 706, 1959.

The 712 "Trimphone", 1965.

Six Bell telephones. Front: two Trimline *telephones. Rear (left to right): the* Card Dialler, *the* Call-a-matic, *the 500 set and the* Princess *telephone.*

Obviously in a range of instruments performing very different functions there will be few identical components or cases. But integration of appearance is not simply a matter of identical appearance.

The Bell instruments have a recognisable family resemblance. The four items in the back row have the same design of handset. The card dialler uses plastic cards, which can be pushed through to record a number. The 'Call-a-Matic' stores 500 numbers, and has an indicator roll motorised to any of 50 positions, with hand selection of the final position. The similarity of arrangement and appearance makes it clear that they are part of the same communications system, whether dial or push-button.

The 'Trimline' has evolved over some 25 years, with a number of reductions in size. One difficulty with miniaturisation is that human fingers remain the same size. The Trimline dial version has a particularly small dial with very thin webs between holes, and a movable stop to overcome the need for a space between 1 and 0. The push-button version has small buttons at much the same centre-to-centre distance as the larger square ones. Both versions have a recall button, so that the handset need not be replaced between calls, and plug-in components to simplify stock-holding and installation.

The Trimline *telephone.*

The dial version of the Card Dialler.

The Call-a-matic *repertory dialler.*

which uses that keyword. Concepts or categories are built up to order by taking, for example, the index cards for 'grey' 'plastics' and 'subscriber's apparatus'. Any number appearing on all three of these index cards are items concerning subscriber's apparatus in grey plastics.

To attempt co-ordination in an organisation as large and as complex as the Post Office, it is important to know the people and departments concerned in each possible design situation, and all the other design items which should be related to any particular one. The aim of the library is to produce in a matter of minutes all the available information about any item, including administrative and engineering control, designer, manufacturer, materials, costs, numbers in use and so on. At present the library has about 1,650 index cards covering about 450 item cards, about the same number of photographs and other sources of information, and about 120 people in authority over design items.

Work on proposals for a complete identification system for the new public corporation is now nearing completion. An identification system means a small set of standard symbols, colours and lettering styles suitable for general use by a corporation and rules for their application in different situations. Identification, particularly of a vast organisation like the Post Office, is of great importance in determining the idea or image that people have of that organisation. Put at its simplest, people tend to think that an organisation that looks muddled and old-fashioned is, in fact, muddled and old-fashioned. The design problem in identification is to find very strong, simple and appropriate elements which are flexible enough to cover all needs from postmen's buttons to neon signs on new office blocks. A basic identification system for the National Giro was accepted in May, 1966 and is already in preliminary use.

Since the time of the pilot survey, we have performed many of the functions proposed for the design management authority. An increasing number of departments have called us in to projects, at first those already under way, but subsequently from the early stages. These projects are of widely different kinds and often call for great specialist experience and design skills. The intention in co-ordinating is not to do the design in the narrower sense, which is the job of the particular designer chosen, but to ensure that adequate background information and briefing are supplied by the Post Office and that due consideration is given to items which will be related in use, even though not related in Post Office organisational control, and to future development.

THE AUTHORS

F. H. K. Henrion, MBE, RDI, PPSIA, AGI, *is a general consultant designer with a long experience in graphic and industrial design. He is head of Henrion Design Associates, a design office staffed half by designers and half by scientists trained in design analysis and rationalisation. He is, or has been, responsible for design co-ordination programmes for Allied Breweries Ltd, Blue Circle Group (The Associated Portland Cement Manufacturers Ltd and Cement Marketing Co Ltd), Bowater Paper Corporation Ltd, KLM Royal Dutch Airlines, BEA, and was the co-ordinating designer for the British Pavilion, Expo 67, Montreal. He is President of the Alliance Graphique Internationale, Past President of the Society of Industrial Artists and designers, a past member of Council of Industrial Design, member of the Summerson and Coldstream Councils on design education of the Department of Education and Science and of the Postage Stamp Advisory Committee. His connection with the Post Office goes back to 1939 since when he has designed posters and displays for the Post Office Savings Bank and the General Post Office Public Relations Department.*

★

Alan Parkin, BA, *was trained as a mathematician and joined Henrion Design Associates in 1961 after research into the application of systematic methods to visual design.*

* * *

A new cabling technique designed to reduce the amount of metal work by about 50 per cent. and provide significant savings in cable and overall costs, is being tried out at the Post Office repeater station at Scunthorpe.

This new system which has been developed by the Post Office and Standard Telephones and Cables Ltd., is an improved version of the traditional cabling racking arrangement and is designed to support and route telecommunications repeater station cabling between racks. Instead of traditional cable racking, a simple open lattice, made from a metal strip and clamping devices, supports a strong wire-mesh platform suspended from the ceiling or mounted on floor supports in the space above the racks.

The facsimile control room of the Australian. *The transmitter (left), receiver (right) and electronic consoles are similar to those used by British newspapers for high-speed facsimile transmission.*
Picture: Courtesy Muirhead and Co Ltd.

SPEEDING THE PRESSES

By M. E. GIBSON, C.Eng, AMIERE

Thanks largely to new high-speed facsimile links provided by the Post Office, newspapers can now send complete issues for printing in far-away satellite offices in less than an hour

WITH the arrival of high speed page facsimile transmission, which enables a complete issue of a newspaper to be transmitted to a satellite office for printing, British newspapers enter a new era.

Over high speed facsimile links provided by the Post Office, the *Daily Mirror* and *Sunday Mirror*, which formerly went by Irish ferry, are now transmitted to Belfast in less than an hour for printing. Such is the speed of this new transmission system that the *Mirror's* experimental plant in Belfast can now print a Republic of Ireland edition. Essential to this new venture are the links which have been provided on part-time 240 kHz wideband circuits between Manchester, where the northern editions of the *Daily Mirror* and *Sunday Mirror* are produced, and Belfast.

Facsimile transmission or, more correctly, facsimile telegraphy, has been a very active aspect of telecommunications for many years. In fact, the first patented version dates back to 1842. It can be divided broadly into two distinct sections—photo-telegraphy (involving the transmission of photographs) and documentary facsimile telegraphy, which is the system used for the transmission of complete newspaper pages.

