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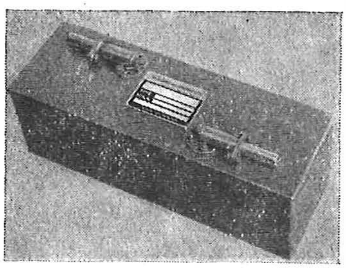

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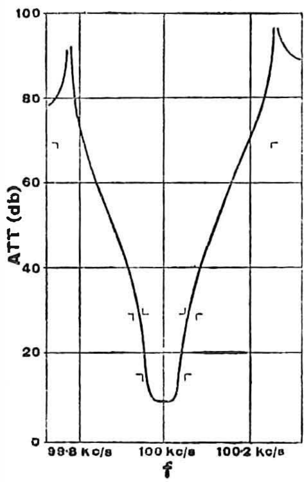

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Post Office Telecommunications Journal

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Contents

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Raising the Calling Rate

EXPLAINING to a Press conference the reasons for the changes in charges announced in July, the Postmaster General emphasized that he has to look at Post Office services with a commercial eye, but that does not mean turning a blind eye to social obligations. One of his conclusions is that the "astronomical amount" invested in the telephone service is the taxpayers' money and, he added, "I have a responsibility to see that we earn a fair return on it. I have an old-fashioned belief that reducing prices often pays".

One problem was to stimulate the calling rate without increasing the demand for telephones, which was already greater than we could meet promptly with the amount of capital investment which we were allowed. Another was to avoid stimulating calls over trunk lines during the day, when the circuits are working "flat-out".

The solution is, by reducing charges and extending the cheap-rate period to stimulate use by residential subscribers (who on average make under one call a day) during off-peak periods. Most calls from residential telephones are made in the evening; hence, reduction of the local call charge from 3d. to 2½d., and cuts in trunk call charges at the upper and lower ends of the distance scale, are unlikely to stimulate calling during the busy hours.

Altogether the changes in the telephone charges, which include lower rentals for Private Branch Exchanges, will cost the Post Office £3.5 million gross a year on present traffic. The aim is to recoup that loss by encouraging more calls.

It is a good sign that we are preparing for the greater commercial freedom we hope for under the plan for a new status by adopting the sound commercial principle of seeking more business by reducing charges: not a common practice today.

The new charges are outlined on page 161.

STD—The First Three Centres

J. M. Harper

AT the end of his article, "Subscriber Trunk Dialling Simplified" (Summer 1958 *Journal*), written before STD had been tried out anywhere, Mr. Kemp talked about the great edifice it would become; he hoped that its foundations would prove to have been well and truly laid.

If he will pardon me for carrying the metaphor a little further, those foundations have now risen above the ground, and the layout of the edifice can be seen. As I write, six exchanges in Great Britain have STD facilities. At three of them the new service has been working for some time, and we can make our first estimates of the success or failure of the planning, in the light of what has happened there.

These three exchanges are Bristol Central, Evesham and Bodmin. Her Majesty the Queen made the first STD call from Bristol on December 5 1958 so the Central Exchange there has now had the system for more than a year and a half. The exchange serves 6,700 lines in a predominantly business area, with very few residential subscribers, in the centre of a major city of some 450,000 inhabitants.

Bristol is a port, and has substantial industry. Bodmin, where the installation was opened on November 25 1959, is a small town in an agricultural area in Cornwall, with 350 Business and 180 Residential lines. Evesham, where STD was opened on January 5 1960, is the centre of the fruit growing district of the Southern Midlands, so that its telephone traffic is very seasonal; the exchange serves 740 Business and 520 Residential lines.

These three towns form a fair cross section of Southern England outside London. There are obvious dangers in basing final conclusions on them, since they include no predominantly residential exchanges, nor is any of them in the major conurbations, but they do give us our first chance to assess the STD service in operation, and our first glimpse of the future.

The most important questions about the operation of STD can be answered in statistical terms, either by measurement or as observation results, and I will deal with them first. In the tables averages are shown for the first three months after the introduction of STD at each place so that the results at the three centres can be compared.

How Subscribers are Dialling Trunk Calls

The first and most interesting question of all in a system which leaves users a choice of manual or STD services was the extent to which they would actually use the new facilities. Table I compares results in this respect at the three centres:

Table I. Analysis of calls to diallable exchanges: average of first three months following the introduction of STD at the centre concerned

Centre	% of calls to exchanges that can be reached by STD		VAG* calls as a percentage of *dialled* calls
	Dialled by Subscriber	Completed via operator	
Bristol (Ctrl)	96.4	3.6	1.4
Bodmin	95.6	4.4	0.6
Evesham	96.5	3.5	1.3

* *Calls received at switchboard on which caller accepted the operator's advice that he could dial the call himself (Verbal Advice Given.).*

Table II. Analysis of calls completed via operator to diallable exchanges

Centre	Percentage of total calls to diallable exchanges									
	Assis-tance*	Con-trolled†	Special Facilities							
			Personal		Transfer Charge		ADC		Total	
			Pre-STD	Post-STD	Pre-STD	Post-STD	Pre-STD	Post-STD	Pre-STD	Post-STD
Bristol (Central)	0.5	0.7	7.1	0.7	2.1	1.1	6.4	0.6	15.6	2.4
Bodmin	0.4	1.6	0.5	0.1	3.7	1.5	2.1	0.7	6.3	2.3
Evesham	1.5	0.7	2.7	0.3	1.2	1.0	1.6	0.1	5.6	1.3

* *Assistance = calls which caller had attempted to dial, but on which he had experienced difficulty.*
† *Controlled = ordinary calls which caller preferred the operator to complete.*

The results for each centre show a marked similarity in the percentage completed by dialling, and the percentage itself is remarkably high. This first, critical test seems to have been passed with flying colours. Preliminary results for the STD installations opened since Evesham also show remarkable consistency with these results, and at Bristol after 18 months the proportion is 97 per cent.

We may, of course, look to certain factors for the explanation. First, the tariff for STD calls, compared with that for manual calls made via the operator, offers a clear inducement to use STD; secondly, the new service is inherently quicker. Both points were emphasized in the White Papers (Cmnd. 303 and 436) in which the system was first presented to the public, and have been constantly kept before the attention of users in instructions and publicity.

Nevertheless, these results are still most encouraging, especially when the wide variety of places and users is considered.

Composition of Calls to the Operator

Table II illustrates in detail the composition of the traffic which, though diallable, nevertheless circulated via the operator. Assistance calls—that is, those on which the caller tried STD but experienced difficulty and felt bound to call the operator—form a very small percentage, and this may be regarded as evidence of the ease with which callers use the new facilities. Controlled calls—those for which the caller decided to call the operator from the outset—are also a very small proportion, indicating the readiness of callers to try the call in the first place via STD.

One notable event at Evesham occurred soon after the opening, when bad weather caused a serious cable breakdown. Although Evesham's trunk outlets were heavily reduced, callers continued to keep trying STD, and relatively little traffic was diverted to the manual board.

Reduction in A D and C Calls

A most striking result is the substantial reduction in Personal, and Advise Duration and Charge (AD & C) calls, especially at Bristol where the traffic is predominantly business. The inference is that a real change in telephone habits may begin with STD. Rather than place a personal call, for example, callers will make a one or two-unit call direct, to find whether the person they want is there. This result was anticipated, but it is most encouraging to find that it really happens. The very low proportion of AD & C calls is probably related to the meters which may be installed in STD subscribers' premises to indicate automatically the cost of the call in units as it progresses.

It seems clear from the figures in Tables I and II that public response in all three places has been to welcome the service, and to make good use of its facilities.

Table III shows the effect on traffic quantities and thus gives a measure of this response to the attractions of STD.

While Tables I and II show a remarkable similarity between the three centres, Table III shows wide divergence in certain respects. This is probably partly to be explained by seasonal traffic fluctuations and by the high proportion of business lines on Bristol Central, which tends to heighten any purely business reaction to the service there.

While STD has clearly led to an increase in trunk calls at each of the centres, only at Bristol is there any significant change in durations. This suggests a greater appreciation by the business community there of the short, cheap trunk call which can be made with STD.

One other noteworthy effect at Bristol has been the increase in the number of trunk calls to exchanges which cannot yet be reached by STD. It will be interesting to see whether this effect will be repeated at other comparable centres, where less publicity may be given to the introduction of the system.

Sufficient time has elapsed at Bristol to permit a tentative comparison of traffic trends once STD is in and working. The graph, Fig. 1, shows three-monthly moving average growth compared with the pre-STD level of calls per working day, for Bristol STD, Bristol non-diallable traffic and the United Kingdom. A rate of increase in STD traffic very much greater than the national can be plainly seen in the early months of 1959. The high level relative to the national figure is maintained and indeed rather improved on in subsequent months by both the non-STD and STD components. Greater economic expansion at Bristol than in the country generally might, of course, account for some of this, but a tentative inference may be drawn that the effects of STD show no sign of wearing off as yet.

Returning to Table III, it will be seen that the variation of the effect on total chargeable time between the three centres is rather less. Once more Bristol is to be distinguished from the other centres; if anything may be deduced from this it is again greater appreciation of STD among the business community.

Effect of STD on Traffic Over Various Distances

In his article in the Winter 1959 *Journal*, Mr. Longley described the STD Trunk Tariff and included a table showing, among other things, the change in charges for each charge step which it produces. Taking this part of the table, we can now compare it with the relative variations in traffic at the three centres (Table IV).

A number of variables must, of course, be taken into account, including the range of destinations available in each charge step from each centre. Nevertheless, the effect of the substantial reduction in the old top charge step can be plainly seen at Bristol. The greater rise at Evesham in the 35-50 miles step may well be explained by the fact that Birmingham falls in this range. This may be our first recognizable evidence of what happens when there is a substantial reduction in charge affecting a particular popular destination. It will become especially relevant when, as will happen next Summer, several large centres at top rate distance from one another, and therefore most affected by the cheaper tariff, get STD facilities simultaneously (all five Director systems are due to have some STD next Summer and Autumn).

Subscribers' Success in Dialling Trunk Calls

The success of subscribers in using the service may be inferred from the small proportion of

Table III:

Effect of STD on trunk traffic: Comparison of pre-STD traffic with levels and durations achieved three months after the introduction of STD

Centre	Calls to diallable exchanges: % increase	Chargeable Duration of *dialled* calls (minutes): Pre-STD	Post-STD	Net % effect on chargeable time	% Variation on calls to non-diallable exchanges	% Variation on total trunk calls
Bristol (Central)	+54.2	4.5	3.9	+34	+22.8	+41.3
Bodmin	+16.5	3.5	3.7	+23	−12.9	+ 6.8
Evesham	+20.2	3.5	3.4	+17	+12.6	+17.7

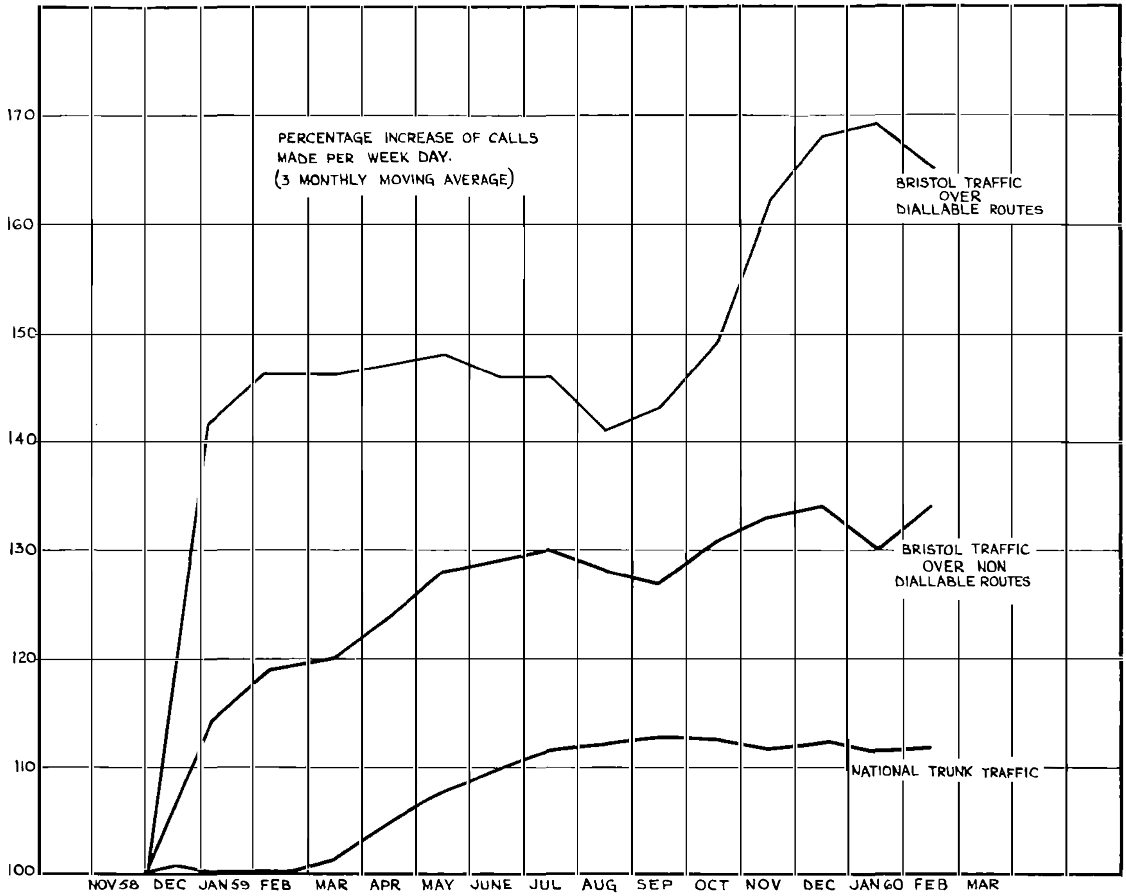


Fig. 1 : Traffic at Bristol

assistance calls but a more direct indication can be obtained from observation results. It is, of course, of particular interest to know whether users find much difficulty in coping with the relatively lengthy national numbers, of up to ten digits, which they are required to dial for STD calls.

Table V brings out the most significant observation results in this direction. Mistakes in dialling may contribute to all three categories according to whether the caller realizes his mistake and if so at what stage; it is notable that Bristol Central area, where one would expect to find the most sophisticated users, shows the highest percentage of errors. Bodmin was a manual-to-automatic conversion. It seems possible that the lower percentage there is due to the concentration of trunk traffic from Bodmin on relatively few destinations, compared with the wide range at Bristol; another contributing factor may be that Bodmin callers, under manual conditions, were not used to any kind of automatic operation, did not have to change ingrained dialling habits, and have also tended to study instructions more carefully.

The speed with which customers adapt themselves to STD may be gauged from Fig. 2, which compares the percentage of failures due to subscriber errors at Bodmin and Evesham over the period since the opening, with an indication, for comparison, of performance at Bristol over a year after opening. The better performance at Bodmin can be related to time on this graph. Evesham appears so far to be varying at about the

Charge Step	% Change in charge	% Change in no. of calls after STD			
		BRISTOL		BODMIN	EVESHAM
		By Pre-STD Steps	By Post-STD Steps	Post STD Steps	Post STD Steps
Up to 35m.	NIL	+24	+24	+19	−4.6
35–50m.	−15	+42	+42	−25	+33
50–75m.	+11	+42	+56	+33	+19
75–125m.	−17	+51			
125m. and over	−30	+97			

Table IV:

Percentage change in charge and percentage increase in calls by charge steps—Diallable Routes—Full Rate Period

Bristol level, whereas Bodmin shows a continuing improvement.

There is one other comparison which will become of increasing interest as STD spreads, but which may perhaps be made experimentally at this stage. Table VI compares performance by subscribers in a representative sample of local dialled traffic with a weighted average figure for STD traffic at the three centres in April 1960. The increase in errors comparing STD with Director three-letter four-figure dialling is in fact less than that comparing Director with non-Director five and six figure dialling. This again is encouraging although clearly at this stage it would be dangerous to draw firm conclusions.

Timing of Local Calls

So far I have dealt with the effects of STD, which is, after all, a trunk facility, on the trunk service. The 1958 White Paper *Telephone Policy—The Next Steps* (Cmnd. 436) announced that "in STD areas all calls will be timed, whether dialled by the subscriber or controlled by the operator," and Mr. Longley discussed the reasons for this. In the first place, the cost of a local call grows in proportion to its length, so that timing is economically justified; secondly, timing permits a reduction in the unit charge, from 3d. to 2d.; thirdly, by increasing the amount of time given for 2d. in the evening we can give a cheap rate period which may help to persuade people to make more of their calls outside the busy hours of the day; and finally it permits variation of time intervals and hence of the tariff, without varying the value of the unit.

Table VII summarizes the measured effects of timing on local calls at the three centres.

A most important aspect of local call timing is the distribution of calls by their duration and hence by the charge raised. At the time of writing we have no information for Bodmin or Evesham, but the pattern at Bristol can be clearly seen in the two pillar graphs (Fig. 3). Nearly 80 per cent. of Full Rate, and 91 per cent. of Cheap Rate calls are completed before the arrival of the second pulse. Subscribers' local call habits seem therefore to be fitting conveniently into the tariff pattern.

Table V:

Subscribers' performance: Analysis of call attempts, three months after the introduction of STD, which were ineffective due to errors by the calling subscriber

Centre	Percentage of dialled trunk call attempts				
	Dialled an Incomplete national number	Dialled an Unavailable national number	Abandoned Prematurely	Other causes	Total
Bristol (Central)	1.6	5.4	0.8	0.2	8.0
Bodmin	1.6	2.7	0.7	0.4	5.4
Evesham	1.4	3.4	1.7	1.3	7.8

Table VI. Comparison of percentage of call attempts ineffective due to errors by subscribers

National Local Non-Director	National Local Director	STD at 3 centres Weighted average April 1960
5 and 6 Digit Dialling	7 Digit Dialling	8, 9 and 10 Digit Dialling
2%	5%	7.2%

Effect on Subscribers' Accounts

With the bulk-billing system, of course, it is no longer possible to distinguish between local and dialled trunk-call charges. The effect of the introduction of STD and local call timing on the total call revenue collected in subscribers' bills can, however, be measured quite easily. Table VIII shows how this has been affected at Bristol. It will be seen that the initial drop, due to the effects of the STD Trunk Tariff on the subscriber dialled calls, was relatively small and was very soon compensated for by the increase in traffic.

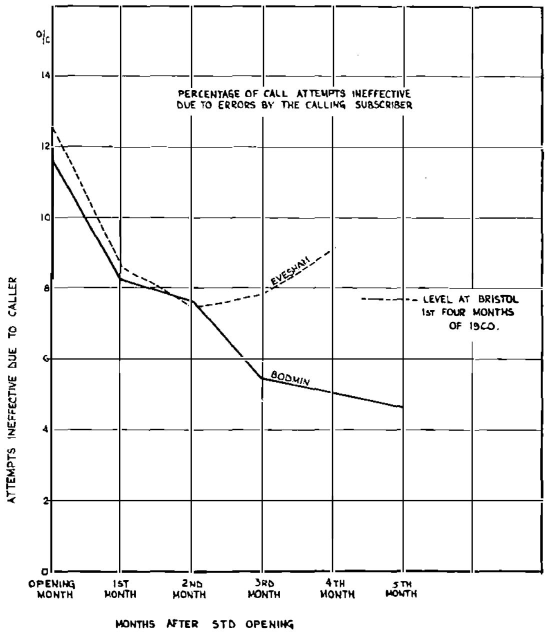


Fig. 2 : Subscribers' performance

Table VII. Effect of Timing on Local Calls

	Pre-STD Tariff 3d. per Call Untimed		Post-STD Tariff 2d. for 3 minutes (6 minutes 6 p.m.–6 a.m.)	
	Average Chargeable Duration	Pence per Call	Average Chargeable Duration	Pence per Call
BRISTOL				
Full Rate	2.92 mins.	3d.	2.30 mins.	2.8d.
Cheap Rate	2.03 mins.	3d.	2.34 mins.	2.3d.
BODMIN				
Full Rate	2.77 mins.	3d.	2.79 mins.	2.86d.
Cheap Rate	5.07 mins.	3d.	4.69 mins.	2.84d.
EVESHAM				
Full Rate	2.15 mins.	3d.	1.95 mins.	2.52d.
Cheap Rate	3.5 mins.	3d.	2.6 mins.	2.28d.

Table VIII. Average quarterly call charges per connexion—percent variation on pre-STD figure

	%
March 1959 quarter (1st after STD)	– 2.5
June 1959 quarter	– 0.5
September 1959 quarter	+ 3.5
December 1959 quarter	+ 11.7
March 1960 quarter	+ 14.7

Allowance has, of course, been made for the introduction of quarterly accounting, and the pre-STD figure to which these are referred was derived from the last bills before STD.

