THE AUSTRALIAN POST OFFICE

COURSE OF TECHNICAL INSTRUCTION

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INTRODUCTION TO TELEGRAPHY

1. GENERAL.

1.1 Telegraphy, as a means of communication, has many applications, all of which serve a common purpose, that is, to provide the means of transferring written, rather than verbal information, from one point to another. The word "Telegraph" originates from two Greek words, "Tele" meaning distance, and "Graphos" to write.

Ever since the beginning of telegraphy, attention has been directed towards the development of a system to automatically transmit and receive messages as printed information with minimum human effort.

Because of the rapid advances made in Telecommunication techniques, this objective has now become a reality. This paper will not give an account of the developmental stages or describe the ways in which the problem has been tackled. However, it will cover the part that Telegraphy plays in the Telecommunications requirements of the modern community.

The main items of telegraph equipment used, and their applications are described so that you may gain a general understanding of the scope and activities of the telegraph services of the Australian Post Office.

Issued 1958.

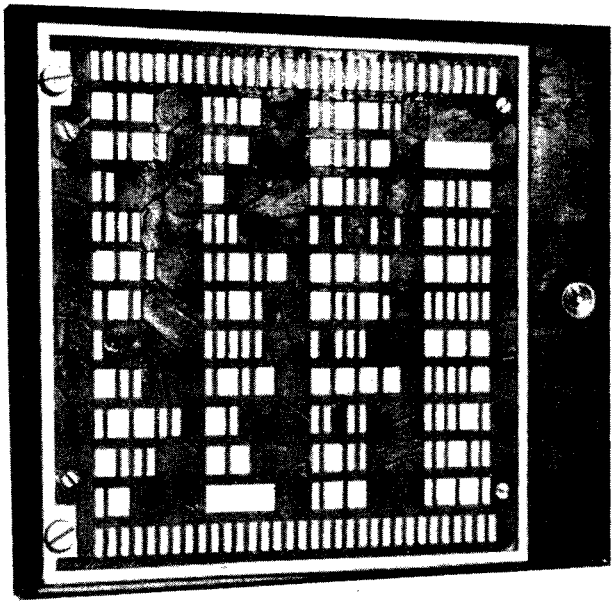
1.2 Telegraph Operation, that is, the process of transferring written information, involves two separate actions, -

- Sending, which is the coding of the information to be transmitted and its transmission as electrical signals, and -
- Receiving, which is the receipt and translation of these signals into intelligence at the receiving point.

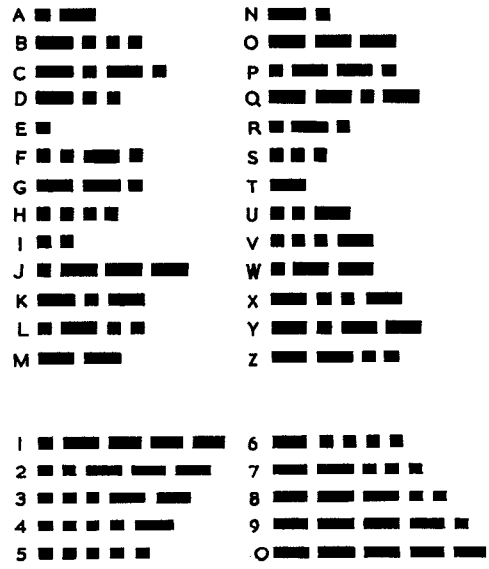
Manual Operation. In manual operation, which is still used to a limited degree, the sending operator, by the manipulation of a key, transmits Morse code as electrical signals over the line. The receiving device, a relay, in response to the electrical signals, produces audible signals which are translated and recorded by the receiving operator.

Because of the cost of manpower involved, susceptibility to operator error, and fatigue, etc., machine operation has almost completely replaced manual operation.

Fig. 1a shows one of the earliest pieces of telegraph signalling equipment used in Australia. This consisted of a segmented metal plate on which an alphabetical code was arranged. Messages were transmitted by drawing a wire across the segments, thus making or breaking the circuit. This code was discarded in Australia in 1897 in favour of the Universal Morse Code shown in Fig. 1b which is still used for manual operation.



(a) Early Form of Telegraph Transmitter.

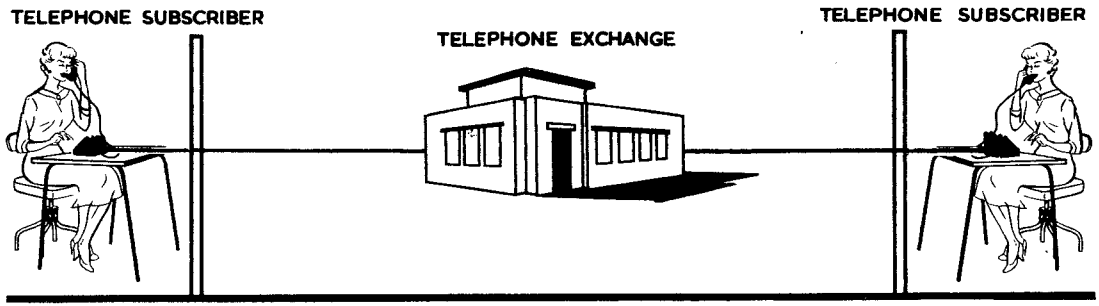


(b) Universal Morse Code.

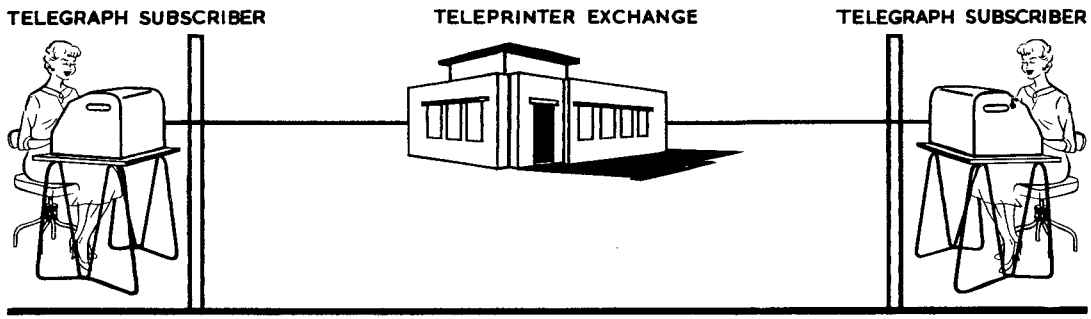
FIG. 1.

Machine Operation. Telegraph machines, (Section 3 of this paper), serve many individual purposes. Simply by the operation of a keyboard, messages are coded, transmitted, received, translated, and presented as printed characters, ready for removal from the machine for immediate use. This system of machine telegraphy has done much to reduce the fatigue associated with manual telegraph working, while also reducing the time, and thus the costs, involved in the transmission of messages.

Today in much the same way as a telephone transmits and receives speech by electrical means, telegraph equipment transmits and receives writing by electrical means. (Fig. 2.) The lines and the interconnection of the lines for telegraph purposes are similar to those used for telephone services.



(a) Telephone Communication.



(b) Telegraph Communication.

Fig. 2.

1.3 The part played by Telegraphy. Compared with Telephony, Telegraphy is free from phonetic errors, thus ensuring a high standard of accuracy, and has a greater degree of secrecy.

Because of this and the fact that is provides facilities that cannot be satisfied by other communication systems, Telegraphy has assumed an important place in communications. This is not always realised by those not directly concerned with telegraphy, for the work of this branch of communications is often not apparent, and could seem less important by comparison with radios and telephones, which are more closely linked with our daily lives.

In actual fact, the work of this less evident branch of Telecommunications is just as essential to our modern communications requirements as that of the other better known branches of Telecommunication.

In the modern community, many private persons, business organisations, and government bodies use telegraph services as a means of communication, sending messages to and from all parts of Australia and the world.

Private messages relating to births, deaths, appointments, greetings or congratulations on birthdays, weddings, and the like, are commonplace, being handled swiftly and efficiently in great numbers from day to day.

In the commercial world, small and large businesses have realised that "speed is the essence of the contract" and that orders placed by phone are not generally accepted as "firm" orders until confirmed in writing, whereas telegraphed orders are accepted. Also, because of decentralisation of industrial areas, fast, reliable, and direct communication between distant branch offices, factories, and head offices, is essential. Quite often information has to be collected from different points and evaluated by a central body. Telegraph machines simplify processes such as these, permitting close control of remotely located activities.

As a result, more and more oil companies, banks, automotive industries, wool brokers, travel agencies, manufacturers and merchandisers of almost every conceivable nature, are taking advantage of the facilities offered by telegraph equipment to more efficiently conduct their business.

Some examples of the applications of telegraphy are given below, and are an indication of the importance and reliance which is vested in this method of communications.

Press Organisations, reporting events occuring at all points all over the world, use telegraphic means almost exclusively for the distribution of news. Telegraph machines work around the clock pouring out millions of words of information over telegraph networks to all points of the globe, in this field alone.

Airline companies and aviation authorities use telegraph networks extensively for the transfer of information about flight schedules, passenger bookings, reservations, aircraft movements and control, etc.

Meteorological centres, by various types of telegraph equipment, obtain information from many widespread locations for the compilation and subsequent distribution of weather reports covering weather conditions existing over vast areas.

Criminal Investigation. Some of the foremost of these organisations in the world use comprehensive telegraph networks as an aid to the prevention and detection of crime.

Stock Exchange quotations are distributed over telegraph networks in many countries, providing an accurate and up-to-date record of financial market fluctuations throughout the world.

Electronic Computors. Telegraph machines are used to "feed" information into, and receive information from, electronic computing equipment.