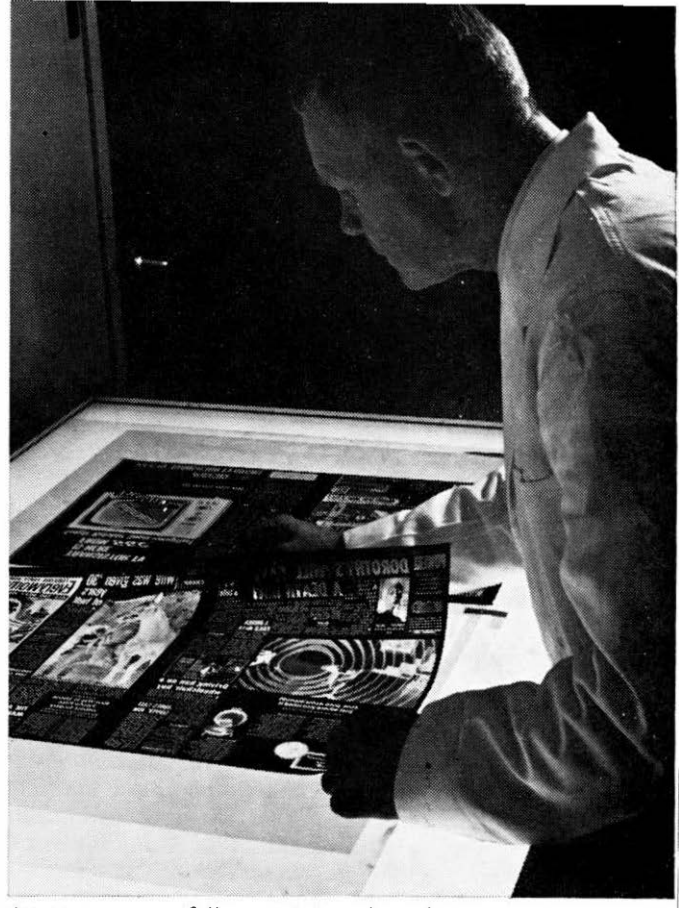
To convert into electrical signals the multiplicity of information contained in a newspaper page, the proof of the page is taken from the printing press and, at the transmitter, is

wrapped around a rotatable drum where a small area of the page is illuminated by a beam of light. As the drum rotates, a lead screw causes the beam to traverse the page, effectively scanning it in the form of a tight spiral. Light reflected from each area as it is scanned passes through a precision optical system and is used to control the electrical output of a photocell. The amplitude of the output signal depends on whether the beam falls on a white or a black area of the print—maximum level for black, minimum for white.

At the receiving end, the signals excite an electrical device which produces a source of light the brightness of which depends on the amplitude of the input signal. This light source is focussed on a sheet of photographic film, the size of a newspaper, which is wrapped around a rotatable drum similar to that used at the transmitter end. The receiver drum is made to rotate in synchronism with the transmitter drum and with correct phase relationship. The light source traverses the page under the control of a lead screw mechanism and exposes the film in the form of a spiral. In this way a reproduction of the newspaper proof is built-up on film. When developed, the exposed film has the appearance of a normal monochrome negative. At this stage a process begins in which a printing plate will be produced from the negative.

A complete newspaper page generally contains some photographs made up of a pattern of minute black dots. As the density of the picture to be printed increases so the cross-sectional area of the dots increases until they almost completely merge at the black end of the scale. Conversely, as the tone becomes lighter, the size of dots decreases. The electrical signal, therefore, needs to contain only information on the black or white make-up of the page, irrespective of whether printed matter or pictures are being transmitted. But the scanning system has to be sufficiently fine to identify accurately the individual dots. The commonly used scanning density is 600 lines an inch. The comparable figure for a typical domestic TV receiver is aproximately 30 lines an inch.

The speed at which facsimile information can be transmitted over a circuit depends on the bandwidth available. The transmission of

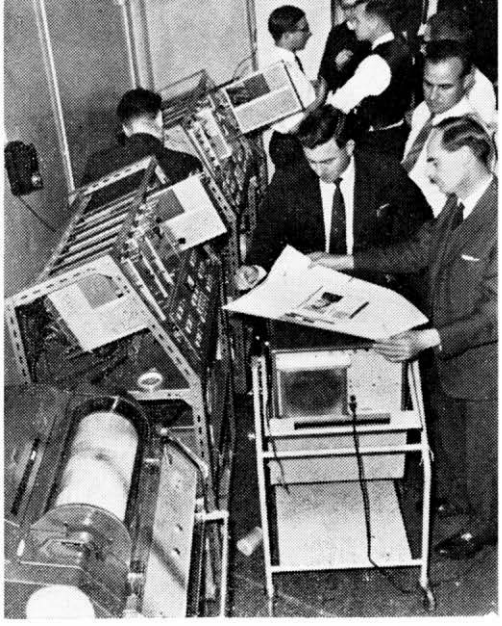


An operator carefully scrutinises through a light table the whole-page negatives produced by the receiver. The negatives are then used to make printing plates. Courtesy: Daily Mirror.

the 'fine dot' information contained in a newspaper page in a time short enough to be economically attractive to the operator, requires a circuit of bandwidth greater than that available from the commercial speech private wire. While the latter is adequate for transmitting Press photographs the recently introduced wideband private circuits are more appropriate for high speed facsimile.

Wideband circuits may have bandwidths of 48 kHz or 240 kHz. These may be recognised as the bandwidths of groups and supergroups of multi-channel carrier telephone systems. Twelve 4 kHz spaced telephone channels become a 48 kHz group and five such groups become a 240 kHz supergroup. Distribution frames exist at the group and supergroup stages and provide access to and from the high fre-

OVER



Engineers from the Post Office, Muirheads and GEC Telecommunications Ltd examine a page proof during the experiments using the Coventry to Rugby looped PCM digital line. Courtesy: GEC Telecommunications Ltd.

quency telephone network. A wideband circuit is made available to a customer by providing him with a suitable "local-end" to the nearest convenient repeater station group or supergroup distribution frame, depending on whether a 48 kHz or 240 kHz circuit is required. As wideband signals are sometimes vulnerable to interference, the local-end connection is usually made by laying a special cable for the customer's exclusive use. The backbone of the circuit—the section linking the distribution frames in the terminal repeater stations—is provided in a manner similar to any other group or supergroup in the telephone network.