Account queries continue to be at a low level, and there is no evidence that bulk-billing has in any way added to the number of disputes.

Public Reaction to the New Service

Assessment of the success of the new service by measurement and observation of traffic characteristics gives a favourable picture. It is important, however, to build up an impression of the service as seen directly by callers and subscribers.

Not only has the public accepted and used STD but some 1,600 of the Bristol subscribers who have it responded to a request in the form of a questionnaire, for their views on it in some detail. Some of the most interesting results of the enquiry are shown in Table IX. Broadly, the enquiry confirms the general pattern of the operational statistics.

This is, perhaps, a convenient opportunity to review what we have learnt about the reception and effects of local call timing. This tariff is an important innovation, and we have waited with interest to see what happened when it was actually introduced.

We have already noted that the tariff seems to suit the calling habits of the majority of users, since all but a few calls are charged only 2d. The results in Table IX confirm this view. As far as general comment and reaction is concerned, there was some correspondence in the columns of the national and local Press when the idea was first presented to the public, and some criticism in other places. Some of this was due to misunderstanding of the implications of the tariff, and in particular the failure to realize that the unit charge goes down, so that most calls actually cost less. When these misunderstandings are removed, most people seem to accept the idea quite willingly.

Subscribers on the exchanges which actually have local calls timed have raised no complaints since they had their first bills on the new tariff. We can deduce from the revenue figures quoted earlier that there has been no dramatic increase in the local component of call charges.

One side effect of local call timing is beginning to appear. Firms which make a lot of local calls to certain fixed destinations are tending to rent more short distance private wires.

As regards the rest of the Bristol questionnaire, one or two interesting features emerge from a detailed analysis of the replies according to class and extent of user. Preference for the new service, among both business and residential users, increases with the amount of use made per day; 98.5 per cent. of firms making over 20 calls a day said that they preferred the new service. The technical excellence of the system as a whole may be gauged by the fact that 88 per cent. of replies said that very few calls, or at any rate not enough to be troublesome, failed to get through.

The National Numbers used in the United Kingdom STD system differ from those used by Continental countries, because they contain letters as well as figures in the codes. It is interesting therefore that 82 per cent. of replies favoured the use of letters in the codes, and that while among replies from residential subscribers making one or less calls a week the proportion in favour was only 74 per cent. among businesses making over 20 calls per day the figure was 91 per cent.

For technical reasons the range of places to which access could be given by STD at the outset in the three centres was limited. The proportion of Trunk Traffic which could become STD at the opening was 60 per cent. at Bristol and about 70

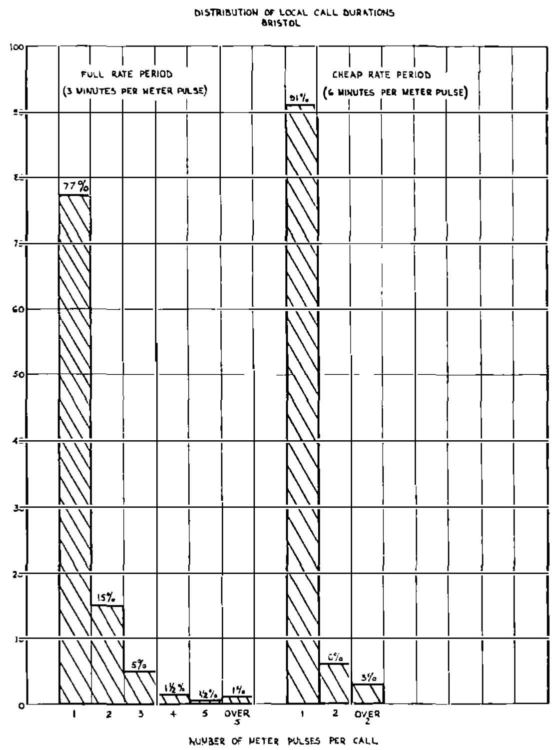


Fig. 3 : Timed local calls

per cent at Bodmin and Evesham. Only 18 per cent. of Bristol replies regarded the list of places to which access was available as extensive, and 49 per cent. as reasonable. The strength of this feeling is borne out by reports of views expressed by Private Branch Exchange operators, at both Bristol and Evesham, that wider access would be welcome. This enthusiasm for the service among specialist users, of course, confirms the generally favourable picture. It is also borne out by the favourable reaction when access from Bristol was increased, so that some 75 per cent. of Bristol Central Trunk traffic can now be dialled.

One or two other effects on business may be noted. The STD system is based on the bulk-billing of calls, so that individual calls are no longer identified on the account. The Post Office had anticipated considerable reaction against this, and two special facilities had been developed to assist customers in this situation—private meters for installing in subscribers' premises, and trunk barring facilities. In the event some 400 meters have been installed in Bristol, while barring facilities have been provided on only one installation there. The corresponding figures for Bodmin and Evesham are 18 private meters at Bodmin and 43 at Evesham, with no Barred Trunk lines at either place.

Some firms which conduct a lot of their business over those trunk routes on which STD is available have also reported perceptible savings on typing costs because STD enables the transaction of more business by telephone. At Evesham, special attention has been given to the possible effect of this on postal traffic, but it is understood that there has been none as yet. There is also some evidence at Evesham that firms in places which have not yet got STD, like London, have nevertheless appreciated the significance of the new service to their STD area contacts and are co-operating by, for example, giving a quicker answer on extensions, or by arranging to call back when the wanted person is not available at the first attempt.

Table IX. Bristol Central Exchange: Main points emerging from the questionnaire to Subscribers

Question	*Percentage of Replies*	
Do you prefer the subscriber trunk dialling service to the old service?	Yes 90	
If you are now dialling most of the trunk calls to the exchanges which can be dialled, is this—		
(*a*) Mainly because dialled calls are quicker?	25.6	
(*b*) Mainly because dialled calls are cheaper?	6.5	
(*c*) For both reasons equally?	59.9	
Does the new service give you quicker connexion to the required number on—		
(*a*) All the trunk calls you dial?	66.1	
(*b*) Most of the trunk calls you dial?	23.2	
Has STD led you to make more calls than you did before?		
Yes	30.6	
No	62.9	
Under the new tariff the charge for LOCAL calls is now 2d. for 3 minutes.		
Do you—	*Business*	*Residential*
Welcome this change?	36.1	42.9
Accept it on the whole?	37.5	25.0
Regret it?	21.7	24.3
Did you find the charge for calls on your first account—		
Less than you expected?	11.7	
About what you expected	52.7	
More than you expected?	18.4	

One difficulty encountered arises out of the combination of periodic metering and delays in reply by Private Branch Exchange extensions. With a tariff which so closely relates call duration to cost, any time which elapses once the Private Branch Exchange operator has answered and before useful conversation begins is wasted money as far as the caller is concerned. This is particularly annoying to users of the new Pay-on-Answer Coin-Box, since they must insert further money as soon as paid for time has run out.

The situation can be improved by arranging for very busy extensions like railway enquiry points to have direct exchange lines, and much effort is being put into education of PBX renters and operators to help in other ways.

The New Coin-Box

In September 1959 the first coin-box of an entirely new pattern was brought into public use in Bristol Central Exchange area. The new box, which Mr. A. V. Leaver described in the Autumn 1959 *Journal*, enables callers to use the STD facilities. By March 1960 all public and subscriber boxes in Bristol had been replaced by the new one. It is rather early to draw conclusions about it, even as tentative as those in the rest of this article, but the story would not be complete without a quick look at some of the important results.

As one would expect, coin-box users find STD a little more difficult than ordinary callers, since they are often strangers to Bristol; one of the worst fears about the coin-box, however, was that people answering calls from Bristol coin-boxes in other parts of the country might be confused by pay-tone, and hang up. So far there is no evidence that this is a serious problem. The operation of the box itself, which was the primary object of the trial, has given users very little trouble.

Whereas we saw earlier that callers on ordinary telephones are dialling 95 per cent. of their calls to the places they can reach by STD, the figure for the coin-box is only about 70 per cent. This is because so many calls from coin-boxes are transfer charge calls, where the caller has no incentive to dial his call. Apart from the transfer charge calls the number of calls to places which can be reached by STD has gone up by something over 130 per cent. since callers were able to dial them but their duration has come down by over 50 per cent. Calls to exchanges which cannot be dialled have also shown an increase. Revenue remains about the same.

More time must elapse, and we must gain experience in a wider range of places, before we can make confident statements about the effect of the new coin-box, but the outlook so far is reasonably promising.

Stop Press

So far I have dealt with events of past months which we have had time to analyse and digest. Readers may be interested, however, in really up-to-date figures for all the centres which have STD so far. I reproduce some of them below:—

Table X

	Increase in calls on diallable routes (over Pre-STD)	*Percentage dialled on diallable routes*
BRISTOL		
Central	72.9%	97.6%
Avonmouth and Bristol South (STD introduced 8.3 and 1.5.60)	21.5%	94.7%
BODMIN	23.9%	94.0%
EVESHAM	14.8%	96.6%
DUNDEE (STD 11.6.60)	8.6%	95.1%
WATFORD (STD 1.7.60)	24.1%	94.9%

The figures for the increase in calls show the same wide variations as we discussed earlier, and no doubt for the same reasons, among others; but it is extraordinary how close the second set of figures are.

Conclusions

The results and reactions which we have studied are, as I pointed out earlier, drawn from three centres which do not completely represent the country. They show wide variations in certain respects, but they do suggest certain broad conclusions which we may draw, always keeping their limitations in mind:—

(1) STD works satisfactorily, and is used by the public for 95 per cent. of all the calls they want to make to the places they can reach.

(2) It has produced a significant increase in revenue-earning time at each centre, and there are signs that the effects are proportional to the size and business activity of the centre concerned. So far these effects show no sign of wearing off.

(3) The new tariff for trunk calls has had effects comparable with those which might have been predicted.

(4) Users show a reasonably satisfactory degree of success in using the service and in dialling National Numbers, and there are no indications that unsuccessful callers are turning to the manual board for assistance on more than a small scale.

(5) Special facilities traffic shows significant reduction with STD, and there are signs that the short cheap call is valued.

(6) There has been no dramatic resistance to, and effect from, Local Call Timing, and in general the new principle seems to have been accepted.

(7) Revenue shows only a slight initial drop, as far as Bristol is concerned, which is more than compensated for by the subsequent traffic increase. Subscriber bills have now gone up, but considerably less than trunk traffic.

The Future

These conclusions justify reasonably optimistic expectations for the future. By the time this article is published seven exchanges will have STD facilities, and we shall be at the second stage of study of results. Dundee and Watford are both very different from the centres we have been studying, and they will give us our first insight into the reactions of users in the industrial towns of the north and the outer parts of the London conurbation. Watford, particularly, will be interesting because it contains the first dormitory areas of any size to have STD. Much attention will be devoted to the effects of local call timing there.

During the later months of this year and from early 1961 the programme will expand slowly, gathering speed in the Spring of 1961. The graph

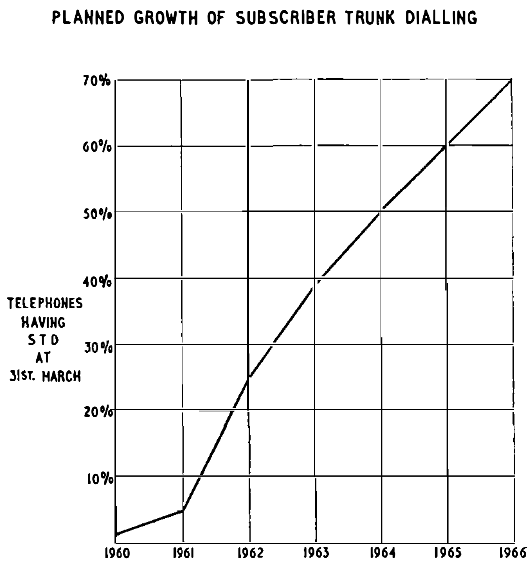


Fig. 4 : Plans for extension of STD

(Fig. 4), first published in the White Paper on *Post Office Capital Expenditure, 1960-61* shows how it will grow into the mid-sixties, as present plans come to fruition.

The biggest test after Bristol, however, will come in the Summer of 1961 when London, Birmingham, Edinburgh, Glasgow, Liverpool and Manchester get their first instalment of STD. We know now that STD is accepted and that it stimulates trunk traffic, in small and medium sized towns. No one can tell what will happen when large cities begin to use the new facilities; the interaction between London and Birmingham, for example, may produce quite unlooked for results.

The "great edifice" is still only a shadow; but one thing we do know, if I may change the metaphor—STD works!

The assembly and correlation of the data which form the basis of this article have of course, been a joint effort involving many people. This effort has been part of the wider exercise of assessing the results of STD in detail. The problems of measurement and observation which this has produced have called for a great deal of work and ingenuity by many people. Quite apart from the author's indebtedness to those who have contributed directly to the article itself, this is a convenient opportunity for those of us directly connected with STD planning at Headquarters to thank the large number of people who have worked and continue to work at the task.

Local Residential Call Charges cut

Reduced Rent for PABXs

The local call charge for residential telephone subscribers will be reduced from 3d. to 2½d. with accounts due after September 1, except where the Twopenny Telephone operates, with STD.

From September 1 the charge for timed trunk calls up to 25 miles will be reduced from 2s. 6d. (2s. 9d. from a call-box) to 2s. od. (2s. 3d. from a call-box) for three minutes. A corresponding reduction will be made for calls over 125 miles, from 1s. od. (1s. 3d.) to 9d. (1s. od.).

The cheap rate period on Sunday has been extended to cover the whole day; hitherto it has not started until 2 p.m. Thus, week-end cheap rates will now apply from 6 p.m. on Saturday to 6 a.m. on Monday.

Also from September 1 charges for Private Automatic Branch exchanges will be reduced:

Type No. 1	*Charge p.a.*
Up to 15 automatic extensions	£200 to £160
25-35 extensions	£280 to £240
Type No. 2	
Up to 15 automatic extensions	£240 to £200
25-35 automatic extensions	£320 to £290
Type No. 3 (privately installed)	
For every 50 extensions	£120 to £90
For each switchboard position	£60 to £50

From August 1 charges for calls in the service area of the experimental car radiophone in South Lancashire have been reduced from 2s. 6d. to 1s. 6d. for three minutes, and the radio fee (added to the initial charge) for calls outside the area from 2s. od. to 1s. od. for three minutes.

Transistorized Telephone for the Deaf

Post Office engineers have designed a new Hearing Aid telephone; the aid is a small transistorized amplifier fitted in the handset and replaces the battery type equipment, which was in a separate box.

The new telephone is available in black, elephant grey and ivory. The additional rental is 15/- a quarter, plus £3 initial charge for colour.

National Trust has Historic Marconi Site

The English Electric Group (which includes Marconi's Wireless Telegraph Company) has handed to the National Trust 40 acres of land at Poldhu, Cornwall—site of the radio station from which Marconi first spanned the Atlantic by wireless telegraphy in 1901.

* * *

The Assistant Postmaster General inaugurated Subscriber Trunk Dialling at Watford on July 1. Watford is the first exchange in London Telecommunications Region to have STD.

The British Contribution to TAT 2

J. F. Bampton, B.Sc.(Hons.), A.M.I.E.E.

THE OPENING IN SEPTEMBER 1959 OF A submarine cable system, providing direct circuits from New York to Paris and Frankfurt, known as Transatlantic Telephone Cable No. 2 (TAT 2), was a further important step in the progress of transatlantic communications. The cable system was constructed under a joint agreement between the United States, France and Western Germany, but both the British Post Office and British manufacturers played a significant part in engineering the link. This article serves to record some of the aspects of the work in which the United Kingdom was involved.

The project is important to the United Kingdom in that, taken in conjunction with the first cable laid in 1956, it provides alternative routing across the Atlantic. In the event of a cable fault interrupting service over one route the circuits available over the remaining route are shared between all parties, permitting an effective, if reduced, service to be maintained. This has proved to be of great value on several occasions.

To make clear how the United Kingdom were involved in this system it is necessary to refer to Fig. 1 which shows both the first transatlantic cable system (now known as TAT 1), and the second system, TAT 2.

The Eastern Telephone and Telegraph Company—an associate of the American Telephone and Telegraph Company—were responsible to the TAT 2 partners for engineering and providing the submarine sections of the route and they proceeded

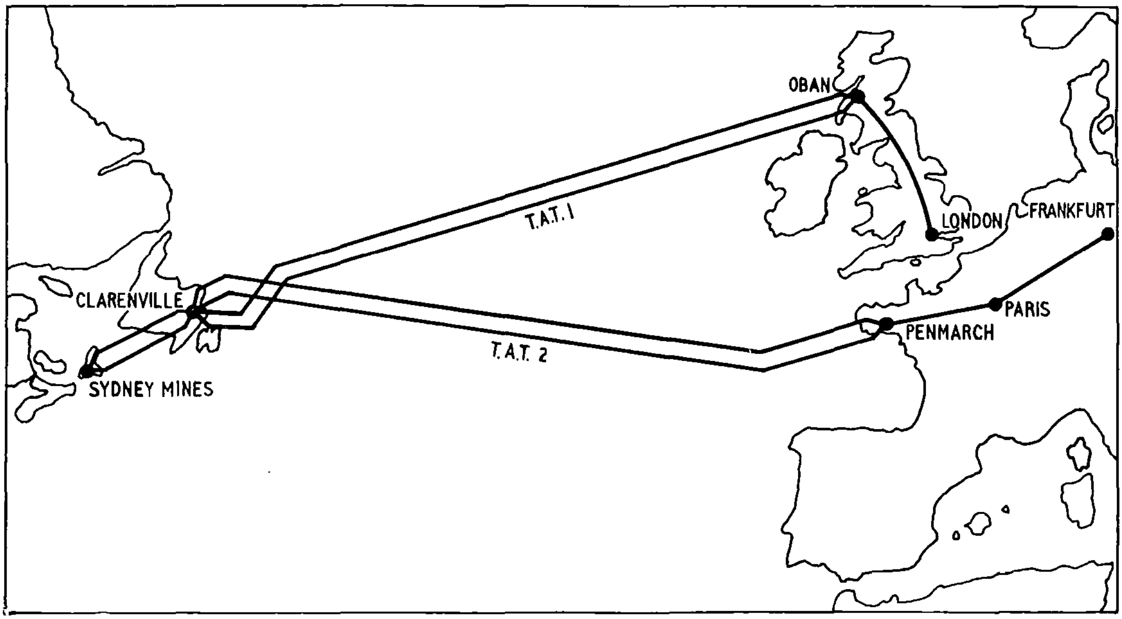


Fig. 1: TAT 1 and TAT 2 cable route

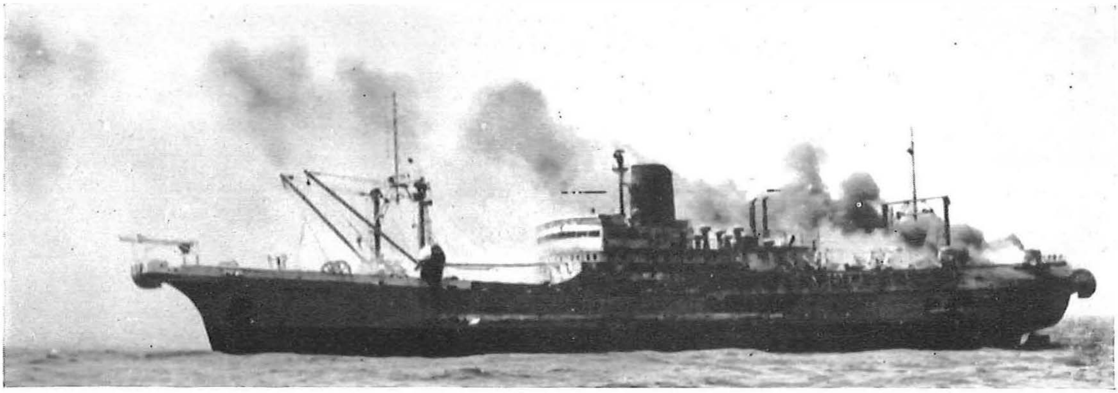


Fig. 2: The still blazing *Ocean Layer*, seen from the German ship *Flavia*, at dawn on June 16, 1959

on the basis that this new system should be technically a repetition of TAT 1. This meant that over the ocean crossing between Penmarch in France and Clarenville in Newfoundland, twin 0.62 in. cables with Bell System flexible repeaters would be used, providing 36-4kc/s circuits, and between Clarenville and Sydney Mines in Nova Scotia, a single 0.62 in. cable using British Post Office rigid repeaters, having a capacity of 60-4kc/s circuits, would be laid.

The E. T. and T. Company, in carrying out its responsibility for the provision of these cables, called on the British Post Office and British manufacturers to provide cable repeaters, equipment and services, very much as they did on TAT 1.