With the increasing trend towards electronic equipment in communications, it is probable that future telegraph equipment will be largely electronically operated. It should be remembered however, that for as long as we have receiving machines printing on paper, much of the machine operation, must, of necessity, be mechanical. The combination of electronic and precise mechanical operating principles has already been introduced in modern telegraph apparatus with advantageous results, and there is little doubt that further developments in this direction will even further enhance the value of Telegraphy in the Telecommunications field.

2. TELEGRAPH SERVICES.

2.1 Many different arrangements of telegraph equipment are now available for different types of telegraph services. In Australia, three main types of service are provided. These have been developed to meet a demand for the particular types of service, and although the classifications apply generally to machine telegraph services, the principles described can also be applied equally well to manual telegraph services.

2.2 If, for either personal or business reasons, any person in Australia wishes to send a telegram, he will use the Public Telegraph Service.

A telegram may be lodged either by phone or at a post office, and, as a general rule, is delivered by messenger from a post office near the recipient's address. The efficient functioning of this service calls for good organisation, as the time between the lodgment of the telegram and its delivery must be a minimum.

2.3 Should a user consistently use the Public Telegraph Service, he may decide to avail himself of the Teleprinter Exchange Service, which is similar to a Telephone Exchange Service, except that communication is by telegraph machine instead of by telephone. The user, known as the subscriber, would be connected to the Teleprinter Exchange Service and by means of a leased telegraph machine operated by his own staff at his premises, he will be able to call any other subscriber connected to the exchange service, or alternatively initiate telegrams for delivery via the Public Telegraph Service.

2.4 If a commercial firm requires constant communication from one place to another, for example, from branch to branch, a third type of service, known as a Private Wire Telegraph Service, is provided. This service with leased machines and lines at each branch and staffed by privately employed personnel provides direct contact and is continually available for the interchange of information.

3. TYPES OF MACHINES.

3.1 The main types of telegraph machines can be broadly classified into two types, namely, page machines and tape machines. These machines, evolved over the years to suit the needs of telegraph communications must conform to standards laid down by an international body known as the International Telephone and Telegraph Consultative Committee (C.C.I.T.T.), so that, if necessary, machines in one country can be used to operate satisfactorily when connected to machines in another country.

3.2 Telegraph Page Machines or page printers, examples of which are shown in Figs. 3 and 4, are similar in many respects to an electric typewriter, and have two main functions.

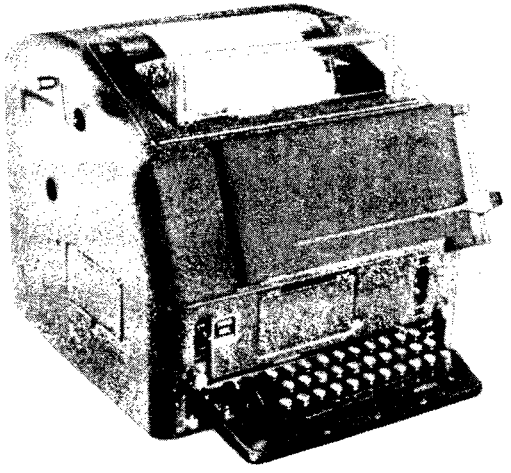
Transmission, which is by manipulation of a keyboard, similar to a typewriter. When a key is depressed, electrical pulses are transmitted over the telegraph line, the selected letter or character being also automatically printed on the page of the transmitting machine.

Reception. When these electrical pulses or signals arrive at the receiving machine, levers are positioned according to the arrangement of the signals, and in response to these signals the receiving machine will automatically print the required letter or character.

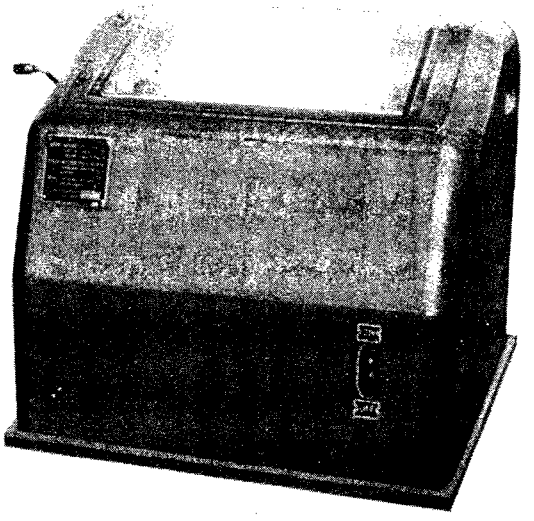
A small electric motor in the machine provides power for the printing operations. The messages, visible to the operator, are printed on a continuous $8\frac{1}{2}$" wide roll of paper, the printed characters being spaced at ten to the inch across the page. A knife edge on the machine allows the paper to be torn off as messages are received.

Many of the telegraph machines used in Australia, particularly as terminal equipment, are page machines.

The keyboard transmitters of these machines are easily detachable, and are removed, as shown, when a machine is required for receiving messages only.

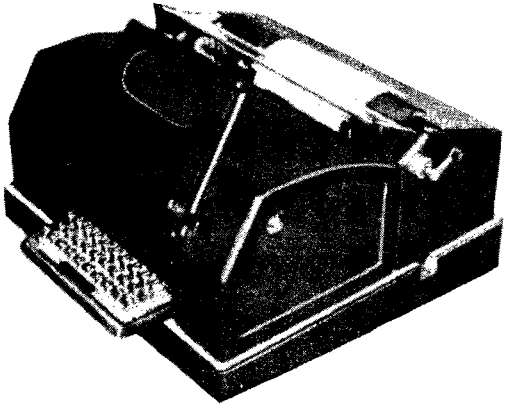


(a) Sending & Receiving Machine.

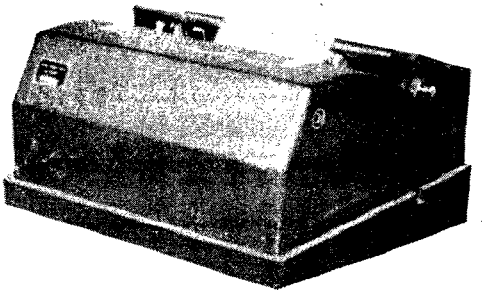


(b) Receiving Machine (Without Keyboard).

FIG. 3. TELETYPE PAGE PRINTING MACHINE - AMERICAN MANUFACTURE.



(a) Sending & Receiving Machine.



(b) Receiving Machine (Without Keyboard).

FIG. 4. CREED PAGE PRINTING MACHINE - ENGLISH MANUFACTURE.
(KNOWN AS TELEPRINTER).

3.3 Telegraph Tape Machines. There are two types of tape machines available. One of these, designed for printing on a continuous 3/8" wide paper tape, is not generally used by the Australian Post Office, but has extensive use overseas. The other type, which uses an 11/16" wide paper tape, is universally used throughout the Australian Post Office and can be arranged to perform several functions.

At "tape-relay" centres, where a manual tape relay system is used, that is, where messages are received on tape for retransmission to other points, tape machines are used almost exclusively, page machines being used only when page copies of messages are required.

The paper tape is used primarily as a convenient method of storing messages, each letter or character of the message being represented by a series of holes perforated across the tape. The row of small holes along the tape feed it through the machines, and play no part in the message.

Machines that simultaneously perforate and print the message on the tape are also used. This simplifies the identification of the messages perforated on the tape. Some of these machines produce a "Chadless" or "Part Perforated" tape so that the typing on the tape can be readily distinguished, while other machines fully perforate the tape and the message is typed on the tape in between the perforations.

Examples of tape machines and the perforated tape produced by them are shown in Figs. 5 to 10.

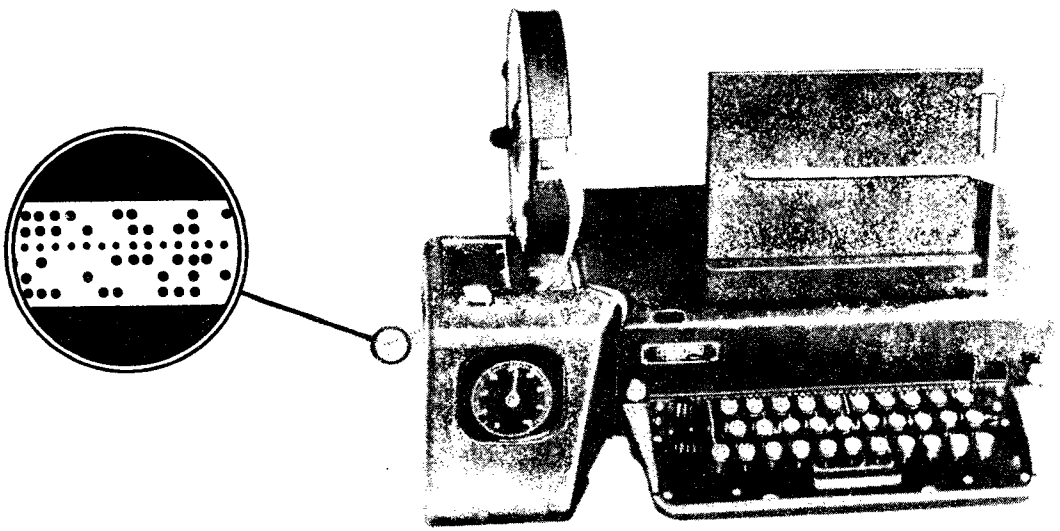


FIG. 5. KEYBOARD PERFORATOR.

3.4 The Keyboard Perforator. (Fig. 5.) The keyboard of this machine is identical to that of a page printer. Tape is perforated when a key is depressed and automatically "stepped on" through the machine after each perforation.

The keyboard perforator shown will only perforate the tape and does not function as a transmitter, that is, it will not send out electrical pulses over the telegraph line. It can, however, be fitted to the Teletype page printer in place of the normal keyboard. The machine is then known as a Teletype Page Printer with Keyboard Perforator Transmitter, (Fig. 6). All the normal functions of a sending and receiving page printer are retained under these conditions, with the additional function of tape perforation being available.