Sometimes it is more convenient to rent a wideband circuit on a part-time basis, particularly if the business to be transacted takes place over a similar and limited period each day. The requirements of national newspapers fall into this category since the height of activity takes place during the evening. In a part-time circuit the local-ends are permanently rented by the customer and switched at pre-arranged times to group or supergroup circuits normally used for telephone traffic.

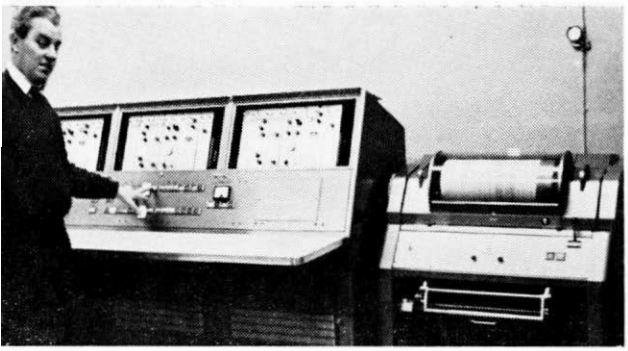
Before switching, it is necessary to busy individual telephone circuits routed in the group or supergroup concerned to avoid disconnecting a telephone circuit while it is in use when the wideband circuit is switched.

The complications entailed in operating such a procedure have led to the restriction of traditional part-time working to 48 kHz circuits. Part-time working for 240 kHz circuits can only be given on a basis which does not require the direct sharing of plant with normal telephone traffic. Radio protection channels which may be hired on an hourly basis thus provide the only practicable method by which part-time 240 kHz circuits may be routed.

The wide-band circuits while suitable for telephony are unlikely to meet the demands of high-speed facsimile transmission. The signal emitted from high speed facsimile equipment has maximum amplitude for black and minimum for white, which means that as the page is scanned at the transmitter the resulting signal will alternate between maximum and minimum amplitude. The essential information is therefore conveyed by the shape of the signal. After transmission over the wideband circuit the shape must be retained within manageable limits, otherwise inaccuracies may occur in the received copy. Delay distortion resulting from a non-linear phase response over the working frequency range of the wideband circuit will almost certainly be encountered because of the electrical filters which are necessary at interconnection points within the group or supergroup link. This distortion, which does not affect the circuit for telephony transmission if present in significant degree, modifies the shape of the facsimile signal by changing the phase relationship between its constituent parts.

The correction of delay distortion in wideband circuits has posed a challenging task to Post Office engineers and its successful solution has played a major role in enabling high speed facsimile to become a reality.

About 80 per cent of the nominal bandwidth of a wideband circuit is available for transmitting high speed facsimile. The remainder, situated at the edge of the band, is unuseable for this purpose because of excessive delay distortion, although it may be used for speech or synchronisation channels. Nevertheless, using a 48 kHz circuit, a full size newspaper page, scanned at 600 lines an inch, may take 20 minutes for transmission while over a 240 kHz circuit it could be expected to take one-fifth of this time.



A Muirhead page facsimile transmitter in the Daily Mirror's Manchester Office. A 32-page issue can be transmitted by facsimile from Manchester to Belfast in less than an hour.

The application of some recent plant developments to wideband circuits is now being studied by Post Office engineers. These may be effective in reducing circuit provision costs and, from the customers' viewpoint, reflect favourably in rental charges. The area where, potentially, most progress could be made is in the local-end section, where special cables are required for the exclusive use of the wideband circuit renter. In addition to introducing new and less expensive types of cable, successful experiments have also been carried out using the digital line section of a 24-circuit, Pulse Code Modulation (PCM) system. These experiments involved co-operation between the Post Office and Muirhead & Company Limited and the General Electric Company who were responsible for the digital equipment.

In the normal useage of wideband circuits, the basic output signal from the facsimile transmitter carriage must be positioned in the group or supergroup band by a stage of modulation before connection to the circuit terminals.

In the experimental digital application, however, a sampling and coding operation replaced the modulator and converted the facsimile signal to a digital form which simulated the line signal of a PCM system. At the receive end of the digital link the basic facsimile signal was restored by suitable decoding. The experiments were made on a looped basis using the Coventry-Rugby PCM digital line and showed that facsimile signals, at least up to the speed normally allowed by a 240 kHz circuit, could be transmitted in this way.

Apart from the obvious application of digital techniques to the local-end section of facsimile circuits, short links (for example, between 15 and 30 miles) may be provided to advantage in this way. However, since PCM is primarily concerned with the junction network, study of its application in the local cable network may be required before the facsimile applications can be fully realised.

It is hardly surprising that newspaper proprietors are enthusiastic about high-speed facsimile transmission. The next step is towards localisation of newspapers where offices in provincial centres would receive the backbone of a newspaper by facsimile systems and insert local interest pages. Clearly, the enormous cost involved in duplicating whole newspaper offices would not permit 'local' national newspaper production by today's methods. But high-speed facsimile has shown that it may not be far away. When it arrives, the Post Office will have an important role to play in setting up and maintaining the wideband facsimile network which will be required.

THE AUTHOR

MR. M. E. GIBSON, *is an Executive Engineer in the Main Lines Development and Maintenance Branch of the Engineering Department. He joined the Post Office in 1949 as a Youth-in-Training in the Canterbury Area and was promoted to the Engineering Department as an Assistant Engineer in 1957.*

IPOEE ESSAY CONTEST

The Institution of Post Office Electrical Engineers' 1966-67 Essay Competition was won by Mr. R. Williamson, a Technical Officer at Norwich. His prize was an award of six guineas and the Institution's certificate.