There were, however, two important exceptions. First, the British cable manufacturers supplied substantially less cable than on TAT 1, for France and Western Germany were providing cable as part of their contribution to the project. Secondly, all the cable laying, comprising two transatlantic crossings and the link between Nova Scotia and Newfoundland, was to be completed in one year, and this required the use of two cable ships, H.M.T.S. *Monarch* (Post Office) and the Submarine Cables Ltd. cable laying ship *Ocean Layer*. The disaster which overtook *Ocean Layer* in the execution of its commission is recalled later.

The British Post Office readily agreed to provide and commission the Newfoundland Nova Scotia link. All the old plans for TAT 1, thought to be safely tucked away in the files forever, were brought out and re-examined to make sure that they were still valid for TAT 2. Some technical changes were necessary because the second cable was longer, as it had to follow a route giving adequate clearance from the first cable. In general, however, changes were very few, and the work proceeded smoothly.

It is perhaps an indication of the policy of co-operation that has been built up between the American and British concerns, that the Post Office should have been called on to accept, on behalf of the E. T. and T. Company, technical responsibility for a link in a project in which the United Kingdom had no direct interest.

Co-operation such as this has been built up since the start of TAT 1 and now extends to many aspects of submarine system engineering. We find British Post Office staff working in such places as Miami, Florida, San Juan and Puerto Rico, testing and commissioning their own equipment, forming part of purely A. T. & T. Company projects; the Post Office has commitments to carry out similar work shortly in San Francisco and Hawaii. This "lease lend" of personnel and technical "know how" works both ways, as evidenced by the fact that American engineers have recently been working in London commissioning the new Bell System TASI (Time Assignment Speech Interpolation) equipment which approximately doubles the amount of traffic which can be passed over a group of telephone channels, because channels are seized only when required to pass speech signals.

Ocean Layer and *Monarch* were scheduled to complete between them all the cable work by August 4, 1959, so that a "ready for service" date of October 1 could be achieved.

Monarch laid the East-West cable without incident, started the laying of the West-East cable and handed over to *Ocean Layer* to complete the

Fig. 3 : Bridge of the *Ocean Layer* after the fire looking towards the Port side

(Courtesy, Submarine Cables Ltd.)

work as planned while *Monarch* returned to England to prepare to lay the Newfoundland-Nova Scotia cable.

On June 15, when *Ocean Layer* had laid the West-East cable to a point 650 miles from France, a fire occurred which swept rapidly through the ship. When it became apparent that the fire could not be brought under control, the order "Abandon Ship" was given and crew and testing teams took to the boats with just about the clothes they stood up in, leaving behind a burning ship with the submarine cable still hanging from the bows.

The intensity of the fire can be judged from the fact that shortly afterwards the steel-armoured cable was burned through, and the free end ran out over the bows and fell to the bottom in some 2,300 fathoms. The ship was subsequently towed to England, but she was considered a complete wreck, and was broken up. Fig. 2 shows a view of the burning ship, and Figs. 3 and 4 give an idea of the internal damage suffered.

H.M.T.S. *Monarch* at that time was at Erith preparing to load the Clarenville-Sydney Mines section. Operations were suspended and *Monarch* was instructed to proceed to Nordenheim, Germany, to load the last section of the main West-East transatlantic cable. With this on board, she proceeded to the location of the end left by *Ocean Layer* and started to grapple. In depths of this sort, about two miles, such an operation can take many days but fortunately on this occasion the end was secured after only seven hours.

Monarch jointed on to the cable and then proceeded to lay the remaining length into Penmarch. She then returned to Erith, loaded, and subsequently laid the Clarenville-Sydney Mines cable.

On this occasion the newly-developed laying gear, which permits cable with rigid repeaters to be laid continuously from the stern of the ship (see Fig. 5) was tried out for the first time, and the trial provided valuable information for the recent laying of the Anglo-Swedish cable and for the CANTAT and COMPAC cables which are to follow.

The final splice, the last of the whole enterprise, was completed on August 22. However, cable systems of this sort cannot be put into service immediately after the final splice is made. A period has to be allowed for final testing and adjustment of the submarine cable link, followed by a further period for connecting the land line extensions at each end and lining-up all circuits between the switchboards in the metropolitan terminals.

To refer back for a moment to TAT 1, a period of 11 weeks had been allowed for testing the submarine cable link and for designing and providing "mop up" equalisers to establish correct operating conditions on the cable. On TAT 2 the Clarenville-Sydney Mines section was by virtue of the laying schedule the last link in the chain to be completed. Delay in commissioning this section meant delay in opening service between New York, Paris and Frankfurt, and our American friends said "We'll be generous, we want you to hand over the link 11 *days* after the final splice!"

To meet the 11-day test period a complete re-assessment of testing methods was required and, using to the full experience gained on TAT 1, detailed instructions of every test and operation were prepared in advance. The testing staff were trained in their functions and a small but complete coil winding and equaliser assembly unit was sent to each terminal station. As time progressed, and news of the loss of the *Ocean Layer* came in, it became imperative that this testing and commissioning period of 11 days should not be exceeded.

When the final splice on the Clarenville-Sydney Mines cable was made on August 22, this work was immediately started, and was continued night and day until completion. The completely tested and equalised system was handed over 10 days later, one day ahead of target.

The route was now ready from Nova Scotia to Penmarch, North America was coupled to Europe, and all that remained was to connect the land line extensions to the submarine system. The final detailed line-up of the whole route was completed and the system was opened for service on September 22, giving 24 high grade circuits between New York and Paris, and 12 between New York and Frankfurt. Even with the loss of *Ocean Layer* the target date of October 1 had thus been achieved.

As a footnote to this article, it should perhaps be recorded that the demand for circuits on this system is such that measures are being taken to obtain more circuits by converting the 36-4 kc/s channels

Fig. 4: Remains of a double bunk in crew's quarters

(Courtesy, Submarine Cables Ltd.)

to 48-kc/s over the submarine sections. This will involve installing 3 kc/s channelling equipment of French design at Penmarch and Sydney Mines. Shortly after this conversion, TASI equipment will be connected at New York and Paris, thereby more than doubling the effective circuit capacity.

With this TASI and 3 kc/s channelling system, special alarm reporting equipment and gain control equipment supplied by the British Post Office is

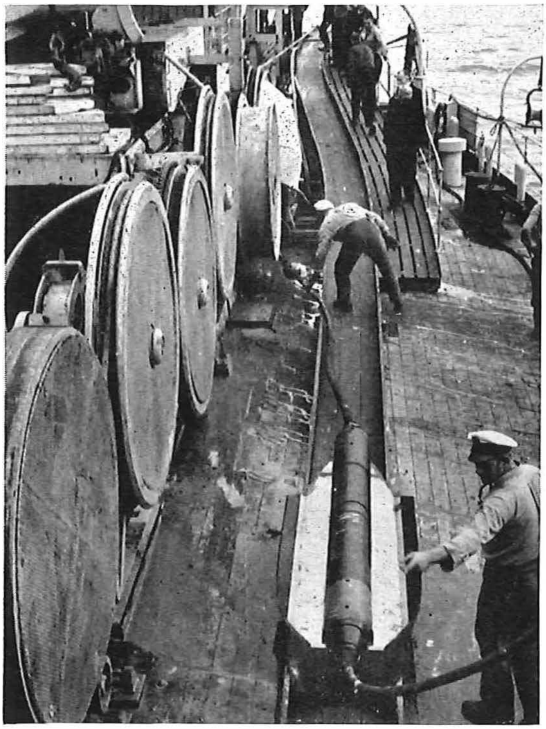


Fig. 5 : Rigid repeater passing V-sheaves on *Monarch*, cable strain being maintained with by-pass rope

(Courtesy, Standard Telephones & Cables Ltd.)

being installed at New York, Clarenville and Sydney Mines, and certain items of the alarm equipment in Penmarch and Paris. Post Office staff will shortly be on site to make final tests and to commission these equipments, which in themselves form a further British contribution to the operation of the whole TAT 2 project.

The Index for Volume 12 will be found on page 200.

TAT 3 in 1963

A new transatlantic telephone cable—TAT 3, the largest oceanic cable yet—will come into operation in 1963, carrying 128 telephone circuits between the United Kingdom and the United States. The agreement between the British Post Office and the American Telephone and Telegraph Company to lay the new cable (which will be owned in equal partnership) was published on July 21; the signed agreement has to be approved by a Resolution of the House of Commons before it can become effective.

The number of calls between the U.K. and the U.S.A. is already three and a half times greater than it was before the first Transatlantic telephone cable opened in 1956, and is growing at the rate of about 500 a month. At first some of the new circuits will be used for calls to Europe, so providing some relief to the Franco-American cable opened in 1959.

New Stage in World System

The new cable is estimated to cost about £12 million. It represents a further stage in plans for the world-wide system of submarine telephone cables in which the Post Office and Cable & Wireless Ltd., will play a major part. The Company will provide the United Kingdom share in CANTAT in 1961 and the trans-Pacific cable between Canada and Australia in 1963–64.

Landing points of the new cable have not yet been settled. It will run direct between the United Kingdom and the United States, unlike TATs 1 and 2, which both land in Newfoundland. The total length will be about 3,400 nautical miles.

The cable will be of the lightweight type, using polythene insulation without external armouring, as in the projected CANTAT. Overall deep sea diameter will be about $1\frac{1}{4}$ in. A single cable will carry speech in both directions.

180 Repeaters

About 180 rigid type repeaters of a new Bell Telephone design will boost speech at intervals of about 20 miles.

The cable will transmit radio programme material but will not be used for live television, the bandwidth not being sufficient.

Installations Extraordinary

C. R. Dancey

To those employed in the telephone service, the words "customer's installation" can conjure up a wide range of possibilities, from the simple direct exchange line through a variety of "plan numbers" to switchboards large and small. These are all standard arrangements which have been developed because, between them, they meet the needs of the majority.

It is not perhaps widely realized that there are nevertheless many customers, particularly in the large cities, whose specialized requirements demand installations which do not in the least resemble the more conventional types. Some of them involving unique designs have merited the attentions of the Engineer-in-Chief's Office, and readers of the *Journal* will doubtless recall descriptions of a few of these in past issues. Only passing mention seems to have been made, however, of a rather humble (in the technical sense) type of equipment which is quite common in central London and is also used in the bigger provincial centres. This is the "key and lamp unit", otherwise known as the "order table unit" or, to some contractors, as "rapid answering equipment". Its main use is to enable a considerable volume of incoming calls to be handled by a team of enquiry or booking clerks, but it also finds application in special installations such as that of the Surrey Fire Brigade (Summer *Journal*).

The Key and Lamp Unit

Key and lamp units are by no means a new development; they were being installed in London as far back as 1926, the equipment being wired up on site in cabinets provided by the subscriber or made up by the Post Office. At least one of these original suites of units (Fig. 1) is still in use at a large London store. The present type of 10-way key and lamp unit (differing little from the original except that it had gained official recognition) was first installed in London in 1939, although it was not until after the war that it came into general use.

The basic unit (Fig. 2) is very simple. It consists of 10 circuits, each controlled by a three-position key and having two associated lamps which are powered from a 6-volt A.C. supply. One is a calling lamp, the circuit responding to the normal 17 cycle

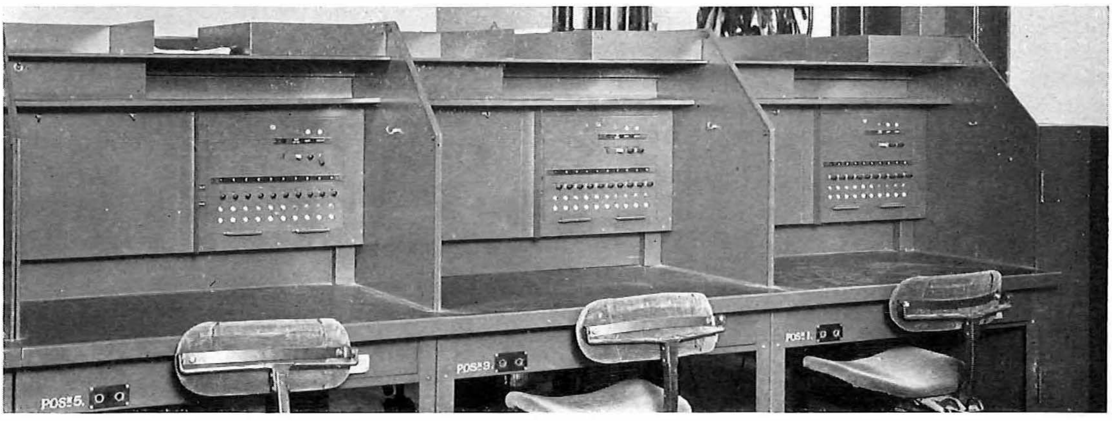


Fig. 1 : An early type of key and lamp installation

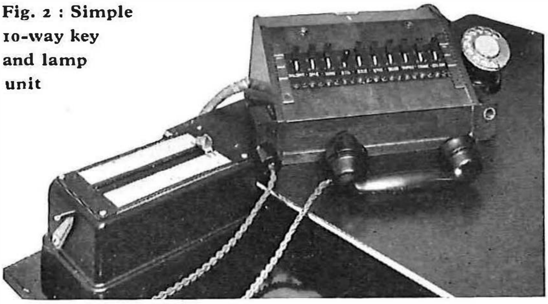


Fig. 2 : Simple 10-way key and lamp unit

ringing current and thus being suitable for the termination of an exchange line or an extension from a switchboard. The second lamp acts as a visual engaged signal which glows when the circuit is in use by any of the clerks. The three-position keys provide "receiving", "holding", and "speaking" facilities, and the clerk normally uses a hand-microphone. Associated with each installation is an apparatus rack (Fig. 3) housing the control relays and power equipment. Although key and lamp units are sometimes used singly, their chief application is in large installations in which each calling signal is presented to a number of clerks, in the same way as a call on an auto-manual switchboard. Such installations may consist of up to a hundred or more key and lamp units.

Flexibility

One of the great attractions of the key and lamp installation is its flexibility. This is at a maximum if each unit is wired back separately to a single large distribution frame for jumpering to the incoming lines. Units can then be grouped to any plan required, with different circuits appearing on each group. In practice, it is sometimes more convenient to wire groups of units in parallel to sub-distribution frames, which are then cabled to the main frame. This economizes in cable at the expense of some of the flexibility, but is dependent on the customer being able, and willing, to provide a convenient site for the sub-distribution frames. Often, however, his furniture lay-out does not permit of this.

Each unit can be built up in capacity by adding further 10-way strips, and there are commonly in use groups of 20, 30 and 50 line units which provide the equivalent of an answering multiple such as is found in a telephone exchange. By the addition of a few relays on the apparatus rack, signalling circuits can be provided between the units, or they can be equipped with outgoing signalling or dialling circuits.

Other refinements available include a flicker signal for delayed answer calls (30 seconds is usual), and a multipled monitoring or observation panel for check on "time to answer" and general service. All these circuits are extremely simple by modern standards, but in performance they hold their own well, and because of their simplicity their fault liability is extremely low.

Location of Equipment

The standard mounting shown in Fig. 2 is intended for desk or table use, and many installations are of this form. The special requirements of some customers, however, have led to housing the

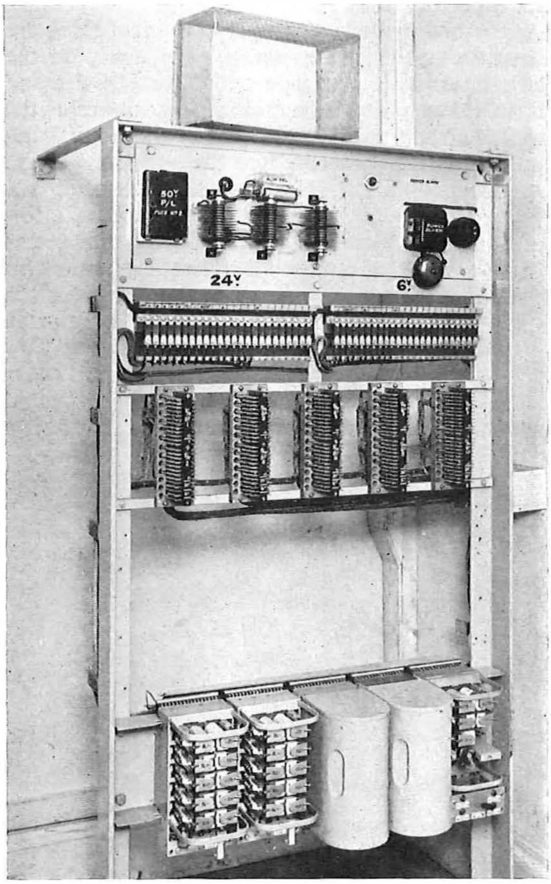


Fig. 3 : Typical apparatus rack associated with key and lamp unit

Fig. 4 : Overhead fittings at the London Forecast Office, Kingsway

(Courtesy, Air Ministry)

units in specially made furniture. Usually the prime object of this is to avoid interference with the user's working space, but some of the designs are original and decorative. These bring their complications in planning and cabling, and the Area Sales, Traffic and Engineering Divisions have to co-operate very closely with the customer. On the engineering side these special designs can have their advantages, because we can often arrange for cabling, distribution points and local wiring to be concealed while ensuring adequate access for maintenance. This is most welcome, because the cable used for multiple-way key and lamp units is sizeable stuff and the sight of it tends to irritate customers who are finicky about their furniture.

The overhead fittings at the new London Forecast Office of the Meteorological Service, designed to clear desk space for charts, provide an interesting example (Fig. 4), while at New Scotland Yard, key and lamp units form an integral part of the design of the Information Suite.

The prime requirement is, of course, that any call can be answered by one of a number of clerks; the circuit arrangements can remain simple because, once answered, the calls are not extended elsewhere. With the flexibility thus available telephone exchange practice can be copied, the number of staff being adjusted to the traffic expected at any time, and suitable loads being offered to the various groups of staff. Additional flexibility can be introduced by associating the key and lamp units with switchboard extensions rather than with direct exchange lines, or by routing the incoming exchange lines to the units via the PBX switchboard, so that calls can be intercepted there at certain times, or misrouted calls picked up and dealt with by the PBX operators.

Although each key and lamp unit installation is an individually designed project, most of the larger ones fall into one of two main classes, those concerned with either (i) order booking or information, or (ii) reservation.

Order Booking or Information

At installations of this kind, each clerk needs ready access to as much information as possible, and a speedy service must be ensured by providing a repetition of the incoming line signals over a number of positions. Such a service is needed for instance by bookmakers, order departments of big stores, and information bureaux in general; their requirements have in fact a marked similarity to those of Post Office Directory Enquiry bureaux.

Automobile Association

Perhaps the most ambitious installation to date is the sweep of consoles in the architect designed Operations Room of the Automobile Association (Fig. 5), an excellent example of the satisfactory results obtained when Post Office requirements are considered at an early stage in planning the accommodation. Because of the diversity of matters dealt with at A.A. Headquarters there is a great deal of specialization; all incoming calls are therefore received first at the main PABX switchboard and directed to the appropriate departments. The information suite deals mainly with breakdown calls and road weather reports, but is also used as a general night service enquiry point.

A main suite of 20 information positions is arranged around the stepped "horseshoe", and an overflow provision of 10 similar positions below (Fig. 5). Each position contains a 30-way key and lamp unit with its equipments fitted as a single row. The 30 lines incoming from the PABX switchboard are connected to the first 18 signals on each position via a grading which gives full availability on the first 12 lines (that is, calls on these lines appear at *all* positions). On all the incoming lines there is a flashing delay signal operative after

Fig. 5 : Operations room, Fanum House *(Courtesy, Automobile Association)*

30 seconds. In addition the following circuits are available on each position:—

(i) Omnibus circuit to the radio operator. He is situated in the glass cubicle at the head of the suites and is in touch with radio controlled patrol vehicles, whose assistance can be obtained if required (an article on the A.A. mobile radio services appeared in the Winter (November) 1958 *Journal*).

(ii) individual outgoing PABX circuit, for calling A.A. garages and other points;

(iii) circuits to the watchkeeper's keyboard (foreground Fig. 5), and manager's office;

(iv) incoming "night service" circuits extended from certain A.A. offices closed at night—for example, Chelmsford, Maidstone.

The clerks can refer to the large maps which are repeated around the walls; they also have their individual sets of reference books.

The information is held in three categories:—

(*a*) common information, duplicated on the positions;

(*b*) information occasionally needed, at the watchkeeper's desk;

(*c*) reference library, behind the radio cubicle.