This arrangement has a particular use where a message has to be transmitted to several points, but not simultaneously. The original transmission can be made from the keyboard when the tape is first prepared, and subsequent transmissions can be made from the tape by the use of a transmitter distributor. Occasions such as this could arise in an organisation having more than one other branch to which information has to be transmitted.

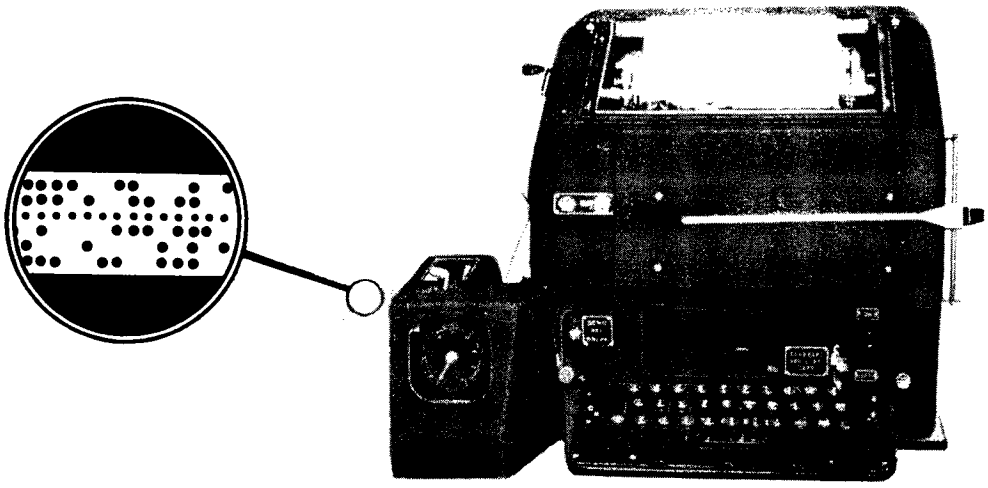
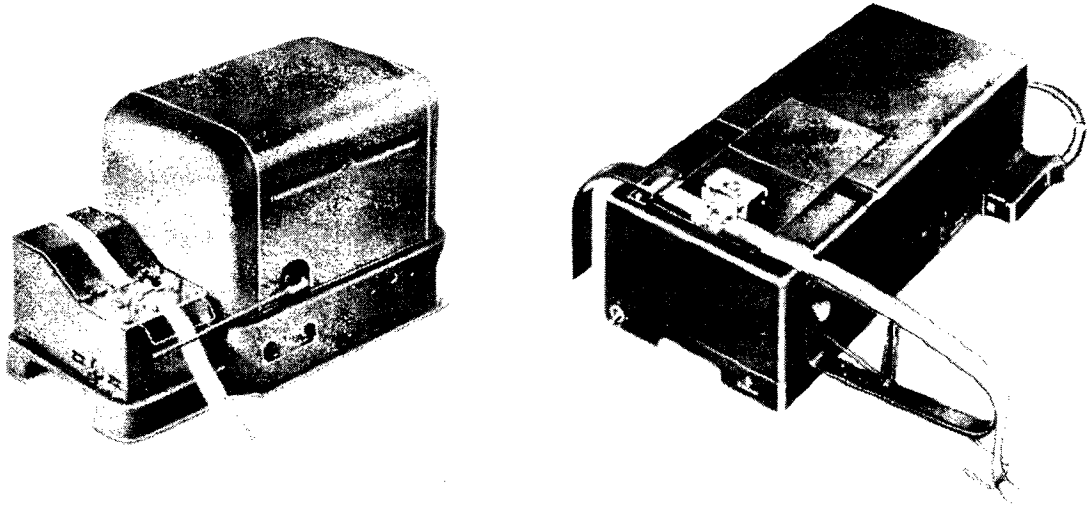


FIG. 6. TELETYPE PAGE PRINTER WITH KEYBOARD PERFORATOR TRANSMITTER.

However, if the keyboard perforator is used alone for the perforation of tape only, there must be some other means of transmitting these messages. As the message is already in tape form, any further typing would be a waste of time.

3.5 The Tape Transmitter Distributor, Fig. 7, converts the perforations on the tape into electrical pulses and transmits them to line at the full speed of automatic transmission, the prepared tape being merely placed in the machine.



(a) Teletype Transmitter Distributor (T.D.).

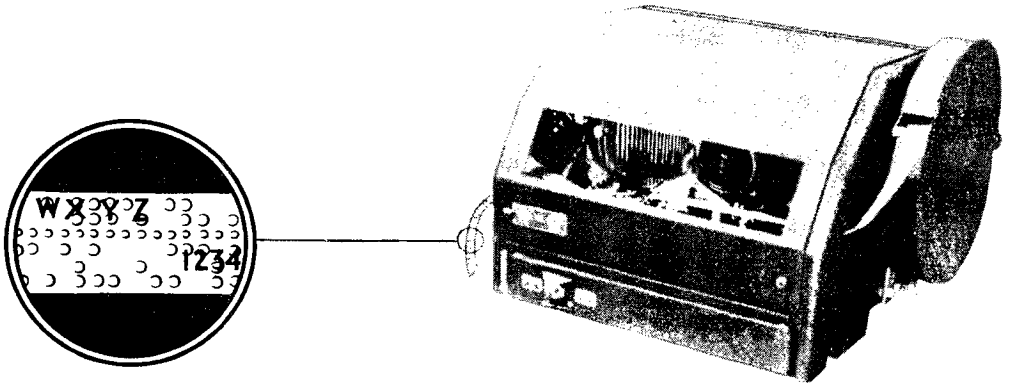
(b) Siemens & Halske Transmitter Distributor (T Send 77).

FIG. 7. TELEGRAPH TAPE MACHINES - TRANSMITTER DISTRIBUTORS.

Transmitter distributors can be used to transmit signals to one or several channels simultaneously. Switching at switching centres permits selection of the required channels for the transmission of particular messages.

A receiving perforator or reperforator receives messages by perforating a paper tape instead of printing on a page. The use of these machines is restricted to places where operators are trained in "reading" the perforations on the tape.

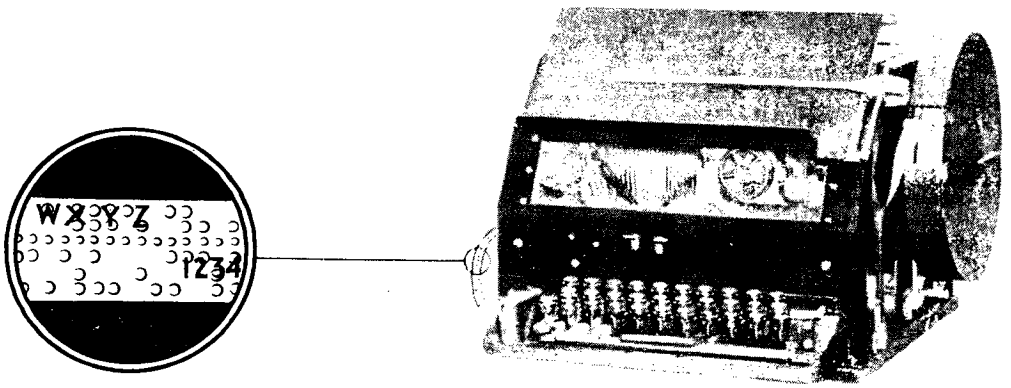
3.6 Typing Reperforators type the message on the tape as well as perforating it, as in Fig. 8, and for this reason are used almost universally for tape reception purposes.



TELETYPE TYPING REPERFORATOR. (R.T.R.)

FIG. 8.

3.7 Yet another development of the typing reperforator is the inclusion of a keyboard. Keyboard Typing Reperforators, Fig.9, can be used to perforate and print tape while simultaneously transmitting the message by electrical pulses over the line. All this is done from the keyboard which is similar to the keyboards on perforators and page printers.



TELETYPE KEYBOARD TYPING REPERFORATOR. (K.T.R.)

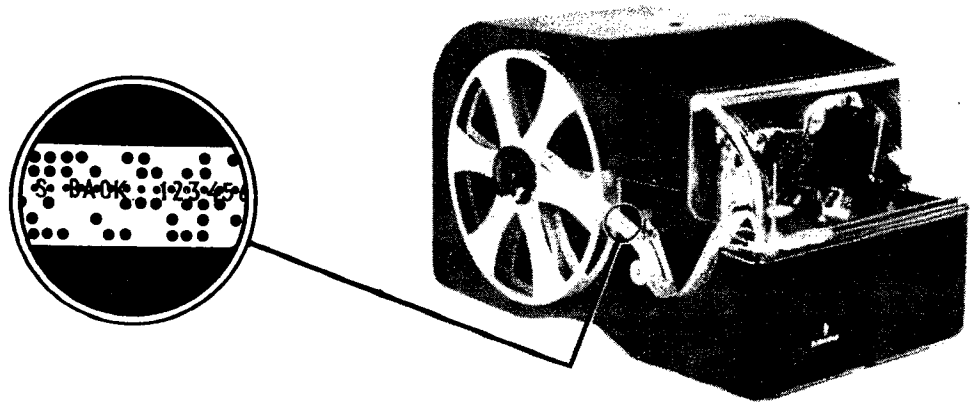
FIG. 9.

The keyboard typing reperforator can also be used for receiving perforated and printed tape messages in the same way as the typing reperforator, when not used for transmitting.

Normally, keyboard typing reperforators are used for the two previously mentioned operations only, but in some cases they are used for tape preparation. This is done by switching the machine into a local circuit, the tape messages being then prepared by operation of the keyboard of the machine, but not transmitted to line as electrical signals.

These conditions, of course, only apply where there are other means of tape transmission.