Prizes of three guineas each and Institution certificates were awarded to Technical Officer T. H. Hopkins, from Banbridge, Co. Down; Technical Officer J. F. Crake, from Blackburn; and Technician 11A J. G. Wardle, from Birmingham.

Five competitors won Institution certificates of merit. They were: TO R. Brewer, Newark-on-Trent; TO P. Bews, of York; TO E. R. Horler, Bristol; TO D. C. Ferguson, of Old Meldrum; and TO H. Yearl, Chesterfield.

★

The number of telephone lines between London and the rest of Europe is now over 1,600—117 more than a year ago. There are 326 lines to France, 309 to West Germany, 272 to the Netherlands, 147 to Switzerland, and 101 to Italy.

How We Helped The Billy Graham Crusade

By MISS F. D. DAVISON
and D. MAUL

Setting up a temporary closed-circuit television network to link 25 cities throughout Britain during the nine-day Billy Graham Crusade was the biggest task of its kind the Post Office has yet tackled

The audience at Earls Court sees Billy Graham on the big screen. Simultaneously, the pictures were shown on other big screens in 25 major cities.

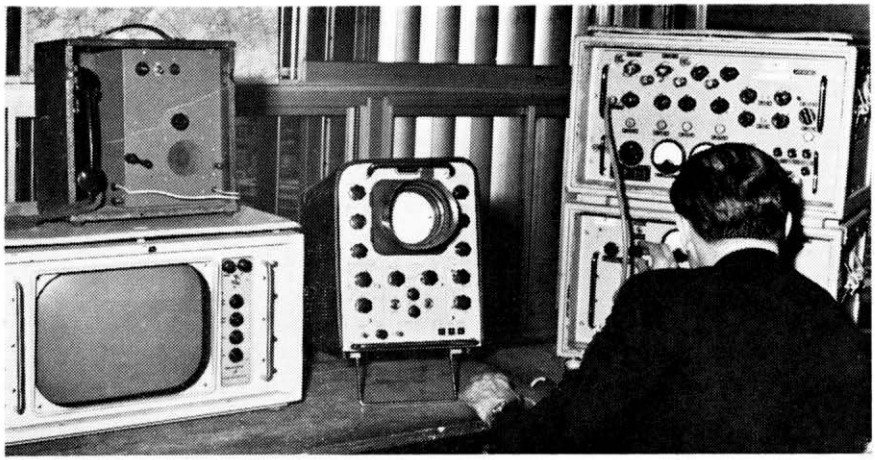
TELEVISION for public showing, as distinct from home viewing, has developed dramatically over the past three years. Using temporary closed-circuit television facilities provided by the Post Office and Ediophor projectors supplied by an equipment contractor, events of public interest can be seen live on the big screen by audiences many miles away.

This novel technique proved so successful during the 1966 Billy Graham Greater London Crusade that his executive committee asked the Post Office to set up a temporary closed-circuit television network for nine days from 23 June to 1 July for the 1967 All Britain Crusade. It was the largest commitment of its kind to be undertaken by the Post Office.

An unusual aspect was the provision of two big screens at Earls Court. Although Billy Graham made a personal appearance there, the audience watched him on big screens simultaneously with the audiences at 25 major towns included in the network. This was achieved by means of a one-way monochrome vision circuit from Earls Court connecting each reception centre and enabling the signal transmitted from Earls Court to be received at the same time. Existing vision circuits and temporary microwave links were used where possible and cable circuits were equipped for video transmission. The network was devised to obtain the maximum results from the resources available, bearin mind the need to link the 25 major centres.

The associated sound network was arranged to allow the audiences at Earls Court to hear the singing of the audience at one of the centres in the network. The return sound was relayed back to Earls Court from a different centre each night.

To provide the vision circuits needed for the



Technical Officer Mr. H. C. Pockett, a member of the London Outside Broadcast team, sets up the 7 Gc/s radio terminal equipment.

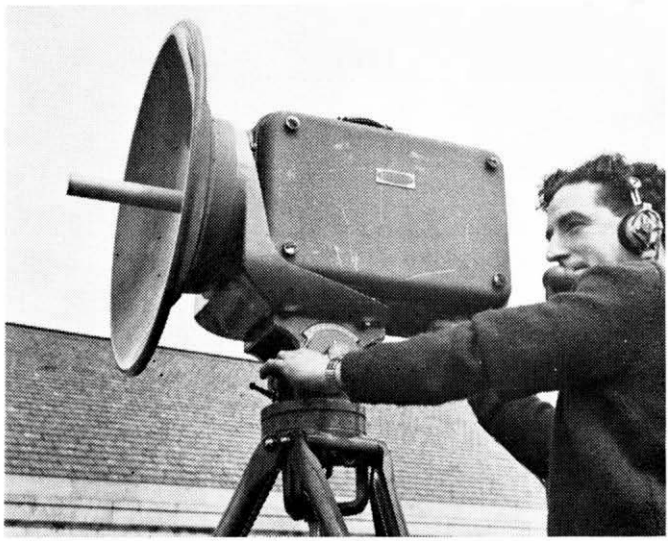
crusade, stand-by microwave radio-relay link channels—known as protection channels—were used. The primary function of a protection channel (all Post Office microwave radio-relay links contain a number of them) is to carry traffic—telephony or television—when a working channel develops a fault. Switch-over is then automatic and virtually instantaneous.

Since protection channels are therefore used infrequently for traffic-carrying purposes, they may be hired by the broadcasting authorities and other users for outside broadcasts and closed-circuit television. Hiring is on the understanding that the channel will be automatically seized at any time if it is needed for telephony or television.

Protection channels are interconnected at main radio stations or repeater stations. Terminal points of the channels are extended to the renter's premises by outside broadcast links using spare coaxial or telephone pairs or portable microwave radio relay links, depending on the availability of plant and the length of the connection.

Earls Court was linked to the London Television Network Switching Centre in the Post Office Tower to give access to the radio-link protection channels radiating from London. At eleven of the 25 provincial receiving centres the main locations were connected to overflow locations. Ediophor projectors were installed at the main locations and 23-inch television monitors at the overflow locations.