The watchkeeper and manager have 50-way key and lamp units on which *all* circuits appear, and can thus pick up difficult calls from any position. The radio cubicle is served by two 10-way units. In the whole installation there is the maximum of flexibility, all units being wired back separately to

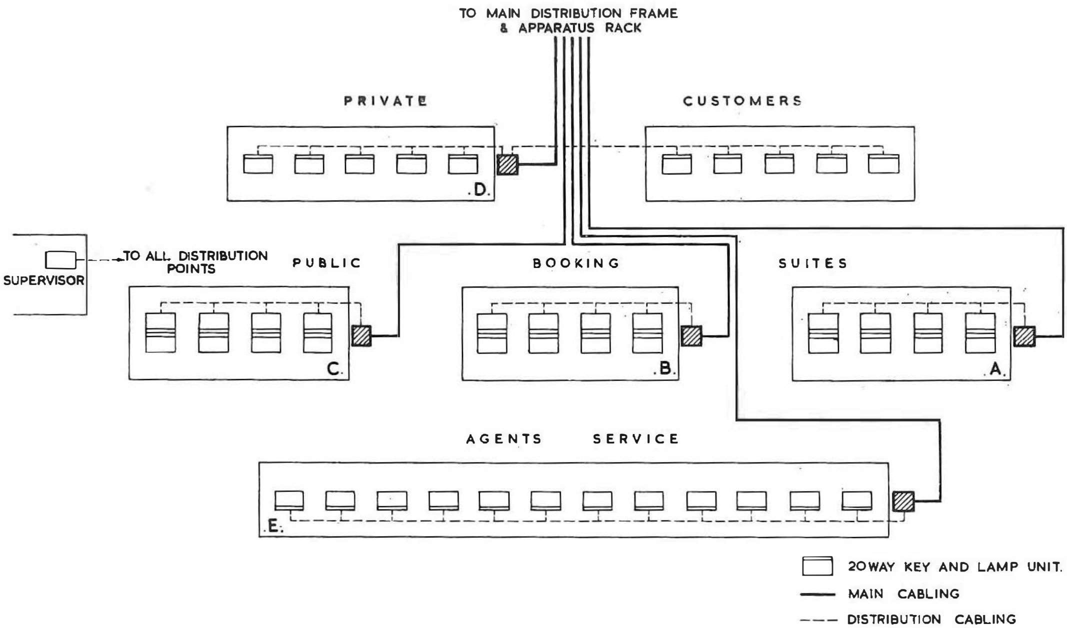


Fig. 6 : Simplified cabling diagram of a typical installation (Keith Prowse & Co. Ltd.—Theatre Tickets)

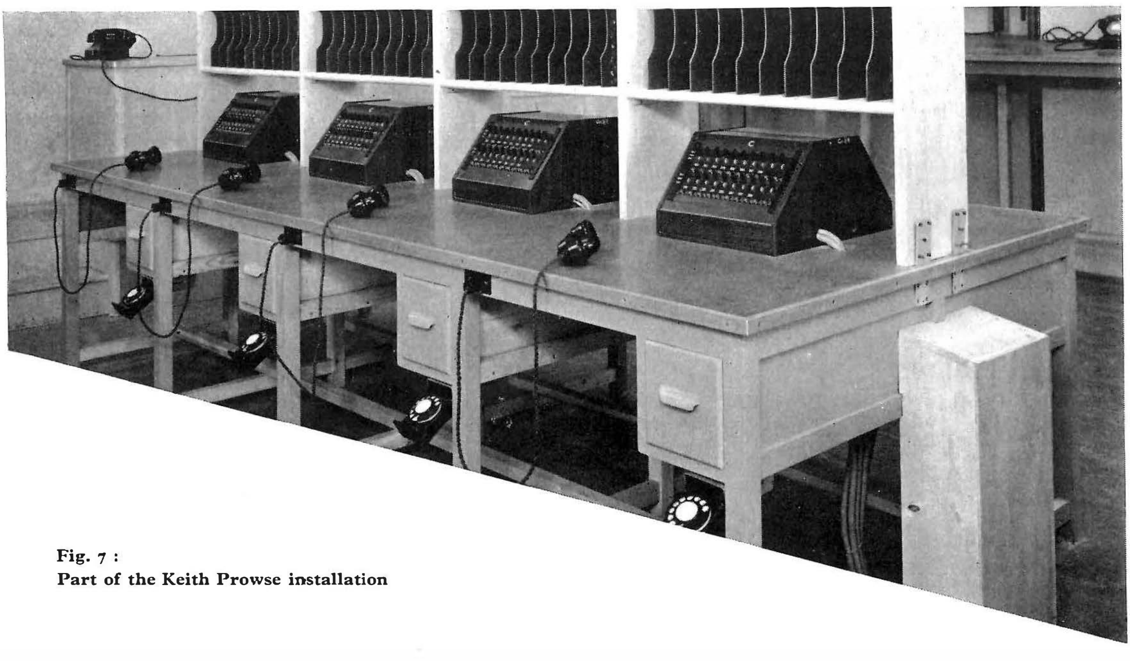


Fig. 7 :
Part of the Keith Prowse installation

the main distribution frame, so that alterations, whether for traffic reasons or because of changes in the organization, can be carried out easily.

Reservations

In these installations there is an additional need to refer to a master copy of information, which itself is changed as a result of the calls received, and must be constantly kept up to date. Examples are organizations dealing with theatre bookings, or travel reservations of various kinds.

In large installations, where it is not practicable to have up to date copies of the master list available to all the staff, the information schedule has to be split into parts and enquiries directed to the appropriate group of staff. If incoming traffic is received via a switchboard, distribution can be undertaken there; alternatively separate groups of numbers can be allotted and publicized so that calls go directly to the correct section. As would be expected the former arrangement is usually preferred in spite of the double handling. Reactions to the possibility of "unfortunate calls" vary, depending perhaps on whether or not the particular business is competitive. Some of the concerns using these installations are very "traffic conscious", however, and solutions range from call queueing systems, recorded announcements and flashing calling signals to liberal staffing or special adjustment of the organization to traffic needs.

Keith Prowse

Fig. 6 shows the simplified cabling diagram of a typical installation comprising a total of 47 20-way key and lamp units; the inclusion of sub-distribution points, providing a certain economy in cabling, will be noted. Incoming calls are received over extensions from the main PABX; they may be extended manually from the switchboard (calls from the public) or dialled direct (from agencies served by external extensions from the PABX). Each suite has a block of consecutive extension numbers.

A photograph of the "C" suite, one of the three on which bookings from the public are received, is shown in Fig. 7; the sub-distribution point is in the wooden housing on the near end of the table. Each of these three suites dealt originally with bookings for specified theatres, and separate master lists

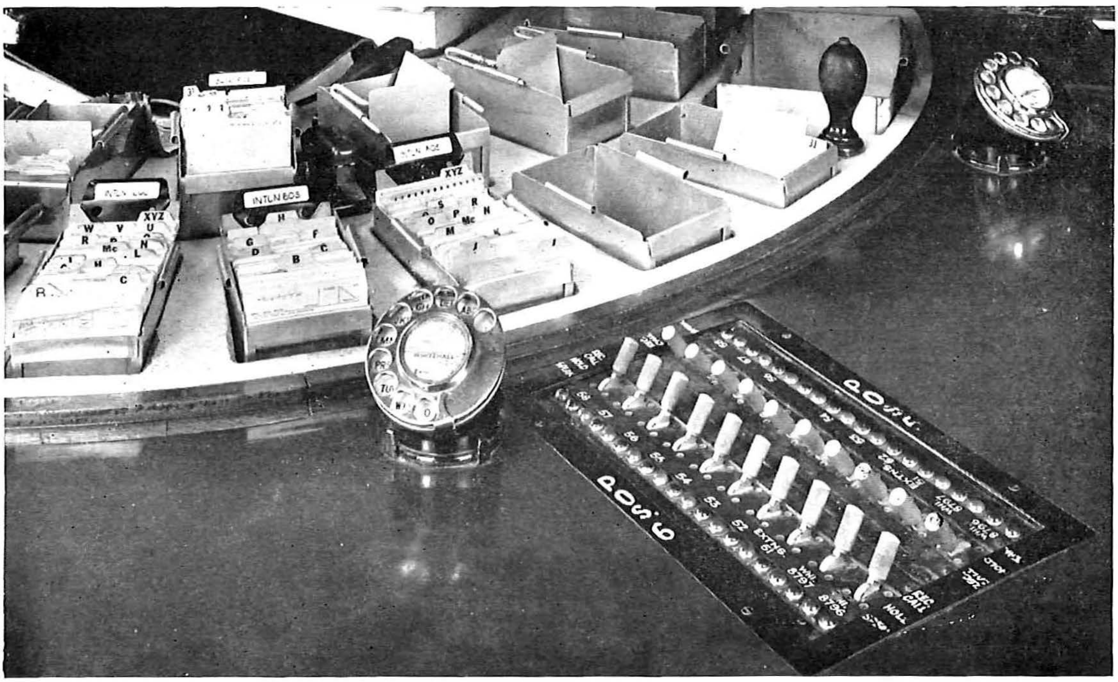


Fig. 8 : Mountings in circular table *(Courtesy Trans-Canada Airlines)*

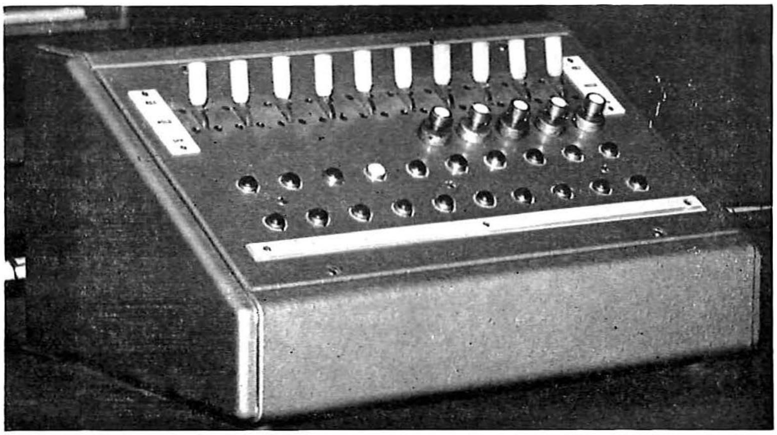


Fig. 9 :
10-way key and lamp unit in metal case

were kept. It was difficult, however, to forecast the flow of traffic with any certainty, and eventually the organization was changed to treat the A, B and C suites as one large group for the purposes of incoming calls. This might appear to be a retrograde step, because the clerks cannot now reach all the records without leaving their seats. In fact, however, businesses which use this arrangement do not seem to find it too objectionable (they are not committed to call valuation techniques!) and their staff welcome the breaks from sitting.

Trans-Canada Airlines

An unusual arrangement of the reservation type is that of Trans-Canada Airlines, part of which is shown in Fig. 8. Here the problem of a common master list has been tackled by arranging the operating positions around a large circular table. The ubiquitous key and lamp units are flush-mounted around the table, while the master information is on cards contained in buckets fitted within a movable central section. The whole central section can be rotated by hand (one of the handles is seen on the right of the picture) so that any set of cards can be brought within the reach of any reservation clerk.

Uses of single units

Although in this article some emphasis has been laid on the use of key and lamp units in large multiple installations, single units are also quite widely called on to provide facilities which cannot be given conveniently by other Post Office standard equipment. An example is their use as "concentrators" in the Private Offices of Cabinet Ministers, where several circuits are required to be terminated and answered by the Private Secretary or his assistants. Certain business customers also make use of facilities of this kind, which are usually provided by the simple 10-way unit shown in Fig. 2, although the mountings vary. A recent local innovation is the use of pressed steel cases with a hammered finish (Fig. 9); these present a pleasing and more modern appearance at a cost less than that of their wooden counterparts.

Are key and lamp units likely to stay with us in the face of present day developments? In relation to booking installations, for instance, we hear that in the U.S.A. there is an airline booking network centred on a computer, which not only gives information to distant points about flights available, but also accepts and records reservations. Computers are, however, notoriously expensive. A more down-to-earth alternative is the PABX with call-queueing facilities, but although this has in fact been introduced by one or two large organizations, its economic justification lies primarily in saving manual handling of internal traffic.

The probability is therefore that key and lamp installations of varying size will continue in use for quite a number of years to come. Some thought has indeed been given to modernizing the standard units to conform with current trends in design, but because they still meet essential needs quite well the project has had to be deferred while other more pressing commitments are being tackled. Whether or not they eventually appear in some new physical form, their flexibility and reliability will continue to make them a most useful feature of our service, and their permutations and combinations will provide an interesting challenge to our planning and construction staff.

Problems of Wayleaves and Damage Claims

S. A. T. Hobcraft

THOSE who have read Dickens' *Bleak House* or have seen the recent television play based on it will understand the fascination of litigation. Perhaps it is because there is so often the possibility of litigation that most cases handled on the "Wayleaves, Damage and Claims" duty in Post Office telecommunications branches generate such absorbing interest. One Telecommunications Controller has called this duty the "Rag Bag" of the branch; certainly a miscellany of items comes its way. Nearly all the problems are different in some way or another, but descriptions of some typical ones may serve to illustrate the kind of work that is done.

"Calais" is said to have been engraved on the heart of Mary Queen of Scots. Certainly the name of one local authority is indelibly stamped in the minds of those who since 1952 have been corresponding with that particular Council about the erection of telephone poles on their housing estates. The Council, filled with civic pride and conscious of the improvements on its post-war housing estates, objects most strongly to poles and refuses to allow them on the highway.

While some poles could be erected unobtrusively off the highway, all poles on council property cannot be put up in this way. In an endeavour to avoid the deadlock now reached, a number of alternatives to the standard methods of distribution has been considered.

In neighbourhoods with very low "forecast penetration"—which means, of course, nearly all council housing estates—some poles have to be erected on the highway if uneconomic costs are to be avoided. A wholly underground system of distribution, for example, might be as much as six times as costly as standard overhead distribution. Similarly, if the wires were arranged to run from poles placed only on council property in, for example, back gardens, it would still be necessary to lay cables from the highway to the distribution poles and the costs might be about one and a half times as much, even if the Council did the necessary trenching on their property.

On one housing estate, however, the layout of the houses in long serried terraced blocks enabled the Post Office to offer a novel "undereave" form of distribution which provided for running wires from distribution poles near the housing blocks and along the housing eaves to the addresses to be served. The Council has agreed to this.

Unfortunately, the other estates are not so suitable for this form of construction because of semi-detached properties and some of the eaves are of metal or asbestos to which wires cannot easily be attached. The Post Office is therefore doing what it can to persuade the Borough Council that on some parts of these other estates standard distribution methods involving "feeder" poles must be adopted. In the meantime, however, the Council—being the body having control of the roads—refuses to allow any poles at all to go up. Fortunately no doctors or other essential applicants require service at present.

Another aspect of this pole business is trying to explain to aggrieved householders why their house, of all those around, should be the one outside which it is necessary to erect a pole. The amount of work this causes (especially when a Parliamentary question, or a letter to an M.P., is involved) has to be experienced to be fully appreciated.

Of course, poles and wires are not the only plant for which permission has to be sought before placing. Problems concerning the depth and course of Post Office ducts and cables are not uncommon and disputes sometimes arise with the Highway Authority—usually the Local or County Surveyor—about such matters as the proposed location of our plant or the use of polythene cable at shallow depth in the footway.

The Engineering Branch are technical advisers to the Telecommunications Branch where engineering problems are involved and usually with their help a solution can be found or some satisfactory compromise reached.

For polythene cable at shallow depth, for example, objections may be overcome by offering an indemnity agreement safeguarding the Highway Authority against any claims arising from damage done to Post Office plant by their workmen, provided reasonable care was taken. All work involving placing cable in the ground as distinct from erecting poles has to be carried out in accordance with the provisions of the Public Utilities Street Works Act, 1950.

The "Damage" complaints might give a newcomer a quite false impression of the way the Post Office goes about its work. As the handling of complaints is centralized there seems to be a steady stream of claims and sometimes the cost of making good is very high indeed.

For example, it cost £60 to compensate a resident for felling without permission a cherished tree in her garden. More than £100 had to be paid when a flat roof was damaged by cable nailed to it. When the retaining wall of an elevated road needed rebuilding because a pole had been put too close to it, the cost was over £120, and quite recently nearly £150 had to be paid when ice formed on wires attached to a chimney bracket and caused the chimney to crash through a kitchen roof below. All such matters are referred to the Telecommunications Branch, either because of the sum involved or because there is doubt about the Post Office responsibility for the damage. However, considering the vast scale of Post Office operations, it is perhaps surprising that claims do not occur more frequently than they do.

Damage to Post Office Plant

There are also instances of damage done by others to Post Office plant, although the Telecommunications Branch is normally involved only where the Telephone Manager has difficulty in securing payment for making good the damage, or where he has some doubts about the validity of making a claim. The policy with these is to ensure that wherever possible the claim bears the full costs of making good the damage. In certain circumstances compromise or abandonment may be expedient, but in general claims are paid in full. Nearly every claim is different and needs treating on its merits.

Apart from damage to property or Post Office plant, claims may be received for injury or for loss of business because of the way in which Post Office work was executed. The most common claim of this type arises from injury because overhead wires are brought down by high winds or a storm. These claims can sometimes be successfully resisted where we can point out that the wire breakages were caused by "an Act of God", but where this explanation is not accepted the advice of the Post Office Solicitor's Department must usually be sought.

Risk on Farms

In rural districts, claims for injuries caused to cattle by their eating pieces of copper wire or stepping on stay rods left in the ground when poles are recovered, or for loss of grazing where turf has been badly replaced after laying a cable, crop up periodically. The difficulty here is to decide whether the Post Office is in fact liable.

For example, one farmer claimed that a newly placed stay in the hedge bank of his field had disturbed his cows. They had milled around near the stay, as the trampled ground clearly showed, and during the excitement one of the cows was alleged to have been injured. Because of its injury this cow could not graze and hay had to be brought to it and a veterinary surgeon engaged. The farmer maintained that the Post Office stay, even though it was clear of the field, had been responsible for the injury. While this might have been so, clearly the Post Office can meet such a claim in full only if liable legally. If the Post Office Solicitor says there is no such liability, an *ex gratia* payment may be considered.

Obviously Post Office policy and action in all matters relating to the erection of telegraphs is governed, in the main, by the Telegraph Acts.

The problems commonly met should therefore be viewed against the backcloth of the Telegraph Acts. Nearly all acts are difficult to paraphrase but this article would be incomplete if the salient features of the Telegraph Acts were not mentioned.

The Telegraph Act, 1863 defines "Telegraphs" as wires used for the purpose of telegraphic communication with any casing, coating etc., inclosing (sic) the same and any apparatus connected therewith, and "Post" means posts, poles, standards, stays or struts or other above ground contrivances for carrying, suspending or supporting telegraphs. It was judicially decided in 1880 that the term "Telegraphs" includes "Telephones". This Act empowered Telegraph Companies to place and maintain telegraphs and posts over, along or across any street or public road and to alter and remove the same, but before placing plant the consent of the "body having control" is required. It also provides that any Notices and Consents shall be in writing and/or print. Section 22 stipulates that above ground telegraphs and posts should not be placed within 10 yards of a dwelling house; a Court subsequently ruled that this does not apply to posts erected in built-up areas.

Another important section (23) says that a Notice has to be published saying that the consent of the body having control of a public road or street has been obtained and describing the intended course of the telegraphs before they are erected. This Notice is not necessary in urban districts.

The Telegraph Act 1868 empowered the Postmaster General to purchase undertakings of telegraph companies and said that the Postmaster General should pay rates on all the land, property and undertakings so purchased. Even today rates are still being paid for the property and wires taken over from the telegraph companies.

A further Telegraph Act in 1870 extended the provisions of the previous Acts to the Channel Islands and the 1878 Act provided for settling differences by a County Court where consent to the erection of telegraphs was refused by public bodies. Section 7 of this Act ensures that any damage done in erecting telegraphs is made good by the Post Office and Section 8 provides for the payment of compensation to the Postmaster General by anyone who has damaged Post Office plant (this applies whether the person responsible is negligent or not).

The Telegraph Act 1892 extended certain provisions in the previous Acts and said that the term "public road" included public footpaths if enclosed between hedges, walls and other fences. Another Act in 1908 dealt with the "flying" of wires over land adjoining roads and provides for the lopping of trees which obstruct telegraphic lines erected in a street or road.

Then in 1911 a Telegraph (Construction) Act enabled the Postmaster General to place telegraphs across or along railways or canals and gave powers for maintenance or alterations. A further Telegraph (Construction) Act, in 1916 facilitated the speedy erection of telegraphs in time of war. Its provisions however still apply and the Postmaster General can appeal to a Tribunal (now the Courts) if the owner, lessee or occupier fails to agree to the erection of telegraphs within two months after being required to do so by Notice from the Postmaster General.

Finally, in 1950, a Public Utilities Street Works Act was passed and this provided for the erection if desired of telegraphs in "controlled" land: that is, land set aside for future road or street widening, and it laid down a procedure or "code" to be followed by the Post Office, electricity, gas and similar undertakings when carrying out all underground works. This Act superseded portions of the Telegraph Acts.