3.8 Typing Reperforator/Transmitter Distributor. This machine, (shown in Fig. 10), combines a typing reperforator and transmitter distributor, and has made possible the reception and automatic retransmission of messages. This facility is essential to a reperforator switching service, where a message has to be received, its destination "read" by the switching equipment, stored in the form of a tape-loop until a free line to its destination is automatically found and allocated, and then the message retransmitted.



Siemens & Halske Model (T loch 15a)

FIG. 10. TYPING REPERFORATOR/TRANSMITTER DISTRIBUTOR.

3.9 The types of telegraph machines and their functions are summarised below. The name of the machine describes, to a large extent, its function.

Page Machines.
Page Printers - Keyboard sending and page receiving.

Tape Machines.
Keyboard Perforators - Keyboard perforation of paper tape.
Tape Transmitters - Transmit messages from previously perforated paper tapes.
Reperforators - Receive and perforate messages on paper tape.
Typing Reperforators - Receive, perforate, and type messages on paper tape.
Keyboard Typing Reperforators - Keyboard sending and preparation of perforated and typed messages on tape. (Also used as Typing Reperforator when not required for transmission or tape preparation.)
Typing Reperforator/Transmitter Distributor - As the name implies, combines the functions of these two machines.

Composite Tape and Page Machine.
Page Printer with Keyboard Perforator Transmitter - Combines the functions of Page Printer and Tape Perforator.

4. THE PUBLIC TELEGRAPH SERVICE.

4.1 Telegraph Services for the public are provided in all countries of the world.

Due to the high cost of lines, the extent of such services in most countries is determined largely by the distances to be spanned and the demand for these services.

The most common method of providing telegraph services is by the establishment of a main telegraph centre, to which all outlying telegraph offices are connected by telegraph traffic channels.

This centre is, in turn, linked to other large telegraph centres which control the telegraph communication requirements in other areas.

Networks built up in this manner extend from one country to another throughout the world, and in cases where line provision is impracticable, radio-telegraph links are set-up.

The methods used in conducting these services vary considerably from country to country, but generally messages are either received at the telegraph centre and "relayed" on to their destination, or, the telegraph channels concerned are connected together and the message is transmitted direct from the office of origin to the office of destination.

The direct connection of public telegraph traffic involves only one keyboard operation and one receiving operation for the transmission of a message between two points, but delays on lines are difficult to avoid unless a large number of channels between telegraph offices and the main centres are provided.

In a country as large as Australia, provision of direct telegraph channels for this purpose is not practicable. This method is, however, used in other overseas countries such as England, where the distances to be spanned are much less than in Australia, and the cost of telegraph channel provision is much less expensive.

4.2 The Public Telegraph Service in Australia. Operated by the Australian Post Office, this service provides telegraph facilities for the public of Australia, who may send and receive telegrams to and from all parts of the world. Messages are handled by post offices throughout Australia, the extent of the telegraph activities of each office being governed by the demand for the service in that particular area.

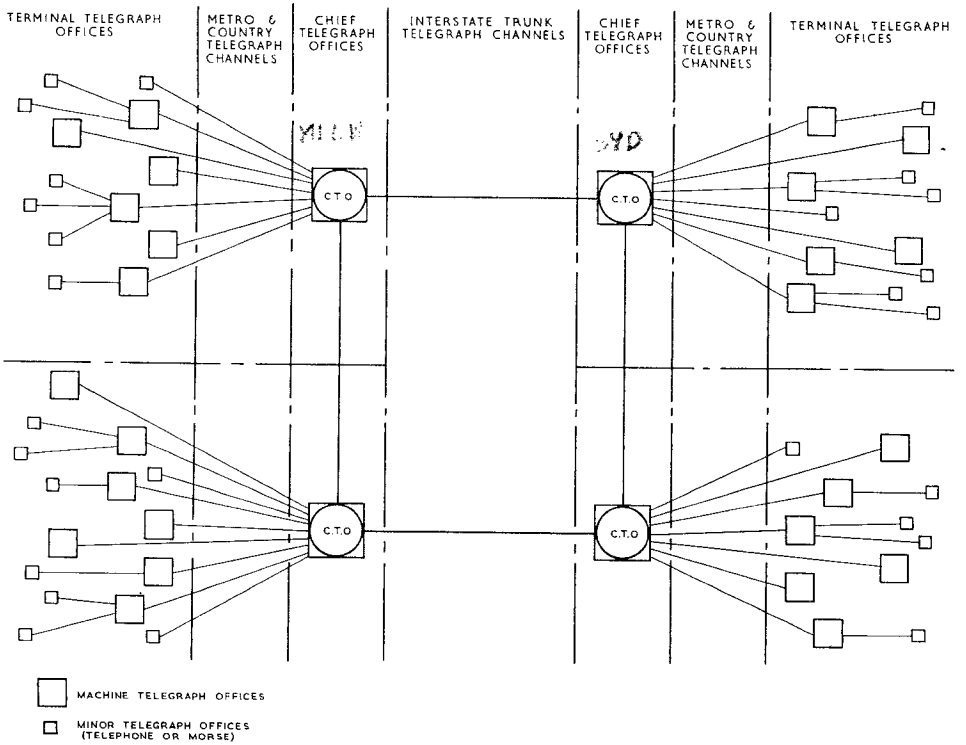
As reliability, accuracy, and speed of communication are very important in telegraphy, telegraph offices must be equipped to meet these requirements, having regard to the cost and standard of service to be provided for each location.

Small telegraph offices where relatively few telegrams are handled daily, do not warrant the provision of elaborate and costly equipment, and are generally provided with a direct contact to nearby larger offices, where the equipment provided can be effectively employed handling the additional messages to and from the smaller offices.

Larger telegraph offices are connected by direct telegraph channels to a Main or Chief Telegraph Office (C.T.O.), within the state concerned, each C.T.O. being linked, in turn, by telegraph channels, with C.T.O's in other states.

In this way, an integrated telegraph communication network has been built up.

A diagrammatic representation of this network is shown in Fig. 11.



LAYOUT OF THE PUBLIC TELEGRAPH SERVICE.

FIG. 11.

All interstate circuits and circuits to the larger post offices are equipped with telegraph machines, the remaining offices being equipped only with morse facilities.

Minor telegraph offices not connected direct to a C.T.O. handle their telegraph business by telephones or morse with the nearest large office, or in the metropolitan areas, with the C.T.O.

A "Phonogram" service is provided in the larger centres and C.T.O's. where telegrams are accepted by telephone for inclusion in the public telegraph service, the charge for this service being debited to the telephone subscriber's account.

A picture-telegraph service operates between the largest centres and capital cities in Australia, and can be coupled with overseas radio-links for direct transmission and reception of pictures on a world-wide basis. Portable picture transmitting units are also available for "on-site" transmission of pictures into the picture-telegraph network.

4.3 Telegraph Office Functions. The functions of a telegraph office vary according to the type and volume of telegraph business handled, and can be understood by a study of the stages through which a telegraph message must pass during its journey from sender to receiver.

Unless a telegram can be delivered locally from the office of origin, which is rarely so, the message must be transmitted to a C.T.O. where it will be received, sorted, and either delivered to an addressee of that C.T.O., or retransmitted to another telegraph office for reception and ultimate delivery.

Telegraph offices, can, therefore, be divided into these two functional types -

Terminal Telegraph Offices, which deal with originating and terminating telegraph traffic for that office, and, in some cases, a limited number of outlying minor offices. Telegraph machines are, as a general rule, provided at terminal offices for direct operation to the C.T.O.

Chief Telegraph Offices. The two main functions of the C.T.O. are -

- The reception and transmission of telegrams originating or terminating at the C.T.O., including those to and from metropolitan telephone offices; and

- The provision of a common control point for the reception, redirection, and retransmission of telegrams passing from one telegraph office to another in the public network.

Because of the arrangement of the public network, only a small proportion of the operations in a C.T.O. are concerned with originating and terminating messages, the majority of the activities being directed towards the passage of "through" traffic.

Each "through" telegram requires at least four operations, one each at the originating and terminating stations, and two at the C.T.O., Interstate messages which pass through two C.T.O's. therefore require six telegraph operations. These operations take into account the initial transmission, reception, retransmission, and final reception of the messages only, and do not include the redirection measures necessary at the C.T.O., which involve the transfer of the received messages to the appropriate outgoing channel for retransmission to their ultimate destination.

The redirection of "through" traffic at the C.T.O. is one of the major factors to be considered in the provision of an economical and effective standard of telegraph service for the public.

4.4 Message Redirection methods vary slightly for different locations according to traffic requirements and local conditions, but, basically there are only two ways by which messages can be transferred from incoming to outgoing telegraph channels for retransmission to their ultimate destinations. These are -

- Manual Message Relay. Copies of manually relayed messages are received at receiving positions in the C.T.O's., carried to the appropriate sending positions by various types of conveyor systems, where they are manually retransmitted to their destination offices by telegraph operators.

- Automatic Message Relay. This involves the switching of telegraph channels across the C.T.O., messages may be automatically received, redirected, and retransmitted direct from the receive position in the C.T.O. to the office of destination. A number of common "cross-office" telegraph communication channels capable of interconnection to any telegraph channel terminating at the C.T.O. are necessary for this purpose. Interconnection can be by manual, automatic, or semi-automatic switching apparatus.