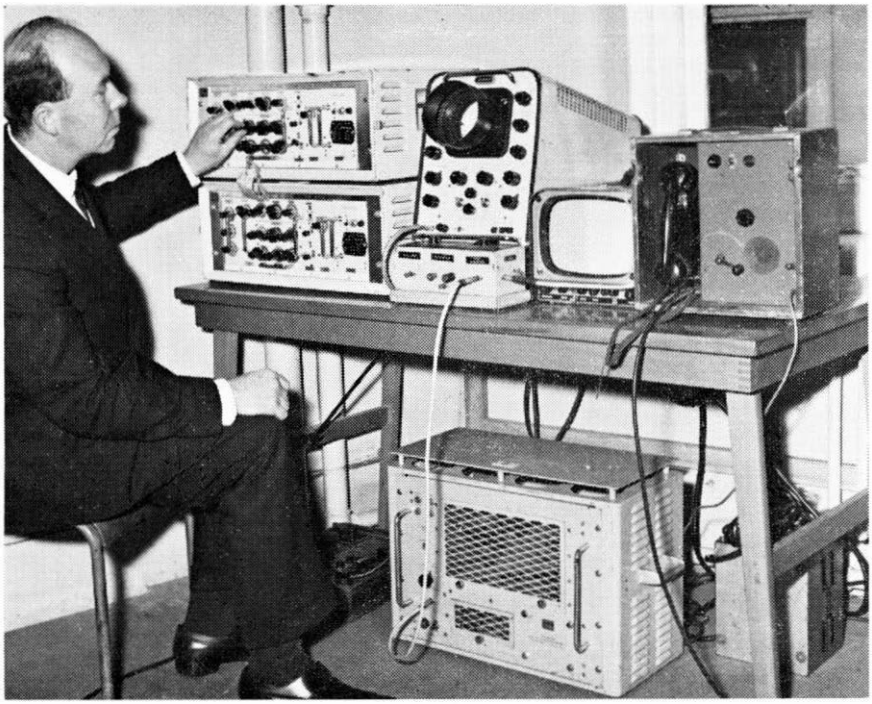
The sound circuits from Earls Court to the 25 vision and 14 sound-only locations were



Technician 11A Mr. J. T. French, of the London team, lines up an 11 Gc/s two-foot aerial. The aerial is connected to the terminal equipment by up to 300 feet of coaxial cable.

provided on inter-city occasional programme circuits (OPs) with temporary local ends from terminal points to the main and overflow locations. In some towns, sound was also extended to local hospitals. A country-wide, inter-city network of OPs is provided and maintained by the Post Office for hire to the broadcasting authorities and other users and these are of a high quality suitable for music transmission.

OVER



Ordinary telephone pairs can be used for vision signals when fitted with specially-designed outside broadcast video amplifiers. Here, Assistant Executive Engineer Mr. D. F. Hall, of the London team, adjusts the amplifiers.

The temporary local ends are usually provided on telephone cable pairs.

In addition to the vision and sound circuits, each main vision location was linked to the Billy Graham organisation's control centre at Earls Court by a two-way control circuit.

Extending the protection channel terminals to the provincial centres was carried out by Post Office Outside Broadcast teams. These teams—based in London, Birmingham, Manchester, Edinburgh and Cardiff—normally provide outside broadcast circuits for the BBC and ITA's programme companies. Since they were numerically inadequate to carry out the Billy Graham commitment in addition to their regular tasks, they had to be augmented by specially-trained staff. A wide variety of conditions, of distance, plant availability and terrain had to be catered for. When the use of telephone pairs was practicable, special equipment and techniques were used to amplify and equalise the pairs for television use. Locating the intermediate equipment for this purpose sometimes presented difficulties—for example, vehicle parking and mains supply when the intermediate points were in street manholes.

When the use of telephone pairs was impracticable, portable microwave radio relay links had to be established. The Post Office has two types of such equipment operating in the 7 Gc/s and 12 Gc/s frequency bands respectively and on which a single hop of up to 30 miles is usually possible, although exceptionally greater distances have been achieved. On the crusade network two hops were occasionally necessary to provide a particular connection. Since transit and receive aerials (2 ft. or 4 ft. dishes—according to the type of equipment) must always be in line of sight, this frequently meant that the aerials had to be mounted on masts, roofs of buildings, roofs of vehicles and sometimes even on the elevated platform of a Simons truck.

On eight nights during the crusade, hymn singing was relayed for short periods from one of the 25 television locations to Earls Court —a different location being chosen each night. This facility meant providing programme circuits in addition to those established for the television and sound-only locations since the latter coud not, of course, be reversed in direction. A Post Office engineer was stationed at

This map shows how the temporary closed-circuit television network which the Post Office set up linked 25 major towns throughout Britain.

each of these locations to provide continuous manual control of the sound level being transmitted to line.

An additional feature of the Billy Graham All-Britain Crusade was a rally held for young people at the Central Hall, Westminster on the evenings of 11 and 12 May. On these occasions sound relays were supplied to two locations on the first evening and four on the second. Sound relays were provided to 24 centres during the Dedication Service at Earls Court on 22 June.

Judging from the variety of requests the Post Office receives for temporary closed-circuit television facilities this method of communication is extremely versatile. Future developments indicate that there may be an increased demand covering many more fields not yet explored.

★Footnote

Requests for nationwide closed-circuit television facilities and facilities for television for public showing (which require authorisation by the Post Office) are dealt with by Inland Telecommunications Department, Tariffs and Legislation Branch, in conjunction with the Engineering Department and Regional and Area Engineering and Sales staff.