Although a working knowledge of the most important sections of these acts is essential, many disputes and claims can be settled by the commonsense of the parties concerned. Most are indeed settled in this way but unfortunately on occasions commonsense prevails only when the Post Office Solicitor has warned that legal proceedings will be started. Sometimes even this is not successful. Judging when the time has come to stand firm, especially when dealing with certain assessors and insurance companies, is just one more factor making Wayleaves, Damage and Claims, contrary to general opinion, a most interesting duty indeed.

New Method of Maintaining Coaxial Line Links

A COAXIAL LINE LINK CARRYING UP TO 960 telephone circuits for 100 miles has in the signal path about 200 valves and sets of associated components and about 1,500 lengths of cable. After a number of years of operation many amplifiers and cable lengths will have been changed and the performance of circuits routed over the line is degraded. To restore the performance to its original standard the equipment has to be thoroughly overhauled and readjusted. This is a long, arduous task that has to be so organized that the circuits routed over the line link are kept in service for as long as possible and any unavoidable interruptions occur at night.

To reduce the need for night work by the engineers transportable equipments (Fig. 1) are used to replace temporarily the working equipment which can then be overhauled during day time. The final readjustment had still to be done at night.

A new method of realigning coaxial line links has now been developed. Test equipment is used which continuously displays the amplitude of the received signal as the sent signal is rapidly varied over the working range (60,000 to 4,340,000 cycles per second). All the networks used during the original equalizing of the line link are removed from the circuit and variable equalizers at the terminal station are adjusted to give the best overall result. When the correct setting of the variable equalizers has been determined, permanent equalizers are fitted along the route at predetermined stations and the terminal equalizers removed from the circuit. Fig. 2 shows the test equipment used.

Using these new methods and new maintenance aids coaxial links will give better service with a lower maintenance cost and with less need for staff to work at night.

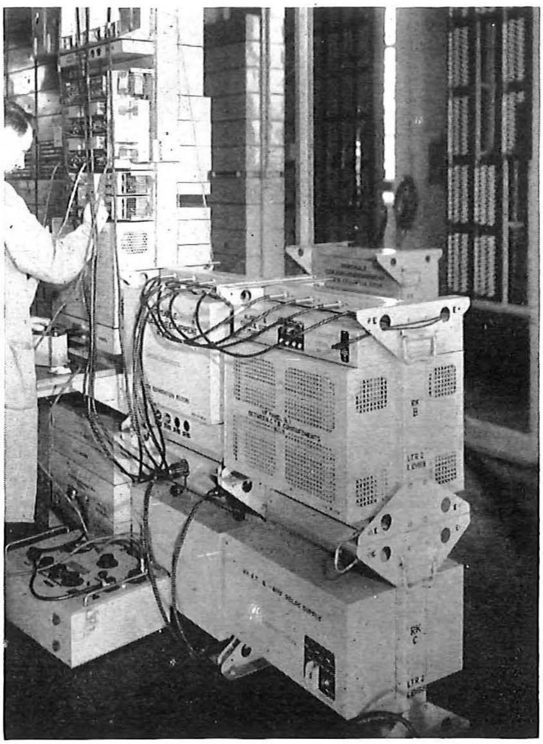
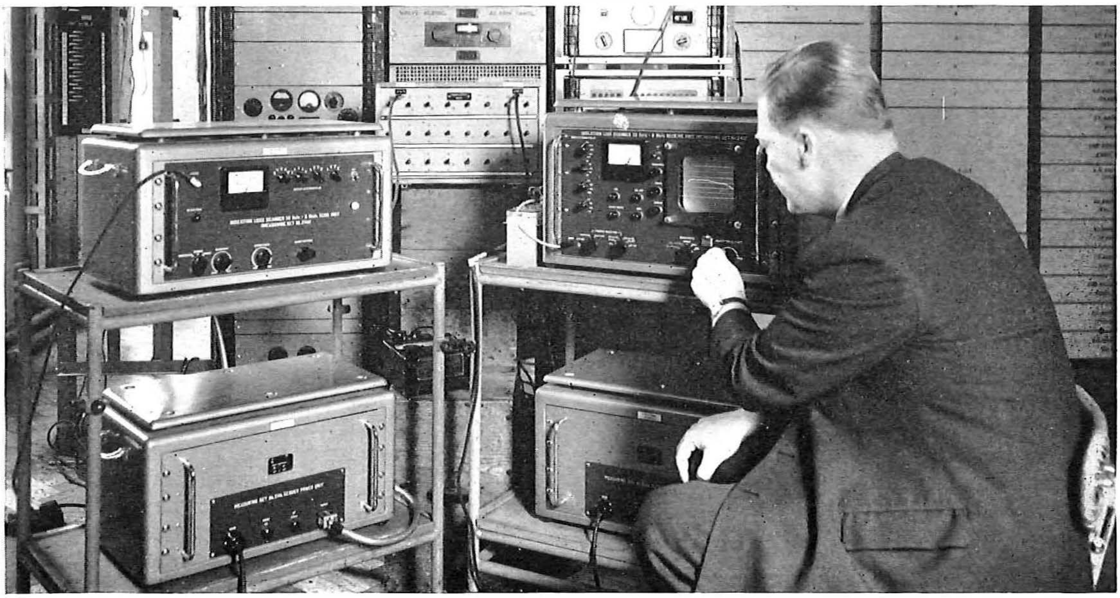


Fig. 1 (opposite): Coaxial line equipment being overhauled while circuit continuity is maintained by the portable racks

Fig. 2 (below): Insertion loss scanner displaying loss/frequency response of equalized coaxial line link



Long-Distance Waveguides

R. W. White, *B.Sc., F.Inst.P., M.I.E.E.*

THE BULK OF THE TRAFFIC WHICH HAS TO BE carried by broadband telecommunication systems consists of either television signals or large assemblies of telephone channels, and two basic techniques—coaxial cable and microwave radio relay—are now well established for providing trunk facilities of high traffic capacity.

In the British trunk network, microwave radio links are used extensively for television transmission but multichannel telephony is still carried almost entirely on cables. Non-linear distortion in most of the early microwave links was quite appreciable, and when loaded with large numbers of telephone channels they fell outside the limits for noise and crosstalk recommended internationally and applied by the British Post Office for new telecommunication plant. Since 1950, however, much effort has been devoted to this problem and very satisfactory solutions have been found. There is now no doubt that microwave radio links can be provided which meet the agreed transmission standards for up to 960 telephone channels, and their application to the trunk telephone network will now be able to increase quite rapidly.

For several years to come, coaxial cables and microwave radio links should be quite able to cope with anticipated traffic requirements but it is important to realize that growth is following a law approximating in form to compound interest with a rate of roughly 5 per cent. per annum for telephony trunk traffic and very much more than that for television. There is no evidence yet that the rates will decrease in the next decade.

Coaxial cable and radio relay techniques are, of course, far from static and in both there is continuous progress towards higher traffic capacities, simpler and cheaper equipment, and greater reliability; but it is pertinent to ask whether there is any possibility that entirely new ways may become available for providing main trunk arteries of satisfactory performance and enormous traffic capacity.

The answer to this question is that techniques are being developed for transmitting millimetre wavelength signals with extremely low loss through hollow metal tubes of accurately circular cross-section, and that these new transmission systems show promise of traffic capacities between 10 and 100 times greater than any previous method of providing trunk communications.

It is important to stress that these millimetre wave systems are still in the laboratory stages and that many very difficult problems have yet to be solved before they can hope to compete in the field with established trunk techniques. However, long-distance transmission over circular waveguides is potentially so important that a brief review of its characteristics, advantages and limitations may be of some interest to those concerned with the operation of our existing telecommunications network.

Let us start by taking a brief look at the general behaviour of conductors and of insulating materials as we progress to higher and higher frequencies.

High Frequency Limitations in Conductors and Insulators

It is well known that the attenuation of cables increases with frequency. The first reason for this is that, as the frequency is increased, alternating currents are restricted to thinner and thinner layers on the surface of the conductors. This so-called "skin effect" raises the effective resistance of the conductors and thus increases attenuation. The second reason for the increase is that some dielectric loss is introduced in any insulating material every time the voltage across it is reversed, and the number of reversals per second is twice the frequency. The higher the frequency, therefore, the greater the loss.

Skin effect is not restricted to cables, but occurs in all conductors at high frequencies. Fig. 1 shows that a thick piece of copper carrying current at a frequency of one million cycles per second (1 Mc/s) behaves as if it had an effective thickness, or "skin depth", of less than three thousandths of an inch,

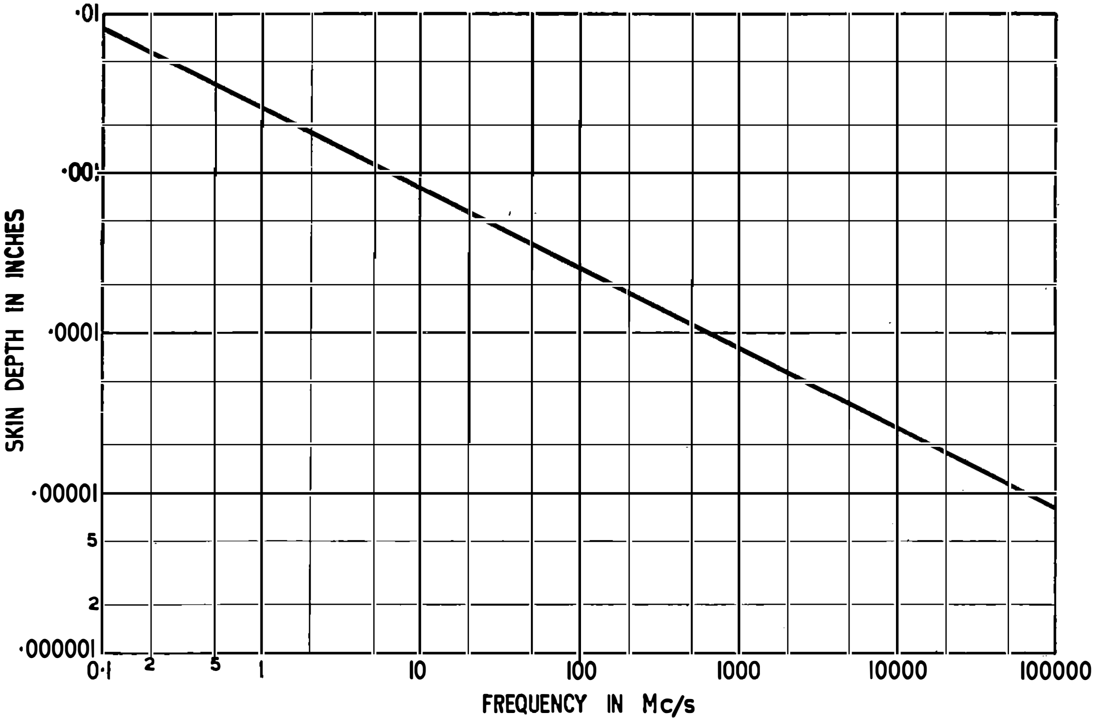


Fig. 1: Skin effect in a perfectly smooth copper conductor

while at millimetre wavelengths (above 30,000 Mc/s) the skin depth has to be measured in millionths of an inch. The current does not, of course, cease abruptly at this depth. Rather, the current density has a maximum value at the surface and decreases smoothly to reach an insignificant value at several times the skin depth.

The modern 0.375″ coaxial cable used so extensively for trunk communications is a good example of attempts to reduce the two sources of loss; (1) by using smooth copper conductors of relatively large surface area, and (2) by relying on dry air plus the minimum practicable amount of solid polythene for insulation. At high frequencies the current in a coaxial cable is restricted to the inside surface of the outer conductor and the outside surface of the inner conductor. As the inner conductor has the smaller surface area of the two, it provides the major component of conductor loss. Dielectric loss is generally small up to the frequencies of a few megacycles per second used for cable communications, but at higher frequencies the losses in solid spacers begin to contribute an important part of the total attenuation.

When waves are transmitted through a coaxial cable, the useful energy is really propagated through the space between the inner and outer conductors. If we can eliminate the inner conductor entirely and propagate the wave through a hollow metal tube, we not only obtain the benefit of a single conductor of large surface area but we also eliminate any need for solid dielectric spacers. Such a hollow tube is known as a waveguide and its properties are of fundamental importance in microwave transmission.

Elementary Characteristics of Waveguides

Waveguides are normally either rectangular or circular in cross-section, although for some specialized applications many other shapes are employed. The walls are normally of copper, and as the skin depth is extremely small at microwave frequencies (cf. Fig. 1) the internal surface should have a mirror-smooth finish.

The first important characteristic of a waveguide is that it behaves rather like a high-pass filter and will not transmit signals below a certain frequency. This cut-off frequency depends on the size and

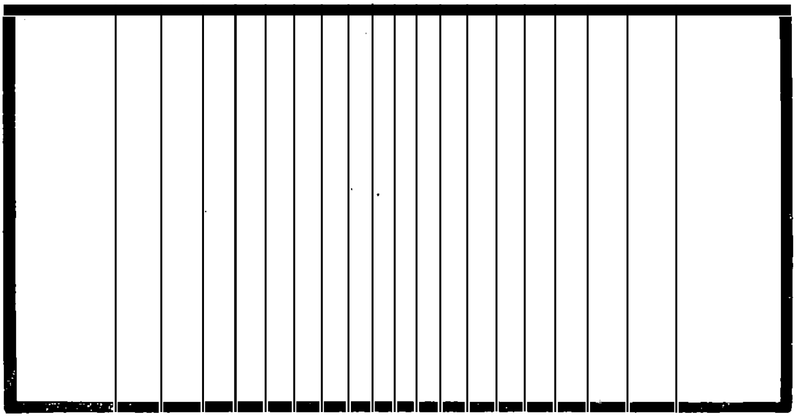


Fig. 2: Electric lines of force for the dominant mode in a rectangular waveguide

shape of the cross-section of the guide and on the dielectric with which it is filled.

Just above the fundamental cut-off frequency only one form of wave can be transmitted, and this wave is characterized by a specific and relatively simple pattern of electric and magnetic lines of force; but the second important characteristic of a waveguide is that, at still higher frequencies, other waves having quite different electromagnetic field patterns can also be transmitted. Each of these possible patterns or configurations is known as a "mode", and each mode has its own cut-off frequency. To a first approximation, the more complex the pattern, the higher will be the cut-off frequency of that particular mode. If we keep the size and shape of the waveguide fixed and continue increasing the frequency used, the number of possible modes increases steadily as we pass the cut-off frequencies corresponding to more and more complex modes. The mode with the lowest cut-off frequency is known as the fundamental or dominant mode of that particular waveguide.

The most common type of waveguide has a rectangular cross-section, and the size is normally chosen so that it can transmit only one mode for the frequency at which it is to be used. The distribution of electric field for this dominant mode in a rectangular waveguide is shown in Fig. 2. It will be noted that the field is most intense mid-way between the two side (narrow) walls and that the lines of electric force terminate only on the upper and lower (wide) walls.

Fig. 3 shows the theoretical variation of attenuation with frequency for a typical rectangular waveguide operating in this mode. This particular waveguide (type WG11) is normally used at about 4,000 Mc/s and its internal dimensions are 2.372″ × 1.122″. As the frequency is increased the waveguide attenuation falls rapidly just above cut-off, reaches a minimum at a little over twice the cut-off frequency and then increases steadily. At frequencies well above cut-off, the attenuation is due primarily to eddy currents in the wide walls, and this component of loss increases with frequency as skin effect confines these currents to a thinner and thinner surface layer. Losses in the narrow walls decrease steadily with increasing frequency and contribute very little to the total attenuation when well above the cut-off frequency.

For comparison Fig. 3 also shows the theoretical attenuation of a 2″ internal diameter coaxial cable of optimum design using copper inner and outer conductors and entirely neglecting dielectric loss. An actual cable of this size would show much larger losses at the higher frequencies on account of the spacers which must be used to locate the inner conductor.

Returning to the consideration of waveguides, it would obviously be very useful if we could find a mode which did not induce eddy currents in either pair of walls, but this seems impossible for rectangular waveguides.

"The Wave with Its Feet off the Ground"

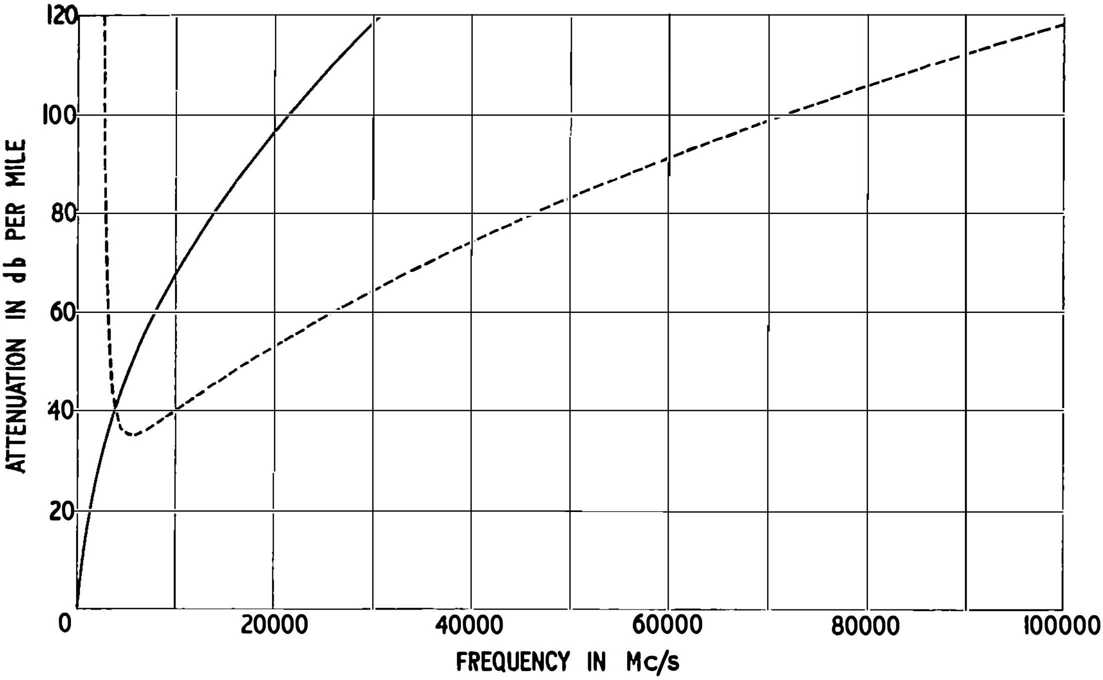
When we turn our attention to waveguides of circular cross-section, again we find that the vast majority of modes have attenuation/frequency characteristics of the same general shape as for rectangular waveguides. In other words—negligible transmission up to a cut-off frequency, then a very steep drop in attenuation to a fairly broad minimum, and finally a steady rise in attenuation with further increases in frequency. Theoretical characteristics for two of the common modes in a 2″ diameter copper waveguide are illustrated by the dotted curves in Fig. 4.

Among the simpler modes, however, there is one which was discovered in the 1930s theoretically to have a most surprising property—its attenuation appeared to decrease continuously towards zero as the frequency increased towards infinity. This is known as the circular electric mode and its calculated curve of attenuation against frequency in a perfect 2″ diameter copper pipe is shown as the continuous line in Fig. 4. At first many engineers either did not believe the theoretical work or were convinced that the mode was so unstable that it could not have a physical existence. They regarded it as just a pipe dream—in both senses!

Today there is no doubt that the mode exists and that it can be propagated with phenomenally low losses in cylindrical waveguides which approach mechanical perfection. An ever increasing effort, in many countries, is now being devoted to the very great problems of its practical exploitation.

When we look at the corresponding distribution of electric field over the cross-section of the waveguide (Fig. 5), we find that no lines of force terminate on the walls and we can begin to appreciate why the copper losses and attenuation are so low. Since this mode appears to travel without its lines of electric force touching the walls, it has been jokingly referred to as "the wave with its feet off the ground". This description, although facetious, is quite a good one as it helps in understanding not only the advantages but also some of the problems of using the circular electric mode.