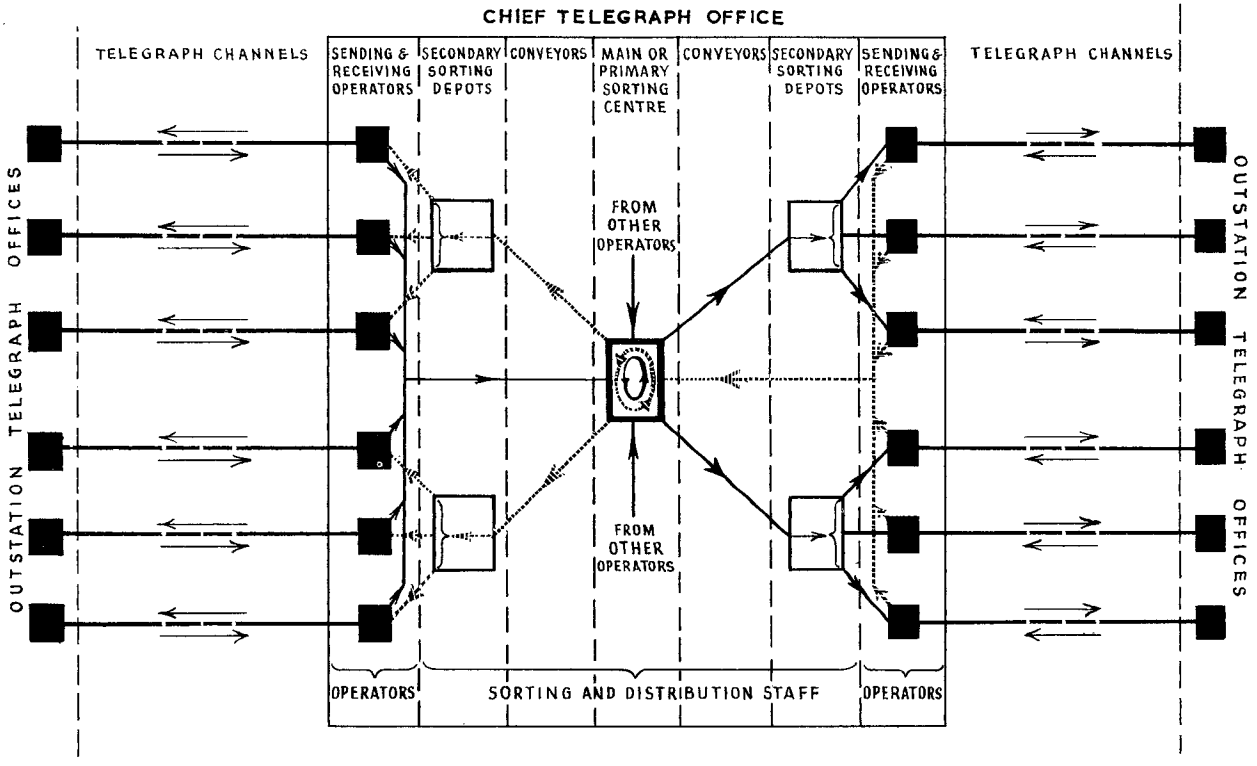
The principles of both the Manual and Automatic Message Relaying methods are briefly outlined in the following paragraphs for comparison purposes.

4.5 Manual Message Relay (Fig. 12.) The telegraph lines from each terminal office terminate at fixed positions in the C.T.O., from where incoming and outgoing messages are received and transmitted. On receipt at the C.T.O. positions, messages are placed into a circulatory system for sorting and distribution to the outgoing positions. Because of the varying destinations, all telegrams are directed to a main sorting centre for primary sorting from where, according to their destination, they are transferred to Local, Suburban, Country, Interstate or Overseas depots.

Secondary sorting is done at the Suburban, Country, and Interstate depots, where the messages are distributed for retransmission to their respective terminal offices or C.T.O's.

For this method of message handling some form of conveyor system is needed to carry the messages to and from each point in the C.T.O.

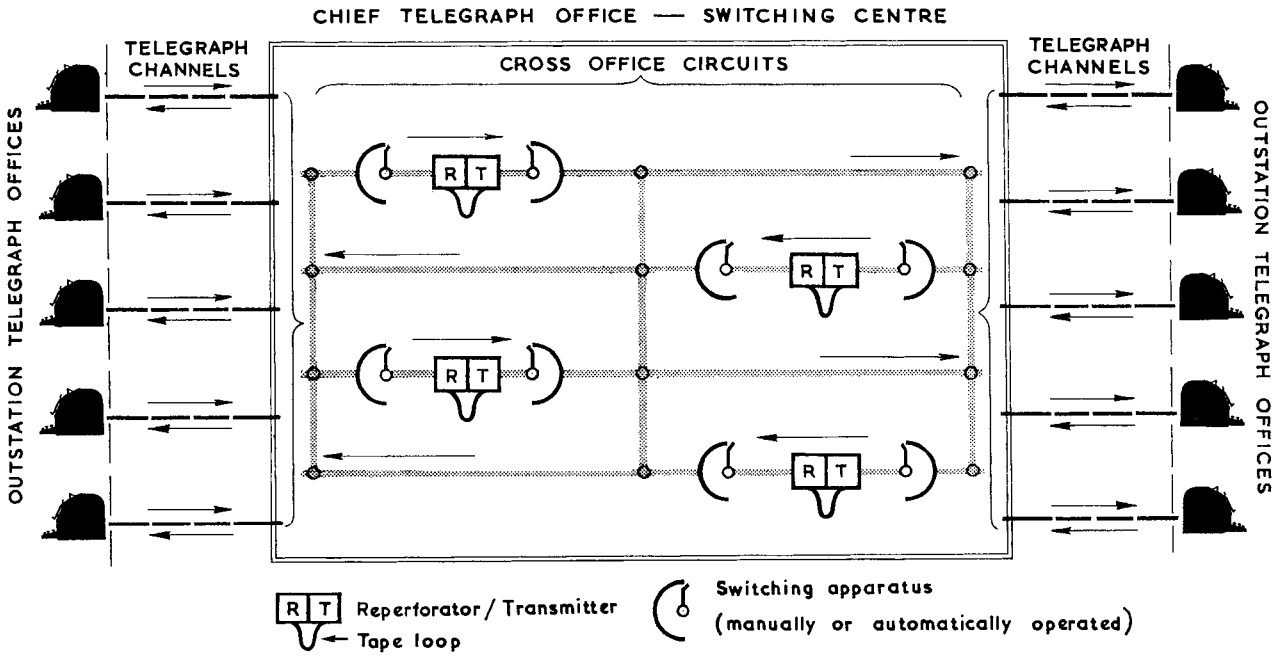
Provision of operators for both sending and receiving positions sorting and distribution staff at both primary and secondary sorting centres, results in high operating costs when manual message relaying methods are used. Added disadvantages are those of the inevitable delays to the messages through the C.T.O., and increased chance of messages being lost or damaged. All of these factors adversely affect the standard of service, both from an economic and efficiency viewpoint.



MANUAL MESSAGE RELAY.

FIG. 12.

4.6 Automatic Message Relay. By interconnecting the outgoing telegraph channel to automatic retransmitting equipment at a central incoming or receiving position in the C.T.O., much of the cost associated with manual message relay can be eliminated. Fully automatic switching and machine equipment can be arranged to include facilities for receiving, recording, routing and retransmitting the messages from office of origin to that of destination without intermediate manual operations.



AUTOMATIC MESSAGE RELAY.

FIG. 13.

Fig. 13 shows basically how a message can be transmitted from a page printer at an outstation telegraph office to any other outstation by one of a limited number of appropriately connected cross-office circuits. A separate connection must be made via the switching centre for each direction of communication, the receiving station being unable to answer the transmitting station over the same connection.

As copies of "through" messages are required at the C.T.O. for recording and checking purposes only, telegrams are received on perforated tape at the switching centres, (C.T.O's.), by reperforator-transmitters which are common to a number of incoming lines. There they are stored until the outgoing line is free, when they are switched to the free line and retransmitted to the office of destination at the speed of automatic transmission.

The automatic message relay system, when applied to message redirection through a C.T.O. and using reperforator-transmitters and appropriate switching apparatus, is known, in Australia, as the Teleprinter Reperforator Switching System (TRESS).

This system involves switching and machine equipment which is more complex and costly to provide initially than manual relay equipment, but this is offset by the limited amount of equipment required, less space occupied, greater efficiency from lines and equipment, reduced operating costs, and reduction of delays to messages.

In short, although the initial cost is high, an overall improved standard of service can be offered by this method at substantially reduced operating costs. This method is therefore used wherever justified by traffic demands.

5. THE TELEPRINTER EXCHANGE SERVICE.

5.1 Layout. Para 2.3 of this paper briefly outlines the function of this service which is specifically provided for people who require direct telegraph communication with many different places daily.

The switching equipment for the interconnection of Teleprinter Exchange subscribers is at the teleprinter exchange in the Main or Chief Telegraph office for that area.

Main exchanges are in Sydney, Melbourne, Brisbane, Canberra, Adelaide, Perth and Hobart C.T.O's., each being linked by trunk telegraph channels to the other exchanges.

Auxiliary exchanges at provincial centres in each State are linked by trunk Telegraph channels to the main exchange in that State.

By use of the network thus established, (Fig. 14), teleprinter exchange calls can be set up between all points in the Commonwealth. Calls can be made, via overseas cable and radio channels, between teleprinter exchange subscribers in Australia and subscribers to similar telegraph systems in other countries throughout the world.