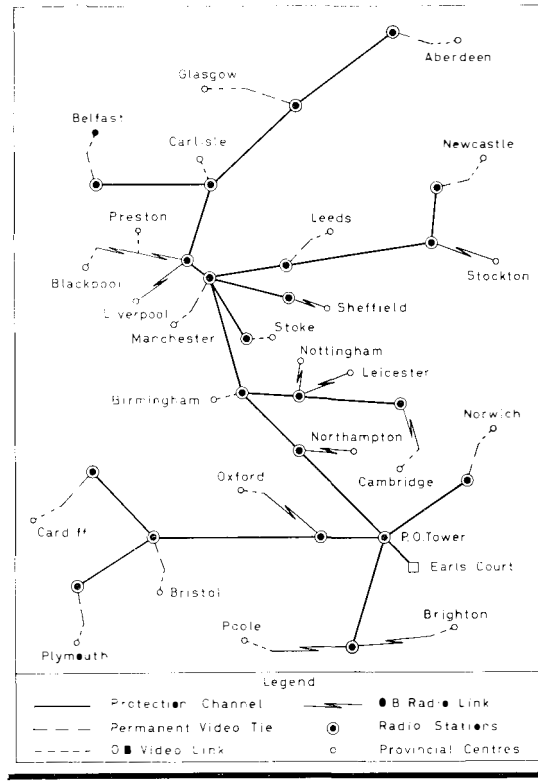
THE AUTHORS

MISS F. D. DAVISON, *formerly of Inland Telecommunications Department, is an Executive Officer in Buildings Standards and Research Branch of the Buildings and Welfare Department. She joined the Post Office in 1964.*

Mr. D. MAUL, MIEE, *is an Executive Engineer in Main Lines Development and Maintenance Branch of Engineering Department and is concerned with the provision of Television Outside Broadcast facilities. He joined the Post Office in 1958 as an Assistant Engineer.*

★

There was a drop of nearly 25 per cent in the number of incidents of wilful damage to public telephones in 1966, the total falling from 175,000 in 1965 to 130,000. The special measures introduced by the Post Office to prevent vandalism and apprehend culprits are thought to have played a big part in the reduction.



A CHAIR IN TELECOMMUNICATIONS

A Chair in Telecommunications Systems is to be established in the Department of Engineering Science at the University of Essex. It will provide teaching at both undergraduate and post-graduate levels and conduct research in telecommunications engineering. The Post Office will pay the costs of the Chair and some supporting staff for ten years.

The Post Office hopes that the establishment of the Chair will put telecommunications more securely within the orbit of university activity, lead to the development of a school of research in telecommunications systems and provide a new source of graduates for the Post Office and industry.

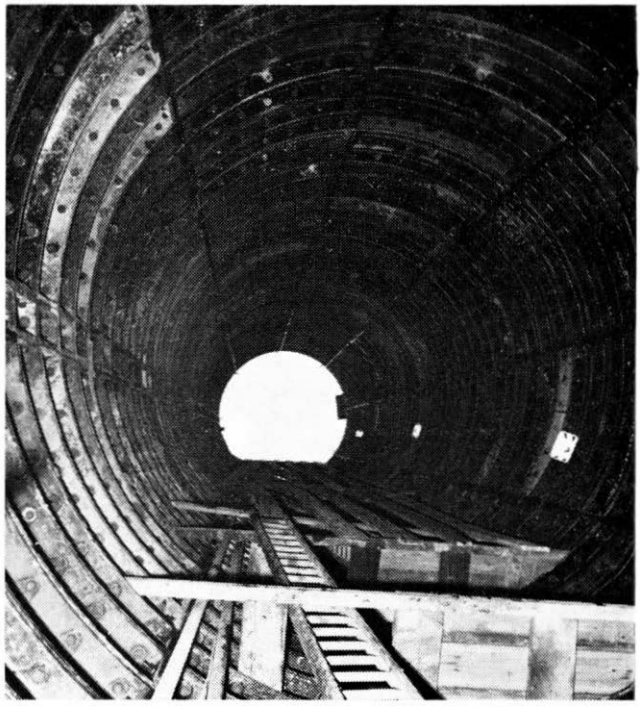
★

The Dial-a-Disc telephone service—introduced experimentally in Leeds last December—was recently opened by the Postmaster General in Newcastle. Callers are able to listen to a different "pop" record on each day of the week, the service being available from 6 p.m. to 6 a.m. on weekdays and all day Sunday. The records are selected from the top seven in the charts. The service uses the same equipment as the Test Match score service and for this reason will be suspended during each Test match.

DEEP FREEZE AT ST. PAUL'S

By F. S. B. SANDERS C. Eng., MIEE

A view from the bottom of the 100-ft. shaft near St. Paul's. The shaft is 15-ft. across.

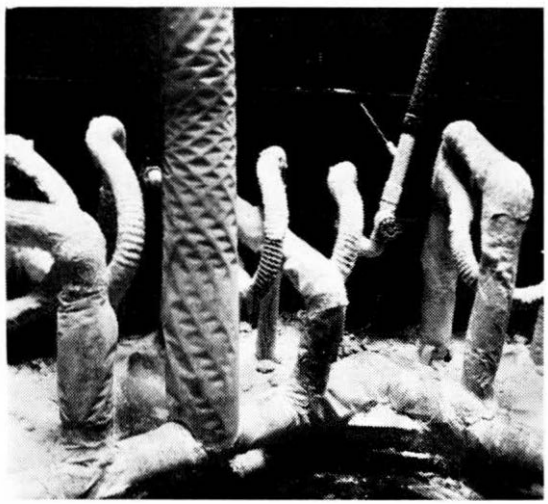


WHEN the Engineering Branch of London Telecommunications Region had to sink a 15-ft diameter lift and cable shaft 100 feet into the ground near St. Paul's Cathedral, they came up against an apparently insoluble problem.

The shaft would pass through a water-bearing layer of sand and gravel and the water would have to be removed or somehow consolidated. But St. Paul's Preservation Act of 1935 forbids the pumping of water from the soil in the vicinity of the Cathedral and previous attempts elsewhere to stabilise London's sand and gravel bed by using chemicals to turn the water into a "jelly" had not always succeeded.

It was suggested that a firm of civil engineers —Foraky Ltd.—who had been specialising in a ground freezing method, might provide the answer. This firm was called in to help and, working closely with the Engineering Branch, they completed the job.