Post Office work in this field is concentrated at present on frequencies around 35,000 Mc/s, the choice having been dictated largely by the availability of a reasonable range of valves and of rectangular waveguide components for that frequency. Extensive work by the Bell Telephone Laboratories has been centred between 50,000 and 60,000 Mc/s. As techniques develop and improve,



——— coaxial cable; outer of 2″ internal diameter; inner of optimum size; losses in solid spacers neglected

- - - - - Waveguide No. 11; internal size 2.372″ × 1.222″

Fig. 3: Theoretical characteristics of a coaxial cable and a rectangular waveguide; copper conductors and dry nitrogen filling

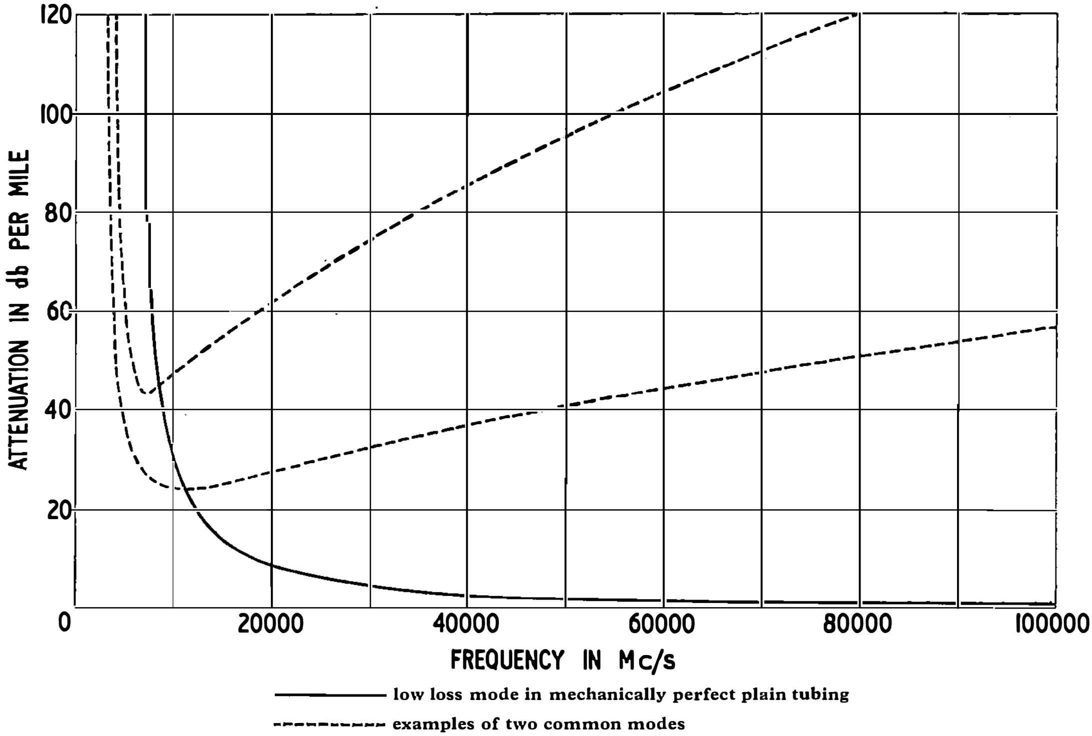


Fig. 4: Theoretical characteristics of a 2″ internal diameter circular waveguide; copper conductor and dry nitrogen filling

continuous coverage may eventually be required from about 30,000 to 100,000 Mc/s—or perhaps to even higher frequencies!

For the low-loss mode, a perfect cylindrical copper waveguide of 2″ internal diameter has a theoretical attenuation of approximately three decibels per mile at 35,000 Mc/s, falling smoothly to about 1 decibel at 75,000 Mc/s; but actual copper pipes, even of the highest precision, are found to have appreciably higher losses.

A small part of this increase can be traced to imperfections in surface finish. As the skin depth at 35,000 Mc/s is only 14 millionths of an inch, even most minute scratches are relatively hills and valleys which add perceptibly to the lengths of the paths which residual surface currents have to traverse.

A much more significant source of additional loss has been found to be the conversion of some of the energy in the wanted mode into various unwanted modes at every change in either the cross-section or direction of the guide. Since changes of diameter of a thousandth of an inch and changes in direction of one or two minutes of angle are important, quite exceptional care would be necessary in manufacturing, handling, laying and jointing this type of waveguide. Our wave with its feet off the ground has great difficulty in maintaining its equilibrium! It is very easily tripped by small irregularities in the walls and it starts to scrape on one side whenever it tries to negotiate even the most gradual of bends, so that unwanted wall currents are produced and some energy is converted to other modes.

Some of these unwanted modes have fairly high attenuation and the energy put into them is rapidly lost. A much more serious problem arises from the conversion of some energy into modes which travel with fairly low losses and various velocities, because some energy from these may be reconverted back to the wanted mode at subsequent irregularities in the waveguide. Wave interference caused by this phenomenon of mode conversion and reconversion gives rise to very severe distortion of complex transmitted signals, and it is undoubtedly one of the most serious limitations in the practical exploitation of low-loss waveguide transmission systems.

Permissible mechanical tolerances on plain copper waveguide are so tight as to make its use virtually impracticable, and in recent years it has become quite clear that modified forms of wave-guide must be used in an effort to minimize mode conversion/reconversion effects and thus relax the tolerances—especially for straightness. One possible technique involves applying a thin and extremely uniform dielectric coating to the inside surface of the plain tubing. In a second and very promising method, the metal tube is replaced by a precision close-wound helix of insulated wire supported by a backing of insulating material having carefully controlled characteristics.

Modulation Methods

Since distortion arising from mode conversion/reconversion effects is so severe, many of the people engaged in this field of research are convinced that the only possible form of modulation is one that can be regenerated—that is, restored to its original undistorted form—at every repeater station. The general technique required for this is known as pulse code modulation (PCM), and if the major problems of coding, decoding and regenerating large enough amounts of traffic can be solved economically, then PCM could be the basis of a workable long-distance waveguide system; but it must be stressed that pulse repetition rates of well over a hundred million per second are involved.

Frequency modulation (FM) is the only alternative modulation system in the running at present. Here we find that permissible tolerances on mode conversion/reconversion are much tighter than for PCM, and even with the best available forms of waveguide structure the mechanical accuracy required is so high that it is still uncertain whether an FM system of appreciable length is practicable. However, since further improvements in the waveguide may be possible, the use of FM cannot be ruled out.

Although modified waveguides are more tolerant of gradual bends than was the plain copper tube, the choice of suitable routes in built-up areas is far from simple. In open country the position is much easier, and it is worth noting that motorways and railways have curves of adequate radii.

In manufacturing, laying and maintaining a long-distance waveguide to the necessary tolerances, and in providing it with adequate protection from accidental damage (including subsidence), many problems remain to be solved. There is no doubt that the system would have to be pressurized against water leakage, and barriers are likely to be required at frequent intervals in order to localize damage in the event of serious water entry. These barriers must be virtually transparent to all the millimetre wavelengths ever likely to be transmitted, and they must allow the pressurizing gas to pass freely.

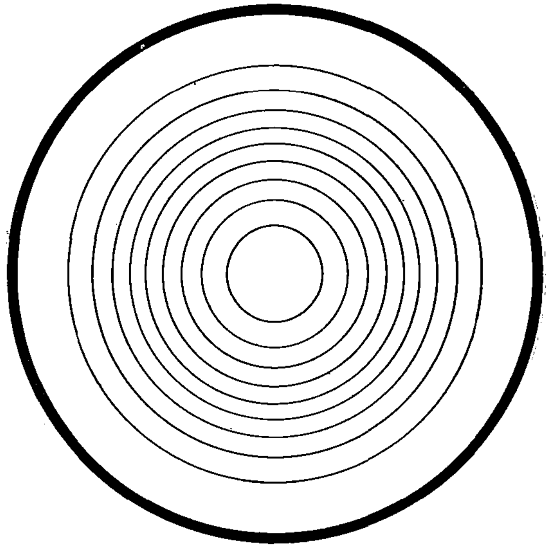


Fig. 5: Electric lines of force for the low-loss mode in a circular waveguide

It is essential to remember, also, that any new trunk system must eventually be competitive with existing systems in performance, reliability and cost per channel-mile if it is ever to be widely adopted. The total cost of a circular waveguide system is bound to be very high, and it is therefore an economic necessity that it should carry a vast amount of traffic, but this makes reliability requirements all the more severe. If you are going to put a large number of eggs into one basket, you must take great care that the basket is sound! At present almost all millimetre wavelength valves are complex, costly and of quite limited life. This last aspect is particularly important, and it is clear that much intensive work remains to be done in the field of microwave electronics.

We may summarize the present position as follows:

Two satisfactory methods of trunk communication—coaxial cable and microwave radio relay systems—are now available for field use and they can readily meet foreseeable traffic requirements for the next few years. A third method, involving millimetre wavelength signals in a high precision circular waveguide, is in the laboratory stages and shows reasonable promise of an ultimate traffic capacity of at least 100 television channels or 100,000 telephone channels. Although many problems have yet to be solved, and little can yet be forecast about its economics, there is no doubt that this is a development of great technical interest and very considerable potential importance in the field of telecommunications.

Essay Competition Results.—W. F. Garrett, Technical Officer, Engineering Department (TPM) has won the 6-guinea prize and an Institution Certificate in the Essay Competition, 1959—60, held by the Institution of Post Office Electrical Engineers.

The following (with the titles of their essays) have won prizes of 3 guineas each, and Institution Certificates:—

H. Bettridge, Technical Officer, Engineering Department (I), *Roto-Finish—A modern Engineering Finishing Process.*

T. Clark, Technical Officer, Grimsby (North Eastern Region), *Atoms and Magnets.*

J. G. Philip, Technical Officer, Aberdeen (Scotland), *Step No. 3 and Works Study.*

L. W. Burkitt, Technical Officer, Lincoln (North Eastern Region), *A Decade of Interference Investigation Duties.*

Institution Certificates of Merit have been awarded to:—

J. G. Mullett, Technical Officer, Southend (Home Counties Region), *Work Study and Exchange Construction.*

A. W. Brighton, Technical Officer, Newport-on-Tay (Scotland), *Fault Statistics—Their Aid to Efficiency and Productivity.*

N. F. Wright, Technician IIA, Birmingham (Midland Region), *The Post Office* 4000-*Type Selector and a Comparison with its Forerunners.*

D. W. Everett, Technical Officer, Southend (Home Counties Region), *A Brief Synopsis of Exchange Maintenance and Faulting Problems.*

R. L. Wood, Technical Officer, Reading (Home Counties Region), *The P.O. Carrier Type Public Address System.*

The essays were judged by J. Stratton, G. Spears and A. J. Leckenby.

Mechanized Ticket Processing to be Extended

The Post Office is to obtain punched-card machines worth nearly £338,000 from International Computers and Tabulators to extend mechanized telephone accounting. Delivery is to be made over the next year.

The Mechanized Ticket Processing accounting system now used in Birmingham, Manchester and other places is to be extended by opening four new units at Cardiff, London, Leeds and Portsmouth, and extending the Edinburgh unit.

The Cardiff unit, to open next October, will serve Cardiff and Bristol Telephone Areas at first and later other areas in South Wales and the South West. The London unit will open at the end of this year, first to serve Centre and City areas and later the whole of London. The Portsmouth unit will open in April 1961; at first it will serve the Portsmouth and Guildford areas and later other areas south of the Thames.

Ultimately the Edinburgh unit, when extended, will serve the whole of Scotland.

By June 1961, eight MTP Centres will be operating, as well as the full mechanized accounting units at Canterbury and Edinburgh; the units will have a capacity capable of dealing with over 500 million tickets per year.

Post Office Honours

Mr. F. J. D. Taylor, M.B.E., Staff Engineer at Dollis Hill, and Mr. F. Wood, Telephone Manager, Leeds, were honoured with the O.B.E. in the Queen's Birthday List.

Two telecommunications staff received the M.B.E.: Mr. J. H. A. Pugh, Assistant Engineer, London Telecommunications Region, and Mr. F. Duerdon, Chief Sales Superintendent, Liverpool.

Among recipients of the B.E.M. were Miss O. M. Botting, Chief Supervisor, City Area, L.T.R.; Miss M. E. Gilmore, Supervisor (Telephones) Windsor; Miss B. G. Hyde, Chief Supervisor, North West Area, L.T.R.; Mr. W. E. Knowles, Technician IIA, Gloucester; Mr. M. Perkins, Technical Officer, Galashiels; Mr. F. R. Pettyfer, Technical Officer, Bournemouth; Mr. S. J. Pusey, Technician I, West Area, L.T.R.; Miss A. P. Smith, Senior Chief Supervisor, Birmingham.

(Television Centre, Shepherds Bush)

The BBC Concentrates its Telephone Communications

F. W. Gilby and H. A. E. Valentine

PLANS laid as long ago as 1944 came to fruition this year when the British Broadcasting Corporation began to occupy the main block of the new Television Centre in Wood Lane, Shepherds Bush, London.

These new premises, with a large extension to Broadcasting House, Langham Place, and the earlier occupation of a large portion of Bush House in the Strand, concentrated much of the BBC's activities in London in three main centres, thus enabling modernization of the telephone services.

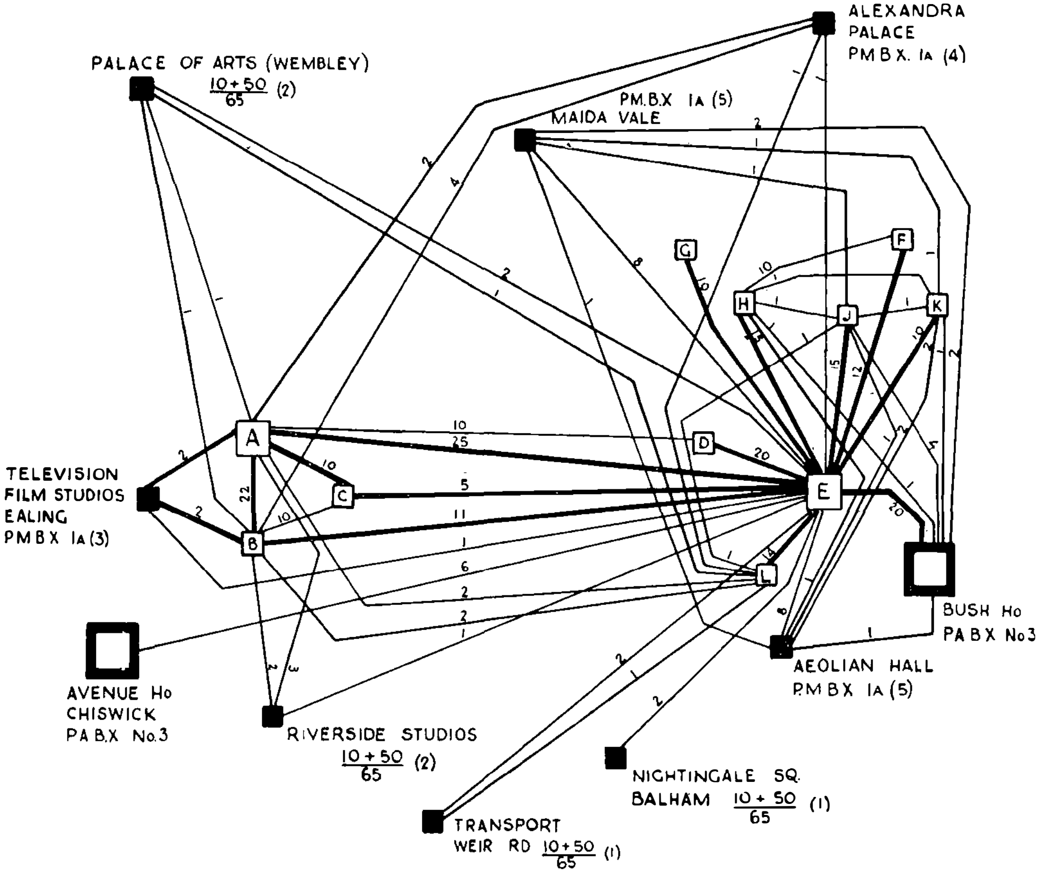
With the help of the Post Office and two telephone equipment contractors, Ericsson Telephones and Standard Telephones and Cables, Private Automatic Branch Exchanges have been installed at Bush House, Broadcasting House Extension and the new Television Centre. The Bush House installation was brought into use in September 1956; those at Television Centre and Broadcasting House Extension were brought into use in March and May this year respectively.

Each of these PBXs serves separate groups of several neighbouring buildings, with intercommunication through the Corporation's rented network of private circuits, so that 90 per cent. of their inter-departmental calls in London can be connected automatically without the services of their own PBX operators and without using the Post Office public telephone exchange services.

Before the new buildings were ready the staff were in about 30 separate premises near Broadcasting House, while there were six buildings in or near Shepherds Bush, three at Maida Vale, and many others in the London suburbs.

The original telephone network is outlined in Fig. 1, which shows only those premises having PBXs; other addresses were served by external extensions. The fact that these buildings were so scattered made the planning of centralized telecommunications services very difficult.

The occupation of two blocks of Bush House in 1956 was a relief measure, and the opening of a



A	*Television Centre*	*PMBX1A*	10 *positions*
B	*Lime Grove*	,,	8 ,,
C	*Woodstock Grove*	,,	5 ,,
D	*The Langham*	,,	5 ,,
E	*Egton House*	*BECB No.* 10	32 ,,
F	*Great Portland Street*	10 + 50	2 ,,
G	*Marylebone Road*	,,	2 ,,
H	*Marylebone High Street*	*PMBX1A*	4 ,,
J	*Rothwell House*	,,	6 ,,
K	*Yalding House*	,,	4 ,,
L	*Harewood House*	,,	5 ,,

Fig. 1 : Arrangement of PBXs and inter-switchboard circuits before introduction of PABXs

PABX No. 3 there, with capacity for 1,200 extensions, did not in itself replace any of the PMBXs shown in Fig. 1. At that time there were eight separate BBC PMBXs in the Langham area, ranging from the 32 position BECB 10 suite at Egton House to smaller installations of the two 10+50/65 type positions at Great Portland Street. The television premises at Shepherds Bush were served by three separate suites of PMBX 1A type positions. Altogether these 11 PBXs served about 3,500 extensions, and each switchboard was connected by a group of lines to one of six London Director exchanges. In addition, each PBX had private interswitchboard lines to many of the others.

At Egton House—the main switching centre—there were 30 groups of circuits to other BBC premises in London, 14 long distance routes to places as far away as Glasgow and Belfast and a dozen or more single circuits to other administrations and to ministries. In all, there were more than 250 circuits in the outgoing junction multiple. The Bush House PABX was linked with the main network by circuits to the Egton House PBX and to some of the smaller PBXs. Calls to Egton House were handled by the operators and calls to other PBXs were connected through the Egton House network of inter-switchboard circuits.

The new buildings have enabled the BBC to vacate at least three of the subsidiary premises and to re-house staff and equipment in more up-to-date accommodation. A PABX No. 3, with capacity for 2,800 extensions, has been installed in the new Broadcasting House extension and offices in the neighbourhood of Broadcasting House are now served by external extensions on this PABX.

At the new Television Centre a PABX No. 3 for 2,000 lines has been installed and the Lime Grove and Woodstock Grove premises are served by external extensions from this exchange.

All this has meant laying many yards of new ductway, building manholes, and drawing in and jointing several miles of cables. This work is too large to describe in detail in this short article, but some idea will be obtained from the following figures:

Ducts laid....................2,318 yards
Manholes built 16
Cable used ....14 miles
Telephones fitted...........6,250
Manhours spent...........70,000

Television Centre

The new PABX opened at Television Centre provides services for the new main block as well as replacing three PMBXs which served four other premises in the vicinity. An increase in capacity to 3,000 extensions can be made within the present accommodation to allow for further growth of television and to serve extensions of the building on the same site.

All extensions have four digit numbers. Access to exchange lines for calls to places in the London Director area is obtained by dialling digit 9, while the BBC operator can be signalled by dialling digit 0 for assistance, 5 for long distance calls which are available only through the BBC operators, or 7 for enquiries. A full multiple of the 2,000 extensions is provided on the auto-manual suite of 21 positions. These are slightly larger than the switch sections PBX SA 7560 usually associated with PABX No. 3 equipment; they are 6 feet $4\frac{1}{2}$ inches tall in sections of three positions and seven sections of the multiple. Repetition of the extension and junction multiple occurs every six panels. The manual suite is finished in light oak with grey plastic facings to the key shelf. Fig. 2 shows a general view of the

Fig. 2 : The new PABX at Television Centre

Television Centre switchroom. The enquiry positions are in the centre of the room.

In the apparatus room the extension line finders are on separate racks from the final selectors and in this respect the layout differs slightly from standard PABX No. 3 equipment, but this has enabled considerable economy in rack space. There are 26 circuits graded from level 8 of the first selectors giving joint access with the manual board to a group of private wires connecting the Broadcasting House PABX. Calls to extensions on this PABX are dialled direct and traffic in the opposite direction is routed via another group of circuits from Boadcasting House and terminated on incoming selectors at Television Centre.

Broadcasting House Extension

Broadcasting House and nearby buildings are served by some 800 internal extensions and 1,700 external extensions on the new PABX. Growth up to 2,800 extensions is possible and the equipment can be increased to a capacity of 3,500 extensions in the available accommodation. The auto-manual switchboard has 24 positions of the same pattern as those at Television Centre and with similar facilities. The automatic switching plant shown in Fig. 3 is also arranged with separate racks of line finders and final selectors.

An interesting feature at Broadcasting House installation is the erection of two main distribution frames, one terminating all external cables for exchange lines, private circuits and broadcasting circuits, and the other terminating all the cables carrying external and internal extensions served by the PABX.