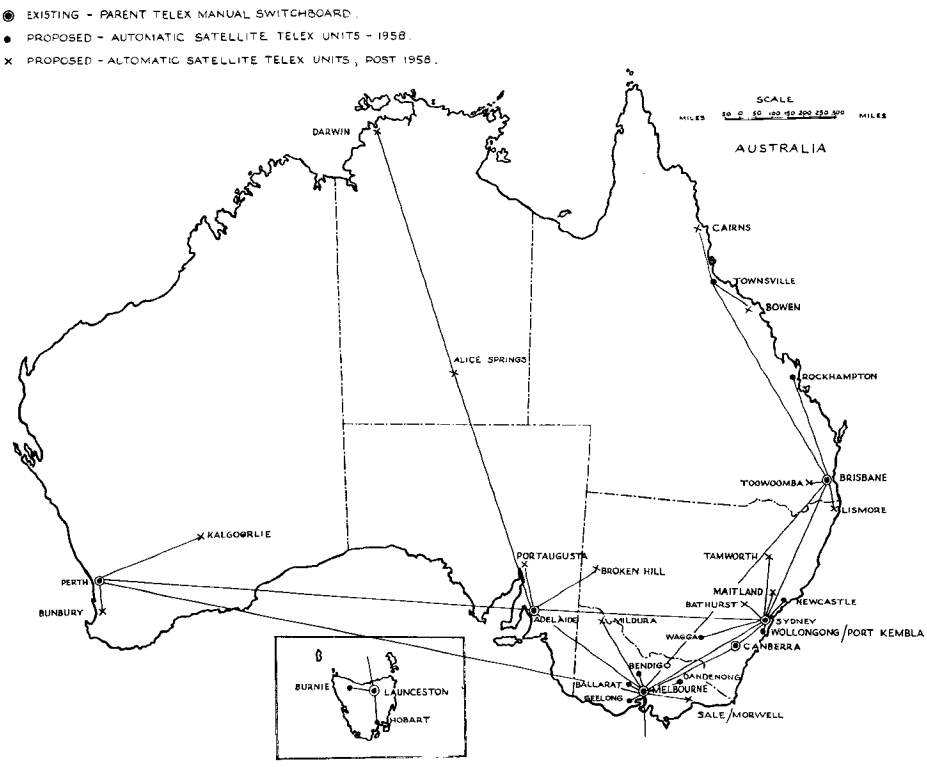


FIG. 14. AUSTRALIAN TELEPRINTER EXCHANGE NETWORK.

5.2 Subscribers Equipment. Subscribers to the Teleprinter Exchange Service are supplied with telegraph machine equipment to suit their particular requirements. For most subscribers, one of the standard page printer exchange extension unit assemblies shown in Fig. 15 or 16 is used.

However, for subscribers requiring tape and page facilities, there are various standard arrangements of tape and page machine units. A popular example of this is shown in Fig. 17, which consists of, a page printer for page reception, a keyboard perforator transmitter for tape preparation and keyboard transmission, while the transmitter distributor is provided for tape transmission.

These assemblies consist of standard telegraph machine units mounted on a Telegraph table, an exchange line extension unit, power supply and signalling apparatus to enable the exchange subscribers to make calls to, and receive calls from, other subscribers in the exchange network.

The main items of the exchange line extension unit are a switching key and bell. The key allows the machine to be switched "off" when not in use, and indicates this condition to the exchange. The bell, operated by a call from the exchange, provides an audible alarm.

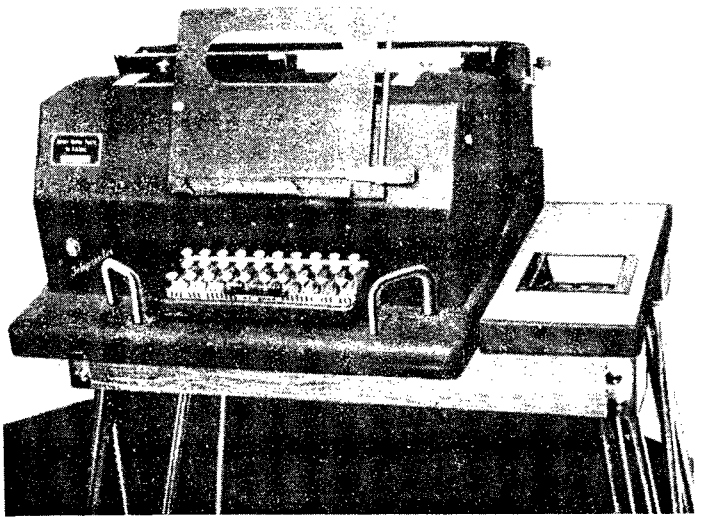


FIG. 15. CREED PAGE PRINTER ASSEMBLY.

FIG. 16. TELETYPE PAGE PRINTER ASSEMBLY.

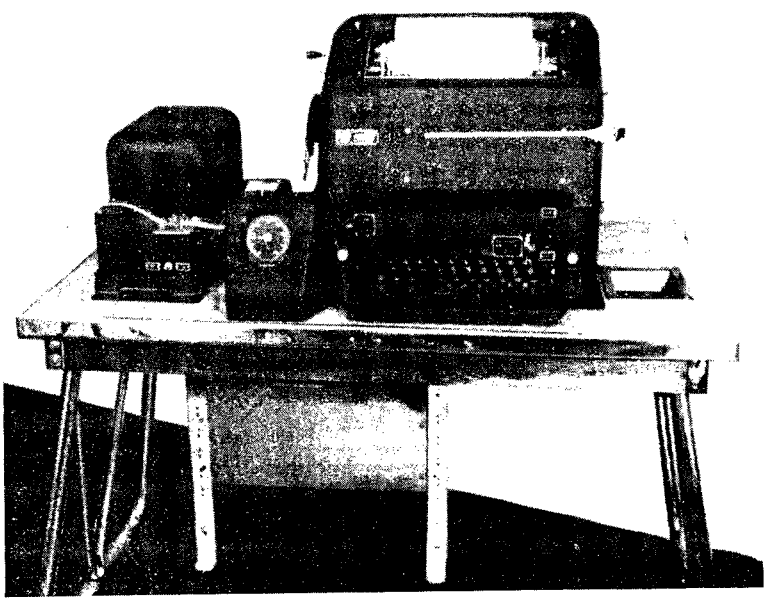
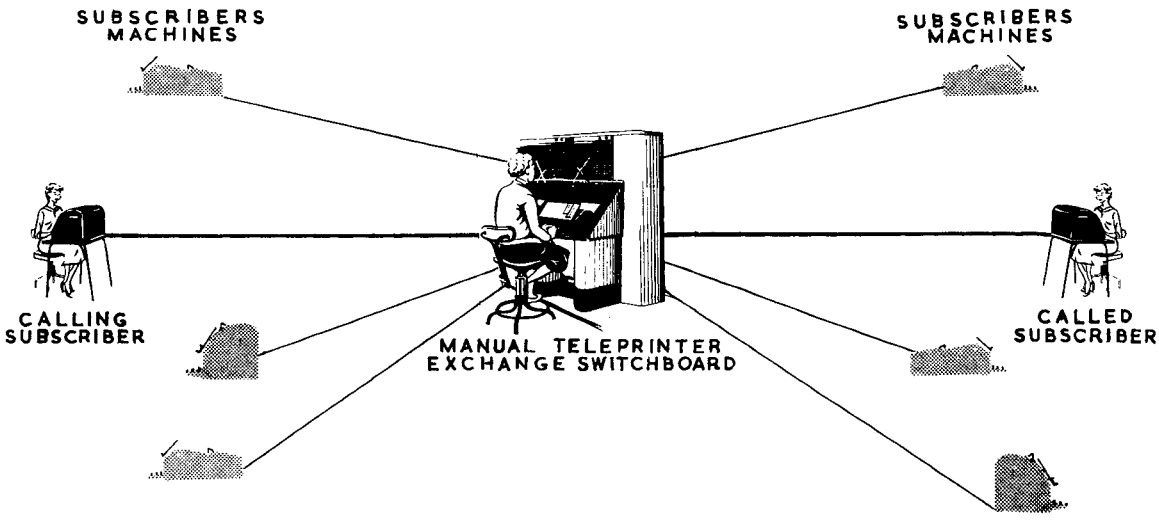


FIG. 17. TAPE AND PAGE ASSEMBLY.
TELEPRINTER EXCHANGE EXTENSION UNITS.

5.3 Exchange Equipment. Direct switching equipment, to interconnect teleprinter exchange subscribers, may be manual, automatic, or semi-automatic.

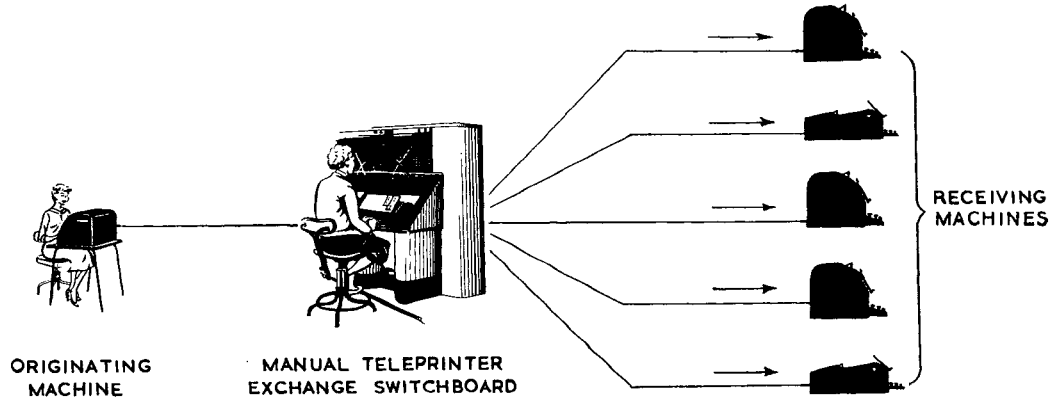


DIRECT SWITCHING OF TELEPRINTER EXCHANGE LINES.

FIG. 18.

5.4 Functions. Apart from the normal connection of one extension to another through a teleprinter exchange, shown in Fig. 18 above, sometimes connections to more than one extension are required, either for the transmission of information to several points simultaneously, or for the interchange of information between several points.