After the cable shaft had been driven down to the top of the sand and gravel bed, about 28 ft. down, the civil engineers drilled a ring of 36 borings round the outside of the shaft and inserted into each boring a 14-ft. long freeze tube which penetrated through the sand and gravel bed into the impervious clay stratum. Each tube was made up of two concentric pipes so that refrigerant could be pumped down the inner tube and returned through the outer one.



Looking like a family of petrified worms, these are the ice-covered freeze rings with a lagged supply pipe in the centre. Note the thermometer inserted in the return pipe (right).

Normally, cold brine is circulated through the tubes and chilled by an ammonia compressor to turn the surrounding soil into an "ice-wall". Since this method would have taken several weeks, however, and speed was essential, it was decided instead to use liquid nitrogen.

An insulated storage vessel of 2,000 cubic feet capacity was installed on the surface and into it road tankers kept up regular deliveries

of liquid nitrogen at minus 196 degrees Centigrade which was pumped into the freeze tubes through a specially rigged arrangement of insulated pipes. Observation holes were dug into the ground around the tubes to monitor the growth of the ice-wall. Within three days the ice barrier had completely formed to hold back surrounding water and in six days it was thick enough to resist all ground pressures. The shaft was then driven down through the frozen sand and gravel and on into the clay. During the freezing operation more than two million British thermal units of heat were extracted from the ground.

As the *Journal* went to press, the shaft had been completed and work had begun on driving lateral tunnels to link with two similar systems which carry trunk and junction telephone cables below London's streets.

*Some 500 miles of trunk and junction cables are now installed in London's underground cable system of seven-ft. diameter cast-iron tunnels. These tunnels avoid the welter of ducts, water pipes and gas mains just below the surface and each tube widens into a chamber the size of an Underground Railway station at intervals of about 2,000 yards.

Post Office maintenance and installation teams enter the tubes through shafts leading to the chambers. The underground cable system enables faults to be cleared without having to dig up roads and cause traffic chaos.

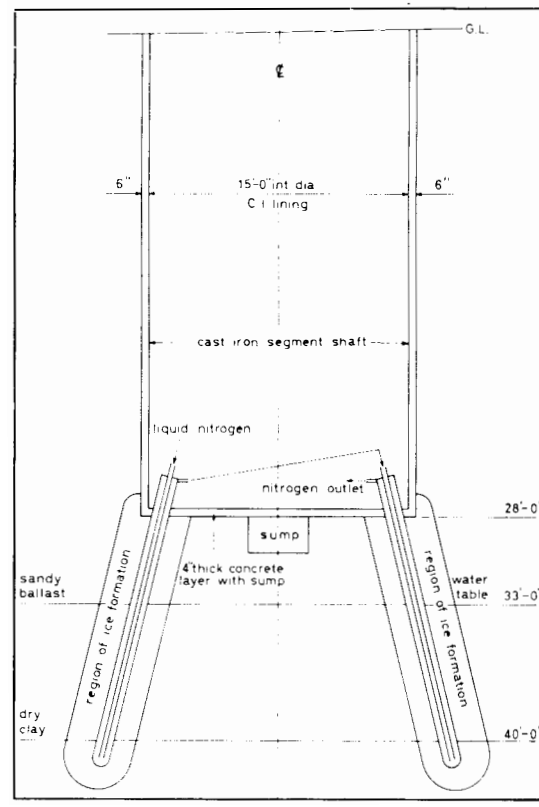
THE AUTHOR

MR. F. S. B. SANDERS *is an Executive Engineer in the LTR Engineering Branch, Power Division, responsible for mining operations and heating and ventilation of telecommunications buildings in the Region. He joined the Post Office in 1931 at Dollis Hill Research Station and served six years in Research, ten years on telecommunications in the LTR NW Area and 19 years in the LTR Power Section before taking up his present post in 1966.*

★

More than half a million more calls were made to the Recipe Service in the year ending on 31 March, 1967, than during the previous twelve months—1,434,568 against 853,653. The service is now in operation in London and 21 other cities in Britain.

The Speaking Clock Service received 193 million calls in the year ended 31 March, 1967—34 million more than in the previous 12 months.



This diagram shows the arrangement that was used to freeze the ground between 28 and 42 feet so that the shaft could be driven down through the water-carrying sand and gravel bed.

★ ★ ★

The Postmaster General, Mr. Edward Short, pleaded with business and industry to make fullest possible use of the telecommunications services the Post Office provides when he opened a joint Post Office-Institute of Office Management Conference recently.

"We can make ourselves into a more efficient machine, but only if you will learn how to use that machine properly," he said. "We can develop useful attachments to the telephone until the cows come home, but your office will be no more effective if you do not find out about them and then use them to the full. . . . There are far too many services of which insufficient use is being made. Our data transmission services could revolutionise the office face of Britain, but before they can help you they must be properly integrated into your office systems. Many firms do not attach enough importance to their telephone operators and telephone installations. Well-trained and intelligent operators are worth a great deal, but they need proper space and equipment."

Telecommunications Statistics

	Quarter ended 30 Dec., 1966	Quarter ended 30 Sept., 1966	Quarter ended 30 Dec., 1965
Telegraph Service			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic)	**2,375,000**	2,847,000	2,706,000
Greetings telegrams	**573,000**	727,000	627,000
Overseas telegrams:			
Originating U.K. messages	**1,780,000**	1,907,000	1,834,000
Terminating U.K. messages	**1,798,000**	1,918,000	1,837,000
Transit messages	**1,506,000**	1,473,000	1,401,000
Telephone Service			
Inland			
Net demand	**163,000**	165,000	218,000
Connections supplied	**176,000**	188,000	205,000
Total orders in hand	**220,000**	232,000	197,000
Total working connections	**6,836,000**	6,744,000	6,377,000
Shared service connections (Bus./Res.) ..	**1,346,000**	1,338,000	1,252,000
Effective inland trunk calls	**233,467,000**	233,823,000	212,598,000
Effective cheap rate trunk calls	**50,291,000**	55,573,000	45,518,000
Overseas			
European: Outward	***2,092,000**	2,073,000	1,814,000
Extra European: Outward	***187,000**	187,000	162,000
Telex Service			
Inland			
Total working lines	**19,000**	18,000	16,000
Metered units (including Service and Irish Republic)	**49,000,000**	46,117,000	41,276,000
Manual calls Assistance and Multelex	**29,000**	29,000	20,000
Overseas			
Originating (U.K. and Irish Republic)	***3,064,000**	3,044,000	2,729,000

*Estimated figures. Figures rounded to nearest thousand.