All extensions have four digit numbers. Access to exchange lines for making calls to places within the London Director area is obtained by dialling

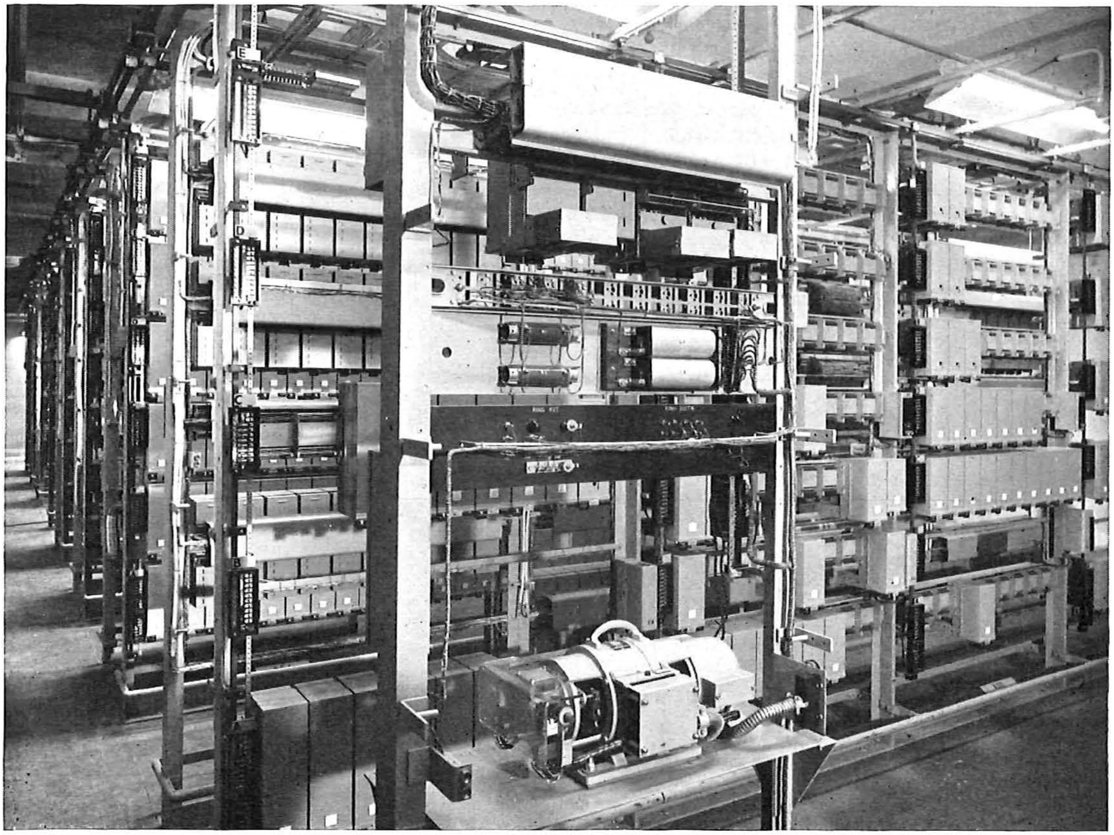


Fig. 3 : Automatic switching plant

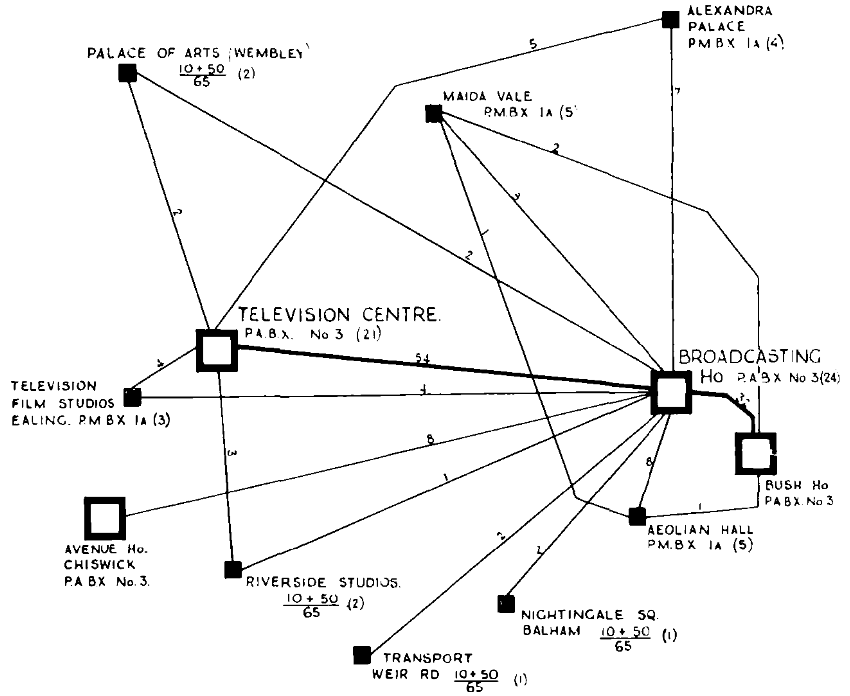


Fig. 4: Rearrangement of PBXs and inter-switchboard circuits with the opening of the main PABXs

digit 9, and the BBC operator is called by dialling 0 for assistance, 69 for trunk calls and long distance private wire connexions, which can be obtained only via the auto-manual board, and 60 for enquiries. Calls to other BBC PBXs are obtained by dialling appropriate single or two digit code numbers; for example, 7 for Television Centre, 8 for Bush House, and 61 for Maida Vale PBX operator.

On calls to other PABXs the distant extension is called by dialling the number required following the routing code digit(s). This PABX is also a tandem routing exchange for calls between extensions on the Bush House and Television Centre PABXs. Long distance private wire calls and trunk calls through the Post Office system are handled at the switchboard on a delay basis.

The new network is shown in Fig. 4.

At both the Television Centre and Broadcasting House Extension installations separate rooms are provided for main frames, charging plant, batteries, and for stores and apparatus repair.

Fire calls at the Broadcasting House and Television Centre PABXs are dealt with first by the BBC's own fire organization, and a code 666, specially shown on telephone dial labels, is dialled to obtain direct access to the BBC Fire Service at each Centre.

This project has not been completed without some difficulties. It has involved a thorough examination of traffic statistics, careful planning and execution of engineering work, and close administrative consultation throughout. Some of the work has been done under severely adverse conditions in uncompleted buildings at Television Centre and Broadcasting House Extension.

The minutes of the numerous meetings over the past years between the BBC, the Post Office, Standard Telephones and Cables and the builders—some well into the evenings—at which every detail of planning and execution was thrashed out, are testimony to the spirit of helpful service and enthusiastic co-operation shown by everyone who had some share in the fulfilment of this major reorganization.

Acknowledgments are to the BBC for the production and use of the photographs of the Television Centre building; to Standard Telephones and Cables Ltd. for the interior photographs of the apparatus room; and to the staffs of the BBC, the Post Office and Standard Telephones and Cables who have supplied information.

Telecommunications Statistics

In this issue we present some figures for the complete financial year to March 31, 1960, compared with those for the two previous years.

	March 31st 1958	*March 31st* 1959	*March 31st* 1960
The Telephone Service at the end of the year			
Total telephones in service	7,361,200	7,532,500	7,855,700
Exclusive exchange connexions	3,345,700	3,464,500	3,652,300
Shared service connexions	1,153,900	1,141,600	1,131,700
Total exchange connexions	4,499,600	4,606,100	4,784,000
Call offices	72,100	73,300	73,700
Automatic exchanges	4,897	4,982	5,088
Manual exchanges	1,099	1,027	921
Orders on hand for exchange connexions	171,400	145,000	143,700
Work completed during the year			
Net increase in telephones	135,300	206,400	330,100
Net exchange connexions provided	350,800	368,900	429,900
Net increase in exchange connexions	25,900	106,500	177,900
Traffic	Millions	Millions	Millions
Inland telephone trunk calls	327	340	383
Cheap rate telephone trunk calls	74	79	85
Oversea telephone calls:			
Outward	2,422,000	2,678,000	3,096,000
Inward	2,388,000	2,596,000	3,035,000
Transit	250,000	290,000	80,000
Inland telegrams (excluding Press and Railway) ...	14m	13m	13m
Greetings telegrams	3m	3m	3m
Oversea telegrams:			
Originating U.K. messages	6,652,671	6,251,162	6,421,000
Terminating U.K. messages	6,523,879	6,292,001	6,448,000
Transit messages	6,130,544	5,607,945	5,635,000
Inland telex calls	3m	* 3m. calls from manual and automatic exchanges. 2m. metered units from automatic exchanges.	* 4m. calls from manual and automatic exchanges. 8m. metered units from automatic exchanges.
Oversea telex calls:			
Originating (U.K. and Irish Republic) ...	1,641,351	1,944,335	2,429,000
Terminating (U.K. and Irish Republic) ...	1,594,283	1,886,869	2,311,000
Transit	14,603	41,398	31,000

NOTES

During the year the telephone order list was reduced from 145,000 *to* 143,700. *At the end of the year* 94,600 *applications for service were in process of being met and* 49,100 *were awaiting cables or exchange equipment.*

The number of subscribers lines on the inland telex system increased from 5,027 *to* 5,923. **During the year automatic telex was extended to Birmingham, Bristol, Dundee, Edinburgh, Glasgow, Liverpool, Manchester, Nottingham, Sheffield, and by March* 31 50.2 *per cent. subscribers were served by automatic exchanges.*

The oversea telephone service was extended by opening service with Mauritius on July 15, 1959. *Public telephone traffic on the first Transatlantic Telephone Cable increased by* 17 *per cent. with Canada and* 18 *per cent. with the United States during the year. The total number of calls over the cable was* 562,087 (*including* 119,170 *on circuits leased for public traffic between U.S.A. and Continental countries*).

The oversea telex service was extended to eight more countries, making a total of 44 *oversea services.*

Transmitting Data by Telex

J. M. Ogilvie

Examining incoming Telex tape containing coded information for automatic posting

(*Courtesy, Bank of Scotland*)

MOST people have a fellow-feeling for Lord Randolph Churchill when he referred to decimal points as "those damned dots" and welcome computer and other devices that eliminate the labour and monotony of counting and processing figures. The *Journal* has carried articles on "Electronic Computers in the Office" (Spring 1958) and "Data Transmission" (Winter 1959). The Bank of Scotland, with its Head Office in Edinburgh, is the first bank to use the telex network for transmitting coded information on punched tape on live traffic for electronic accounting machines.

With the development of electronic data processing equipment has come the need for means of feeding information to machines and of recording the processed outputs from them. As the teleprinter is a machine for transmitting and receiving intelligence and operates by converting intelligence into electrical impulses and, at the receiving end, by changing back the electrical impulses into printed characters, it is not surprising that equipment and methods used for many years in telegraph communications are being widely adopted in data processing systems.

The main disadvantages of using the teleprinter itself as a means of transmitting information direct to these systems are the possibility of error on the part of the operator and the relatively slow speed of sending. These shortcomings have largely been overcome by using punched tape. This tape, which is supplied in 1,000 foot reels, is simply a strip of high quality paper eleven-sixteenths of an inch wide and a few thousandths of an inch thick and capable of being punched with one or more holes in any one of five tracks along its length. Of the 32 combinations available from the five tracks, two are used for differentiating between letters and figures, thereby increasing the total number of codes sufficiently to cover the alphabet and the 10 decimal numbers plus ordinary punctuations and machine operating codes. The tape can be prepared and its accuracy checked by the operator in her own time before being fed into the processing equipment by automatic transmitter at a speed of 66 words a minute.

Other advantages of punched tape are its low cost (one million code combinations can be accommodated on tape costing less than £2) and the provision of a continuous record which can be stored and which, by its nature, cannot be inadvertently transmitted in wrong sequence. Its most important characteristic, however, is its capability of storing intelligence.

Centralized electronic accounting machines of International Business Machines (IBM United

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DUNFERMLINE NO 11/23RD
A00 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A01 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A02 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A03 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A04 9784810LIST   126000156705%   15539540CHQ  BOOK   X000000100
A05 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A06 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A07 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A08 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
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A30 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A31 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
A32 9784810LIST   126000156705%   1539540CHQ  BOOK   X000000100
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Fig. 1: Part of page copy from a tape

Kingdom Ltd.) were installed at the Bank of Scotland's Branch Office at George Street, Edinburgh, for posting to customers' accounts transactions dealt with during the same day. Because of the nature of the Bank's business, only local branch offices near enough to George Street for messengers to deliver at the close of the day's business could be served by the centralized accounting equipment. The Bank was interested in extending the idea to remote branches and the telex service was suggested as a means of speedily transmitting data from a distance.

As an experiment, telex equipment, consisting of a Teleprinter 7E/RP (that is, teleprinter with reperforating attachment) and an automatic transmitter, was joined up at a Dunfermline Branch Office some 13 miles from Edinburgh and a Printing Reperforator No. 1 with keyboard was installed at George Street.

Extensive tests made over the telex and telegraph networks have confirmed that the average transmission error rate is of the order of 1 in 40,000 characters transmitted. To meet the needs of customers who require an error rate significantly better than this, error detection equipment is being developed which will work with 5-unit codes over both point-to-point and switched connexions, and reduce the number of undetected errors to something between 1 error in 10^5 to 1 in 10^6 characters. The intention is to produce separate sending and receiving units for hire within the price range £50–£100 per annum for each unit.

The Bank required that the transmission error rate should not exceed one character in 30,000–40,000. To confirm that such a standard could be achieved, more than half-a-million characters were sent between the Dunfermline and Edinburgh branches; only three errors occurred, thus satisfying the standard required.

To carry out this exhaustive test, a Teleprinter 7E/RP and Auto Transmitter were installed at the George Street Office. A prepared tape was transmitted from Dunfermline and received at Edinburgh in both page and tape form simultaneously. The tape was re-transmitted to Dunfermline where it, also, was received in page and tape form. This process of successive retransmission of the received tape was continued until the half-a-million and more characters had been sent.

Comparison of the final with the original page copy showed all the errors that had occurred during the whole series of transmissions. This technique saved much time by avoiding the need for examining the page copy in detail after each transmission. Fig. 1 shows part of the page copy from a tape towards the end of the trial run. Each line is the same so that addition or loss of character is immediately apparent by the displacement of the line and the unsymmetrical layout produced. The three errors referred to above will be seen on the 2nd, 5th and 22nd lines.

As the IBM machines themselves incorporate a number of checks on the information fed into them any transmission or operating errors that occur do not necessarily pass undetected. To safeguard against information being posted to the wrong account, each Bank customer is given a personal account number which is printed, with his name, on all his cheques. The account number takes the form of a composite number made up in such a way that the sum of the first and second pairs of digits equals the third pair: for example, 153954, as shown in Fig. 1. If for any reason, the number presented to the machine does not conform with this pattern, the information is rejected automatically. Transposition of digits, perhaps the most common error in figure transmission, and the sending of incorrect digits are, therefore, automatically safeguarded against.

The data transmitted by the Bank consists largely of credits and debits to individual accounts. As a safeguard against errors these figures are totalled after a certain number of items has been sent. This total is transmitted to the distant end where addition of the individual entries received provides a check of the accuracy or otherwise of the individual transmissions.

The cost of data processing equipment and computers can be high and their installation is often economic only when they can be kept fully occupied. Apart from other obvious advantages, transmission of data over wires from distant branches to a central point, either by telex or by private wires, provides a means of exploiting this expensive equipment to the full and there is little doubt that there will be increasing scope for development of these methods as mechanization and automatization techniques develop and are adopted throughout industry and commerce.

That the Bank of Scotland is satisfied with the results achieved so far is apparent from their request to extend the scheme to branches in London and Glasgow.

Tape to card converter machine showing tape received by Telex passing through the machine being read by it, and causing punched cards to be prepared
(Courtesy, Bank of Scotland)

The Post Office Supplies Department

THE SUPPLIES DEPARTMENT IS THE GENERAL Stores of the Post Office. Its customers are the 350,000 members of the Post Office staff. It supplies them with the things they need to give service to the customers of the Post Office.

Each year it spends about £35 million on purchasing the stores needed to maintain the wide range of Post Office activities: stores for the construction, maintenance and operation of the telephone and telegraph services; stamps, postal orders and the like for sale over Post Office counters; stores to keep the postal services running; protective and uniform clothing for the staff; and, of course, forms, stationery and office requisites.

In all, more than 60,000 different items are supplied, ranging from tin tacks to telephone switchboards, from pins to pillar boxes, and from postwomen's hats to the ceremonial frock-coat of the Postmaster General's doorkeeper.

The Department also runs sizeable printing works in London and Edinburgh—undertaking, among other work, the production of visible index files and directory enquiry lists. It also distributes this *Journal* and other Post Office publications, including the telephone directories. It performs agency services for overseas governments. And it keeps an ever open door at all hours of the day and night to meet emergency demands for stores.

The staff of nearly 4,000 executive, clerical and Supplies grades are engaged on an equally wide range of activities. They assess requirements, arrange for purchase and manage the stocks of stores. They operate 25 storage and distribution depots with a total covered storage area of about 1¾ million square feet and nearly a million square feet of open storage.

Main Engineering, Postal and Security Stores depots in London, Birmingham, Edinburgh and Hemel Hempstead are supported by subsidiary depots, such as those at Bridgwater, Hereford and Newhouse, and by 11 pole depots at seaports. The Department's drivers ferry supplies in the vehicles of the Supplies Department fleet regularly from the depots to the Section Stocks, Works Order Stores, Head Post Offices and other Post Office establishments over the length and breadth of the United Kingdom. The fleet's running miles each year are around three million.

The Supplies Department is progressively modernizing its operations with the aim of

Left to right: Mr. G. M. PUNNETT, Assistant Controller; Mr. H. J. HARDING, Deputy Controller; Mr. C. J. GILL, Controller; Mr. H. H. SIMMONS, Assistant Controller; Mr. F. E. GATES, Assistant Controller; Miss C. PACKHAM, Secretary continuously improving the service it gives its customers and of reducing the size of its stocks and the cost of its operations. Requisitions for engineering stores are handled by punched card methods —and a computer (the first to be used in the Post Office) helps to control stock levels and to speed decisions about purchases. A wide range of mechanical handling devices has been put to work in its depots to speed stores movement and to take a lot of the backache out of the job. Progress is being made, too, with the modernization of its storage facilities; new purpose-built depots in Scotland, at Bridgwater and at Hemel Hempstead are in use and others are planned.

United Kingdom—Sweden Cable

H.M.T.S. *Monarch*, the Post Office cable ship, laid a new telephone cable between the United Kingdom and Sweden in June, which will come into operation in October.

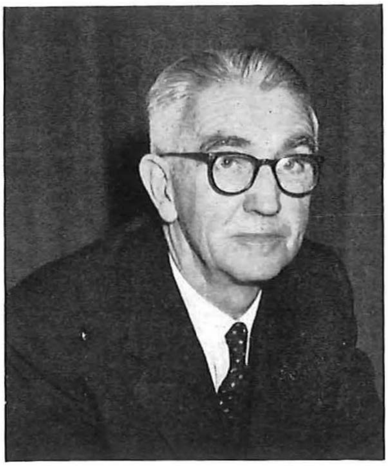
The new cable, which is the longest two-way submarine cable laid to date, and contains 28 repeaters, has a capacity of 60 telephone circuits and will provide relief to the Anglo-Dutch cables over which most of the United Kingdom-Sweden telephone traffic passes at present. It will also provide a direct and more economic route of the telephone and telex traffic between the two countries, and via Sweden and Finland. The cable runs between Marske, near Middlesbrough, and Gothenburg, Sweden.

Marconi's Wireless Telegraph Company have recently completed a new radio installation on *Monarch* which is believed to make it the first ship in the world equipped with High Frequency transmitting equipment embodying a main amplifier having no tuned circuits.

South Molton Street Post Office, London which has been re-designed by Sir Hugh Casson and Professor Misha Black, incorporates new style telephone boxes.

The left-hand wall of the office has been squared up by building in the new boxes, which are lined with a pale blue laminated plastic with glazed aluminium framed doors with black plastic push rail on which the word TELEPHONE is engraved in white.

Mr. Russell Jones, O.B.E.



(Courtesy, Western Mail and Echo)

Mr. H. Russell Jones, O.B.E., a member of our Editorial Board since 1954, retired on July 1.

His place has been taken by Mr. L. J. Glanfield, Telecommunications Controller, Midland Region.

Mr. Jones had been Telecommunications Controller in Wales and Border Counties since 1946. He joined the Post Office as a Sorting Clerk and Telegraphist in 1920 but had spent most of his working life on the traffic side of telecommunications—in the July *Post Office Magazine* he wrote his personal reminiscences of "Forty Years in 'Traffic' ". With his long experience, expressed through an engaging personality, he has been a most valuable member of the *Journal's* Editorial Board. He contributed on Decibel Notation in Telephone Transmission to our Spring 1957 number.