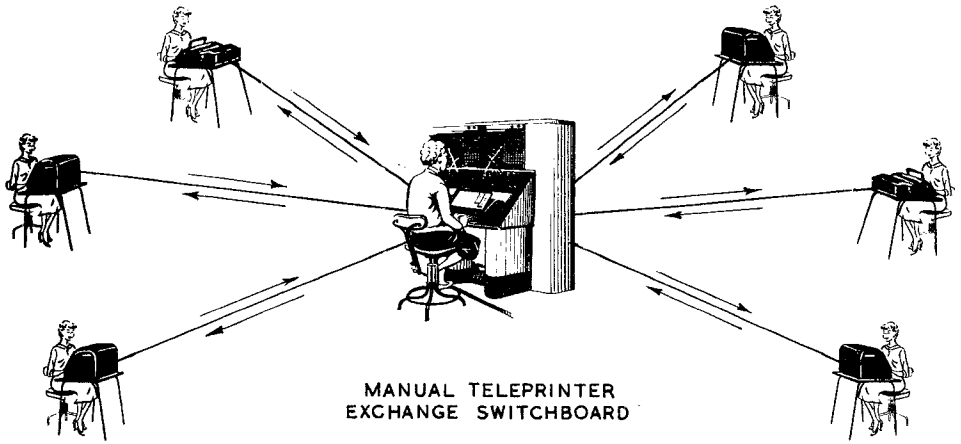
These "Broadcast" and "Conference" facilities are provided at all teleprinter exchanges. (See Figs. 19-20).



BRAODCAST NETWORK, TELEPRINTER EXCHANGE.

FIG. 19.

For "Broadcast", communication is in one direction only, (Fig. 19). The originating station can transmit messages to other stations simultaneously, but the receiving stations cannot transmit messages.



CONFERENCE NETWORK, TELEPRINTER EXCHANGE.

FIG. 20.

For "Conference" conditions, (Fig. 20), communication is in either direction, but not simultaneously; all stations receive a copy of any message transmitted, but only one station can transmit at any one time.

5.5 Manual Operation. Both cord and key type teleprinter switchboards are provided for the manual switching of telegraph circuits. Although similar in operation to telephone switchboards, variations are necessary because communication is by means of telegraph machines and not telephones. The switchboards must be equipped with a telegraph machine so that the operator can ascertain the requirements of the individual subscribers, and also, if necessary, monitor "through" connections without interrupting them.

Line, Busy, and Supervisory Lamps, Jacks, Cords and Keys, have the same general functions as those of telephone switchboards.

5.6 Types of Manual Teleprinter Switchboards. Fig. 21 shows a key-type teleprinter switchboard which is used on small networks. This unit provides for 4 extension lines and an operator's machine and is used mainly at subscribers premises for the interconnection of local extensions. A link back to a main Teleprinter exchange switchboard permits extended connection into the larger networks when required. The unit is designed for table mounting; the separate enclosed rack houses signalling apparatus.

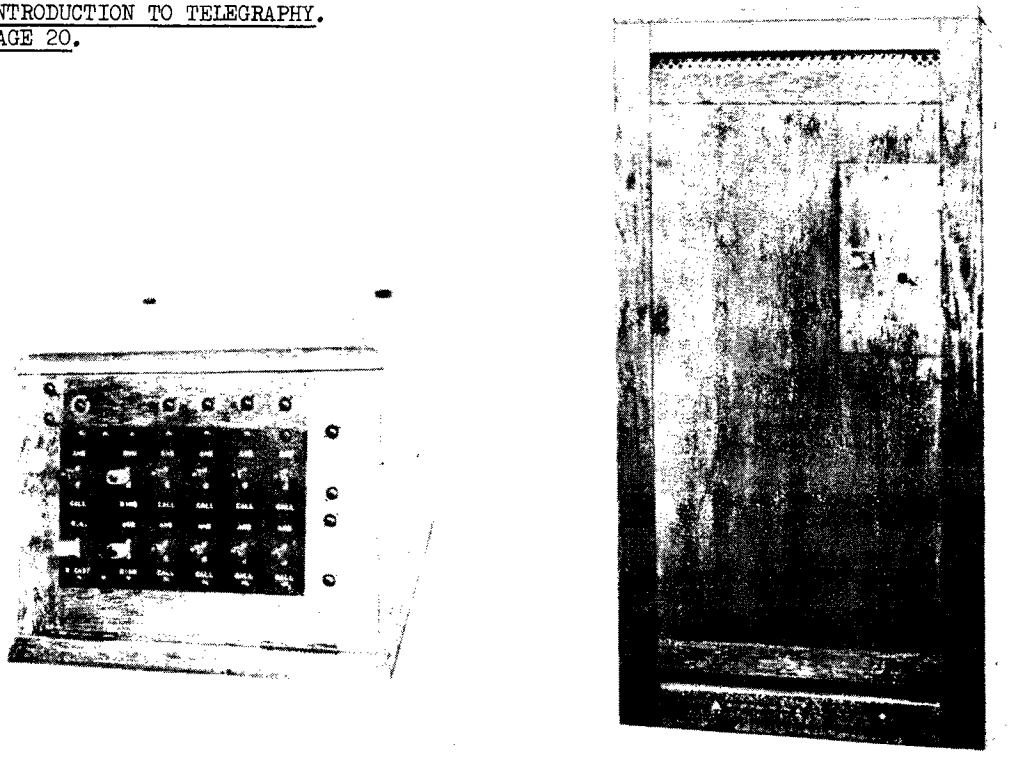


FIG. 21. 4 LINE KEY TYPE TELEGRAPH SWITCHBOARD AND SIGNALLING RACKS.

Fig. 22 shows a cord type teleprinter switchboard for the interconnection of up to 30 extension teleprinter lines and one operator's machine. Up to four of these switchboards can be grouped together to give a total capacity of 120 lines. The operator's machine is mounted on a table beside the switchboard as shown.

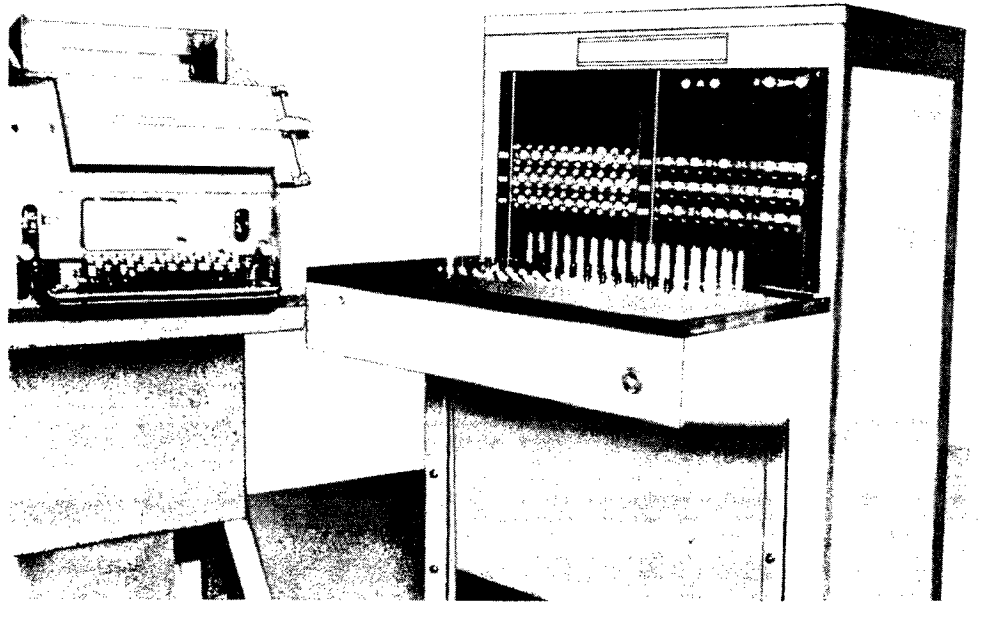
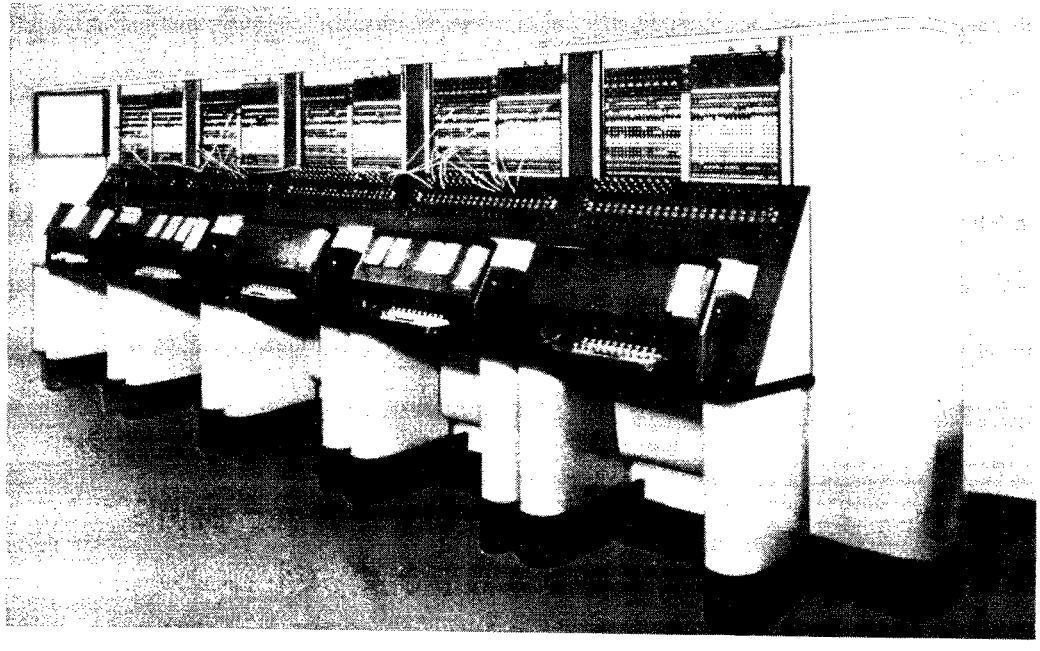


FIG. 22. 30 LINE CORD TYPE TELEGRAPH SWITCHBOARD.