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Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Post Office.

Correspondence. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: 01-432 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co.".

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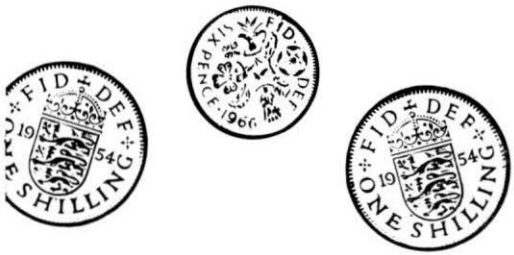

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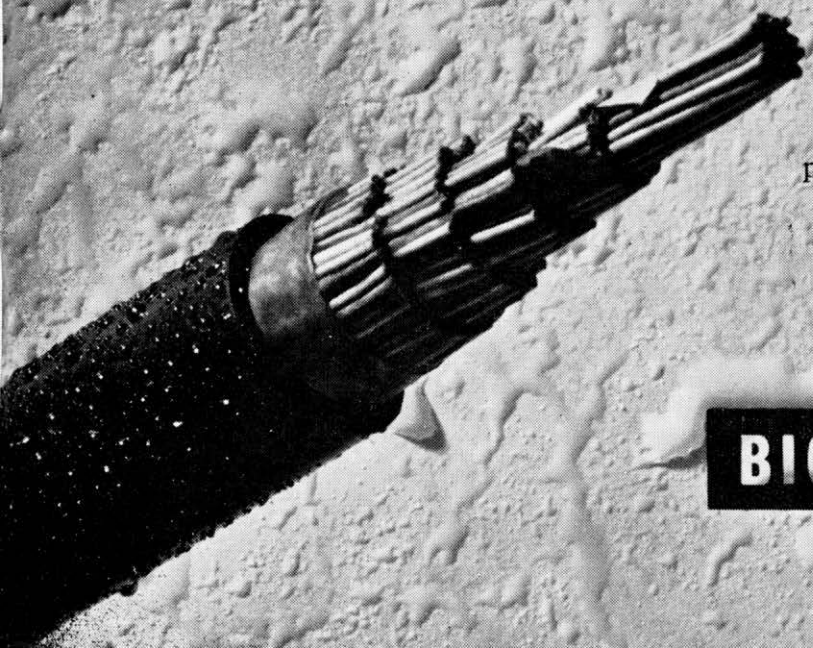

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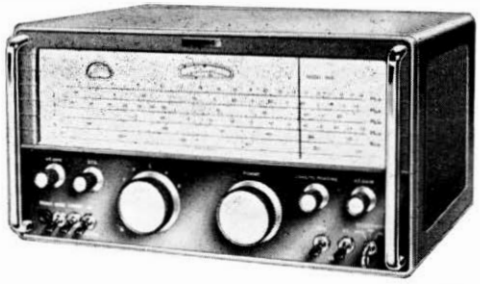

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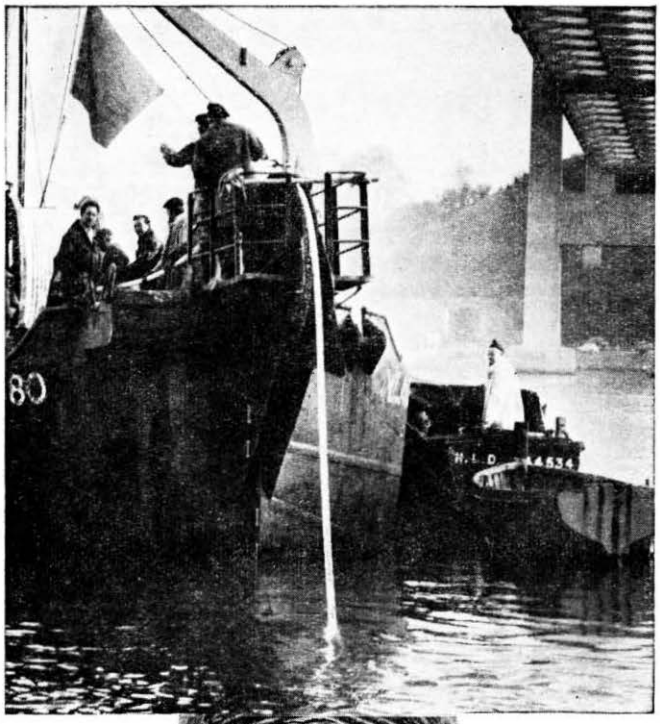

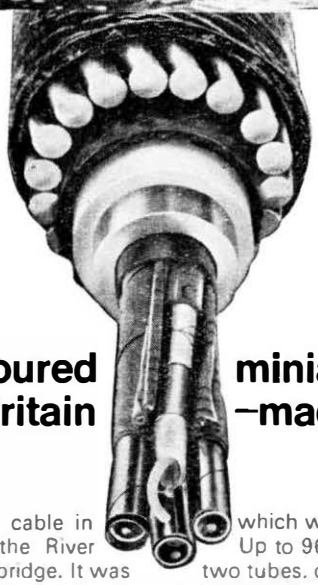

The first armoured miniature coaxial cable to be installed in Britain —made by Pirelli General

The first armoured miniature coaxial cable in the U.K. was laid recently across the River Tamar in the vicinity of the new road bridge. It was manufactured by Pirelli General and forms part of a 54 mile telecommunications link between Plymouth and Truro which has been installed by the Pirelli Construction Company, except for the river crossing which was handled by the General Post Office. Up to 960 conversations can be held over each two tubes, of only ·174 inch diameter and the performance is well within CCITT limits for this type of circuit. This installation follows the first of these links (Salisbury-Bournemouth) which was completed in record time by the Pirelli Construction Company.

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