During his last few months he was for a time Acting Deputy Director, as well as Telecommunications Controller, in Wales and Border Counties Directorate. He received the O.B.E. in the New Year Honours list, 1959.

* * *

Sir Gordon Radley, whose retirement from the Director Generalship of the Post Office we recorded in our Summer number, has joined the English Electric group as a director of Marconi's Wireless Telegraphy Company, Marconi Instruments, Marconi International Marine Communications, and the English Electric Valve Company. He will devote part time work to developing telecommunications equipment for world markets.

Towards a Definition of Automation

AUTOMATION—IN THE SENSE OF AN EXtension of automatic processes—is being increasingly applied in the Post Office in the postal as well as the telecommunication services but it is a question whether all these developments can be properly described as automation. The word is somewhat loosely used, and not only in the Post Office.

T. H. Flowers, asking in our Autumn, 1957 issue "What is Automation?" did not attempt a strict definition of the word; neither did the 1956 Report of the Department of Scientific and Industrial Research, on which Mr. Flowers based his article.

Exact definition of "automation" is not merely a matter of verbal purism; an attempt to define it, and to distinguish "automation" from other developments in automatic operation, will help us to see more clearly what we are doing and where we are going. This article is an attempt towards defining "automation" as applied in the Post Office.

Two American definitions are:—

(1) *Automation* is the system and method of making processes automatic by the employment of self-controlling, self-acting machines for performing the necessary operations.

(2) *Automation:* The entire field of investigation, design, development application and methods of rendering or making processes or machines self-acting or self-moving; rendering automatic: theory, art or technique of making a device, machine, process or procedure more fully automatic: the implementation of a self-acting or self-moving, hence automatic process or machine.

Delmar S. Harder of the Ford Motor Company, Detroit, who is credited with first coining the word (in 1947) introduced it simply as an abbreviation of the even uglier "automatisation", defining it as meaning "the automatic handling of parts between progressive production processes". Some writers appear to accept it as merely expressing a development of the process started by James Watt and his kettle. But John Diebold of John Diebold and Associates, New York, said to be a "co-begetter" of the word, said firmly in a statement before a United States Congressional Sub-Committee in 1958, that "it is basically, a single new philosophy, and a single new technology". "Fundamentally", he had said earlier in his statement, "it deals with the transmission and use of information for the purposes of machine control, and for the purpose of optimising productions".

Another possible definition, suggested by Mr. F. J. M. Laver of the Post Office Engineering Department, is:

Automation: *Originally formed by contracting "automatisation". This term now denotes:*

(1) *Intensive mechanisation, comprising the co-ordinated automatic control of machine systems, the automatic transport, testing and treatment of materials and products throughout a sequence of operations.*

(2) *Automatic data processing used to monitor and regulate a group of linked activities.*

NOTE: "Automation" is commonly used to represent:

(*a*) *the theory, art and technique of automatic systems for industrial and commercial use;*

(*b*) *the processes of investigation, design and conversion to automatic methods.*

Two simple definitions are:

Automation means, in effect, the output of one machine put into the input of another.

Automation (or automated) equipment is self-acting under a programme.

Telephone Automation

Readers will recall that the word was used in the title of the Post Office White Paper of November 1957, *Full Automation of the Telephone System*, in which Simplified Charges (Group Charging) and Subscriber Trunk Dialling were announced. In the sense that one automatic machine, GRACE, sends out the instructions to operate other groups of automatic equipment the system can be regarded as approaching true "automation".

But Subscriber Trunk Dialling is scarcely an example of the application of (in Diebold's terms) "a single new philosophy, a single new technology". "Automatic", in the phrase "automatic telephony", simply means "to render automatic": that is, a service previously operated manually is now handled automatically. "Full Automation of the Telephone Service", for trunk (and eventually oversea) calls as well as for local calls, should perhaps be regarded as a large extension of the process of removing the need for human intervention in the moment-by-moment operation of the telephone system. In other words, "automation", as applied to automatic telephony, really means "to extend the mechanical or electronic operation" of these processes needing human intervention.

With LEAPS—the London Electronic Agency for Pay and Statistics—which is now computing wages totalling £120 million a year for 112,000 London staff, the Post Office has certainly applied automation in accounting. A computer has also been installed in the Post Office Supplies Department for computing stores.

With the development of mechanical or electronic machines in sorting offices for separating letters from packets, segregating "long" and "short" letters, "facing up" letters for passing through the stamp cancelling machines, and sorting letters and parcels, the postal services are progressing towards automation. Separating, segregating and facing up machines are working experimentally at Southampton; Norwich Sorting Office has recently been equipped with nine electro-mechanical letter sorting machines, which are also being installed in ten more offices; address codes are being marked on envelopes in phosphorescent codes which the sorting machine can read and an electro-mechanical parcel sorting machine is operating at Leeds.

The Post Office in general is certainly advancing *towards* automation of many of its services.

OUR CONTRIBUTORS

J. F. BAMPTON ("The British Contribution to TAT 2") is a Senior Executive Engineer in the Submarine Cable Section of the Engineering Department Main Lines Development and Maintenance Branch.

C. R. DANCEY ("Installations Extraordinary") has contributed previous articles to the *Journal* and an outline of his career appeared in the Spring 1957 issue. Formerly in charge of the Headquarters Training School, he became Deputy Telephone Manager, Centre Area, London Telecommunications Region, in July, 1958.

F. W. GILBY, joint author ("The BBC Concentrates its Telephone Communications") wrote "Telecommunications Network for London Transport" published in the Winter 1958 *Journal*, and his career is outlined in that issue.

J. M. HARPER ("STD–The First Three Centres") joined the Post Office as an Assistant Principal in 1953. He was Private Secretary to the Director-General for nearly three years, from 1956 to 1958, and was promoted to Principal in September 1958. As a Principal in the Inland Telecommunications Department he was Secretary of the Post Office party who visited America in November 1958 to study the Bell telephone system. Since then he has been in charge of Equipment Design Division of Telephone Mechanization Branch in ITD. This division is concerned with exchange equipment design and facilities, and particularly with these aspects of Subscriber Trunk Dialling.

S. A. T. HOBCRAFT ("Problems of Wayleaves and Damage Claims") is an Assistant Telecommunications Controller II at Post Office Headquarters, Wales and Border Counties, and in addition to dealing with Wayleaves and Damage Claims is responsible for Circuit Estimating and Programming. Appointed a Sorting Clerk and Telegraphist (Telegraphs) at Plymouth in 1938, he served in the Royal Signals throughout the war and in 1948 became an Assistant Traffic Superintendent in London Telecommunications Region, Long Distance Area. Transferred to Taunton in 1950, he was promoted to his present post in 1957.

J. M. OGILVIE ("Transmitting Data by Telex") contributed an article ("Telephones in the Highlands and Islands") to the November 1954 issue. He entered the Post Office as a Youth-in-Training in 1933 and served in the Engineering Department until 1940 when he became an Assistant Traffic Superintendent in the Edinburgh Telephone Area. From 1943 he served in the Signals Landline Section of the Royal Air Force at HQ 26 Group of Bomber Command and at HQ Transport Command. Since the war he has been employed on telephone, telex and telegraph work at Post Office Headquarters, Scotland, and was recently transferred to the Inland Telecommunications Department on promotion to Chief Telecommunications Superintendent.

H. A. E. VALENTINE, joint author ("The BBC Concentrates its Telephone Communications") entered the Post Office in 1937 as a Skilled Workman II and served in the Engineering Department being promoted Inspector in 1938. In 1942 he transferred to the Traffic side on promotion to Assistant Traffic Superintendent and is now a Senior Telecommunications Superintendent in London Telecommunications Region, West Area.

(Continued overleaf)

R. W. WHITE ("Long-Distance Waveguides") is an Assistant Staff Engineer in the Microwave Division of the Engineering Department Research Branch. After training as a physicist, he spent two years on the Scientific Staff of G.E.C. Research Laboratories before entering the Post Office in 1939 as a Probationary Assistant Engineer. After a year at Dollis Hill on teleprinters and radio transmitters, he was transferred to an out-station in South Wales and worked on the development of frequency modulation techniques. Since 1948 he has been in charge of the Post Office Research Laboratory at Castleton, near Cardiff, and since 1957 he has been responsible also for the Research Laboratory at Backwell, near Bristol.

Book Review

Telegraph Switching Overseas

Teleprinter Switching by E. A. Rossberg and H. E. Korta (351 pages, 208 illustrations and eight tables, published by D. Van Nostrand Company Limited. 70s. 0d.).

With the completion of our own telex automatization by the end of the year, subscriber-dialling to Western Europe following six months later, and round-the-globe dialling via the Commonwealth cables on the horizon, this book is of particular interest at the present time. It is a translation from German and aims to contain, in a single volume, a comprehensive and systematic survey of the main telegraph switching and message relay systems in use throughout the world, with particular reference to their differences and peculiarities.

Both authors are with Siemens & Halske AG and the book is, therefore, written against the solid background of experience with their well-tried TW 39 system. This system, which is used in a good many countries as well as in the long-established Federal German network is naturally fully dealt with. The keyboard-selection register system of the Netherlands is also well covered, and other differing systems such as those in Scandinavia and France are described. Both public telegraph and telex services are included in the survey.

The information on the United Kingdom system is disappointing as it is restricted mainly to the public telegraph network (TAS); on telex only the manual system is described, ironically at a time when it is already on the way out and due to be completely replaced within a few months. Presumably this is because a very little published information about the automatic system was available at the time the material was assembled.

A smaller, but nevertheless useful section is devoted to message relay systems and the final section to more general matters such as telex rate structures and testing facilities, including some useful appendices. The illustrations are helpful and adequately chosen.

Primarily this is a book for the telegraph engineer, but it contains a good deal of interest to the non-technical specialist which is not readily and conveniently available elsewhere.—D.P.

Publication and Price. The *Journal* is published in November, February, May and August, price 1/6. The annual postal subscription rate is 6/6 to any address at home or overseas.

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 Department.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters, G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

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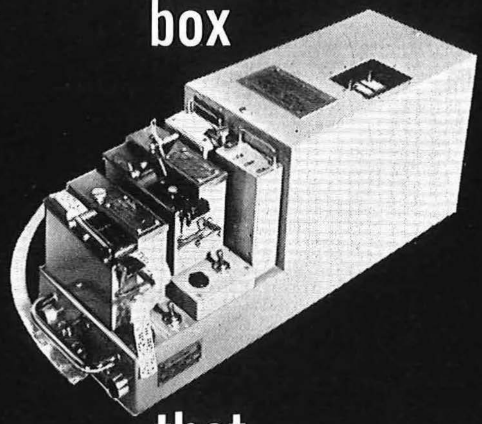
the little box



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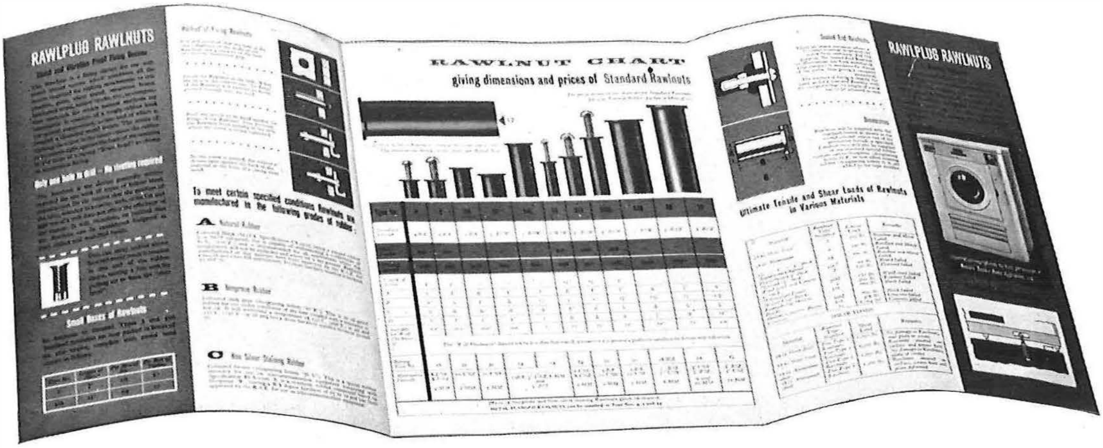

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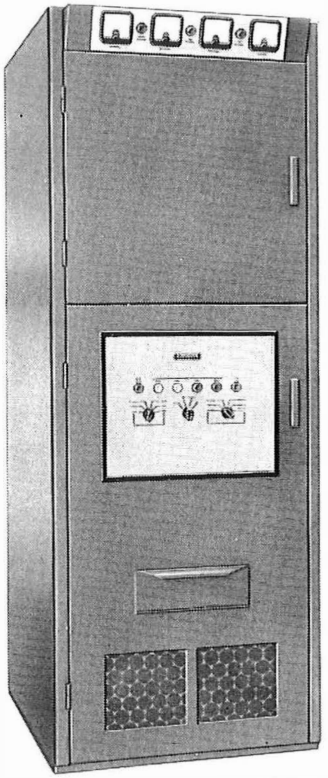

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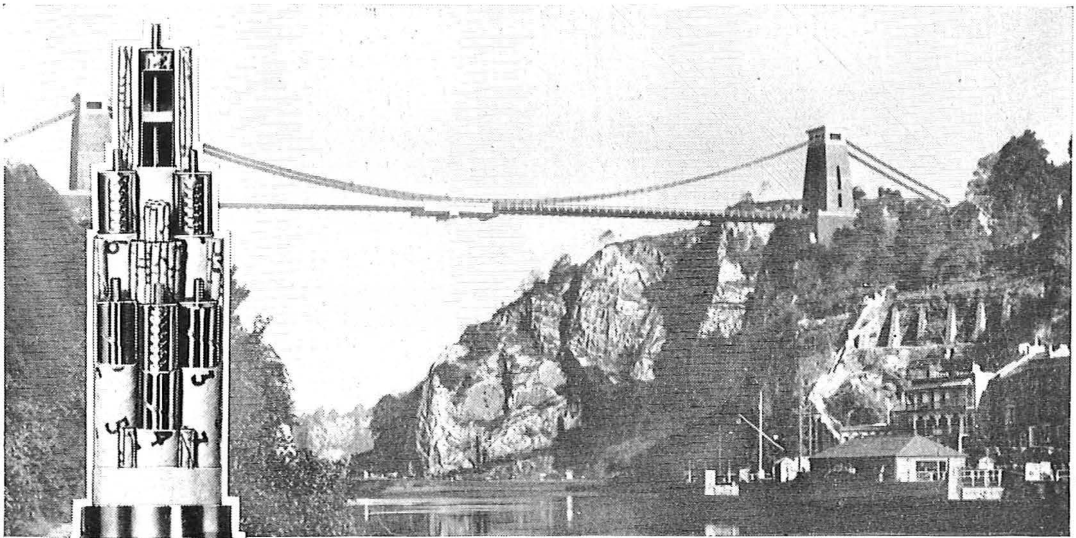
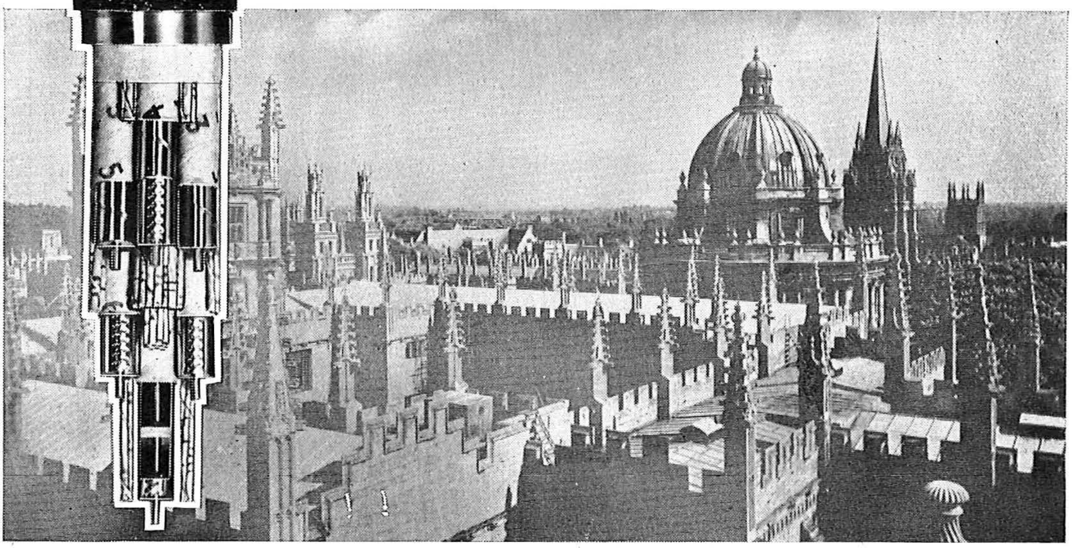


S.T.C. coaxial cable for S.T.D.

A 6 tube, type 375 Coaxial Cable incorporating 32 pairs 20 lb/mile conductors has been manufactured and installed between Bristol and Oxford by Standard Telephones & Cables Limited for the British Post Office. The cable, necessitated by the introduction of the Subscriber Trunk Dialling (S.T.D.) system in Bristol, provides additional trunk circuits between Bristol, Oxford, Birmingham, London and other principal cities. S.T.C. pioneered the introduction of the first coaxial cable and have been responsible for all subsequent developments. Already the company has manufactured and installed in the U.K. alone over 3000 route miles of cable incorporating over 10,000 miles of coaxial tube. This further contribution to the U.K. telephone system re-emphasises the leading position of S.T.C.



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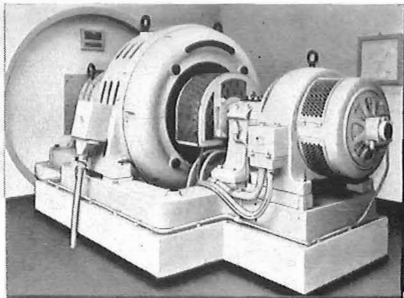

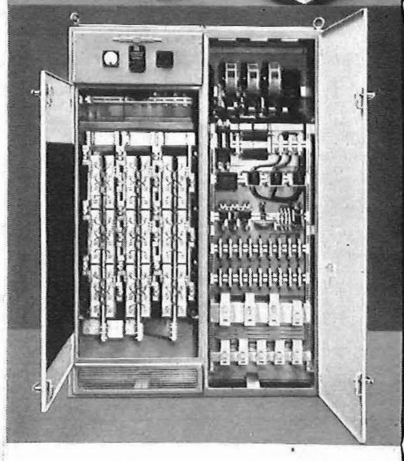

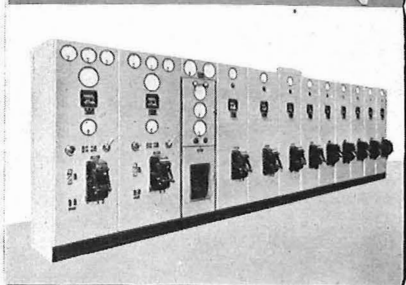

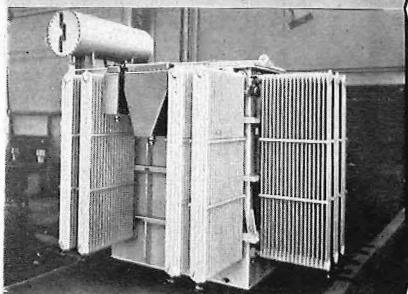

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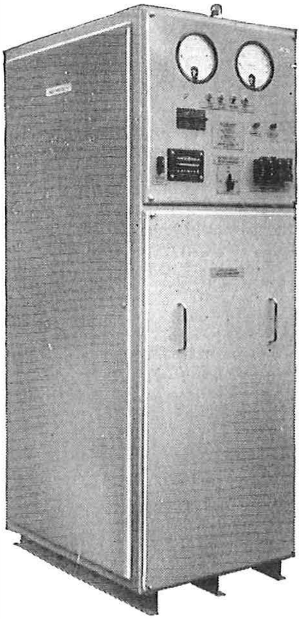

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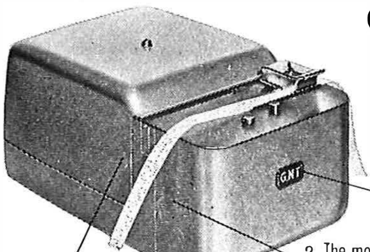

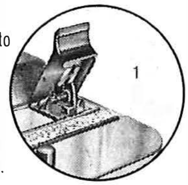

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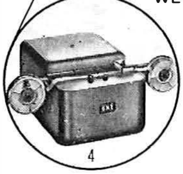

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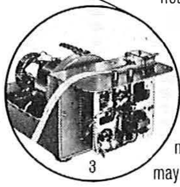

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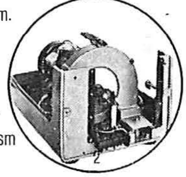

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