Fig. 23 shows a five-position Cord Type Multiple Telegraph Switchboard. Each operating position contains its own jack-field, cords, keys, and operator's machine, the page-copy of the machine being illuminated by a built-in fluorescent lamp. The design is such that a switchboard of the required line capacity can be provided by the assembly of a number of operating positions and appropriate connections in the cross connecting cabinet. Nine operating positions are required for the nominal 500 line capacity of the switchboard design. This capacity can, however, be doubled by the addition of further positions and the use of a "split-multiple" which gives a full appearance of all jacks over two adjacent positions instead of the normal full multiple when working to 500 line capacity.



500 LINE CORD-TYPE MULTIPLE TELEPRINTER EXCHANGE SWITCHBOARD.

FIG. 23.

5.7 Exchange Line Concentrators. Teleprinter exchange subscribers are normally provided with an individual line between their premises and the exchange.

Where it is not possible to provide an individual line for each subscriber over the full distance, such as in remotely located industrial areas, an alternative arrangement can be made to provide service.

This is done, as shown in Fig. 24, by connecting the subscribers lines to an Automatic Line Concentrator in the area.

The concentrator is then connected back to the exchange by a lesser number of lines which are equally available to all subscribers in the group.

All calls, both from and to, any subscriber in the group, are routed via the concentrator and the exchange.

The concentrators, being fully automatic, obviate the need for manually operated teleprinter switchboards or line concentrators (which would otherwise be necessary to provide exchange facilities) and thus reduce operating costs.

As far as the operation of the subscribers apparatus is concerned, the procedure for initiating a call to the main exchange is identical to that of a subscriber connected direct to a manual exchange, unless of course, all lines to the main exchange are in use, when a "busy" signal is returned to the subscriber.

The subscriber, when calling the exchange switchboard, is automatically connected to the switchboard by a uniselector, which functions as a line finder by searching for the line and connecting it, via a free junction, back to the manual switchboard.

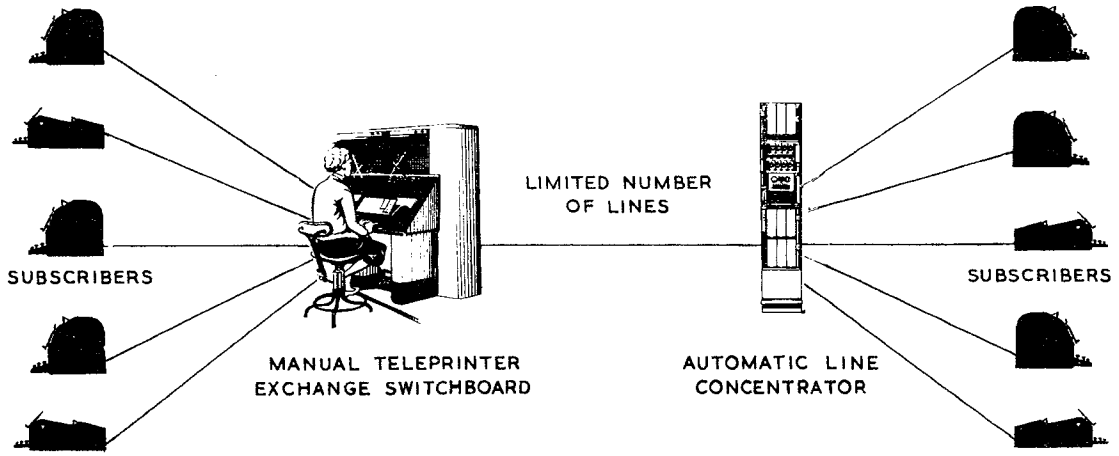


FIG. 24. LINE CONCENTRATION.

The connection of a call from the switchboard to a subscriber via the concentrator is made by the switchboard operator, who dials the required subscribers number. The automatic line concentrator switching equipment responds to the dialled impulses and effects the required connection, providing, of course, the called subscriber is free.

The basic switching elements are shown in Fig. 25.

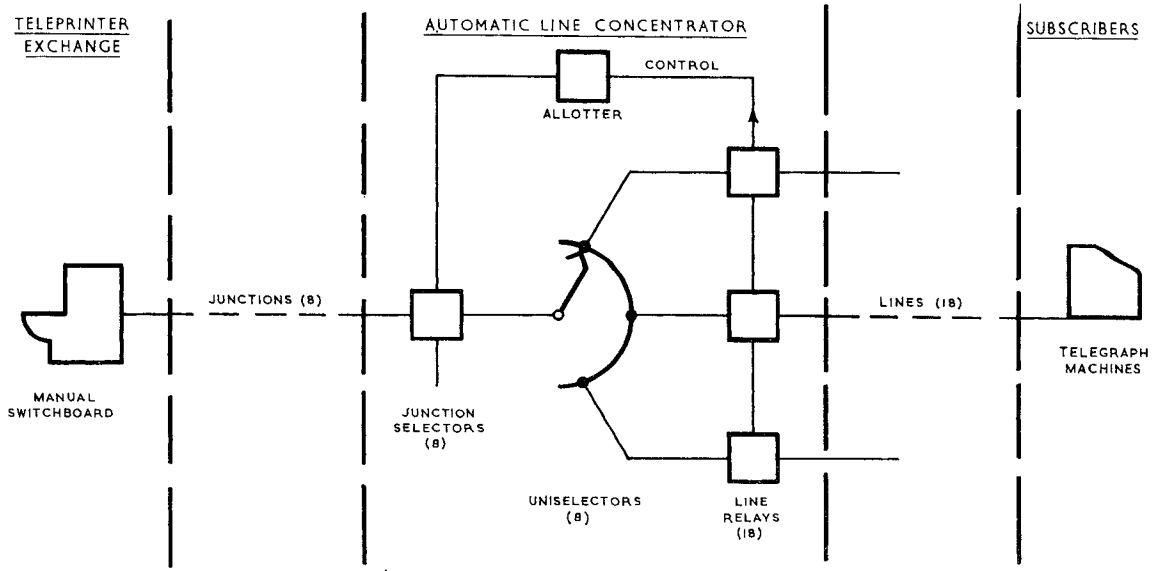
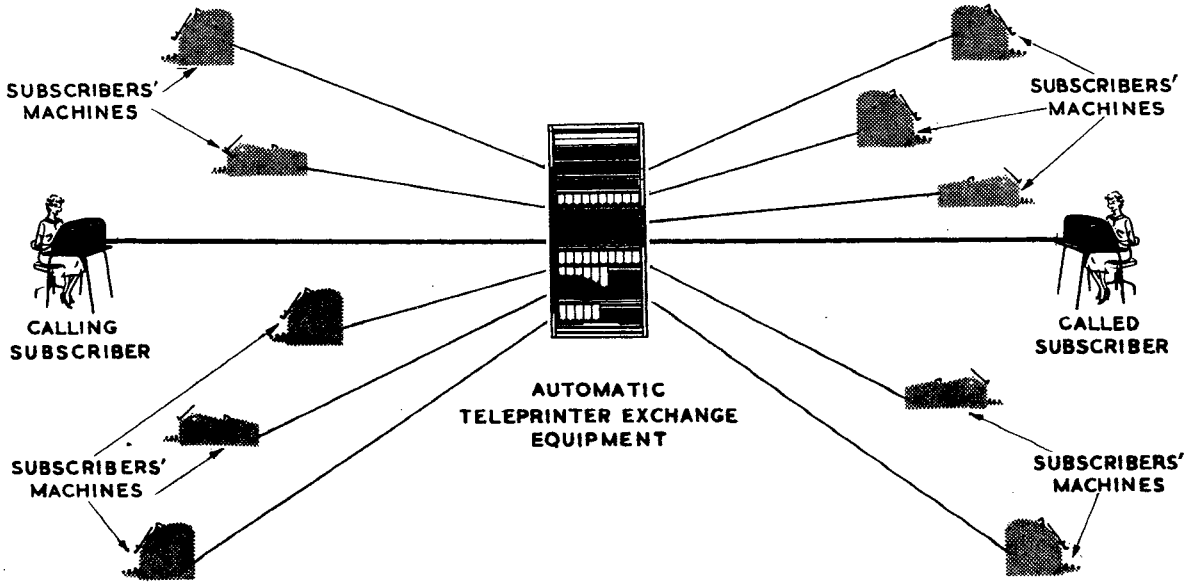


FIG. 25. SWITCHING ELEMENTS OF AN AUTOMATIC LINE CONCENTRATOR UNIT.

5.8 Automatic Operation. In a fully automatic direct switching system, the manual switchboards are replaced by automatic switching equipment at the teleprinter exchange. (See Fig. 26).

This system uses a machine keyboard for calling and establishing the connection to the called party, each keyboard calling signal having an equivalent switching number according to a nationwide numbering scheme.

Calling signals are received at the automatic exchange, stored, and translated into impulsing trains corresponding to their equivalents in the numbering scheme, for the operation of the switching equipment to establish the routing of the call. Except for an operator to handle special services and conference or broadcast calls, the setting up and supervision of calls is fully automatic.



DIRECT SWITCHING OF TELEGRAPH LINES THROUGH AN AUTOMATIC TELEPRINTER EXCHANGE.

FIG. 26.

Another method of automatic switching uses a telephone dial at the subscriber's premises to operate switching equipment for the routing and connection of the call. Telegraph communication is then by telegraph machine over the established connections through the telegraph switching network.

This system of dial calling to establish the connection from subscriber to subscriber requires additional equipment at the subscribers premises, and is not used in Australia, but is used by some overseas telegraph organisations.

6. PRIVATE WIRE TELEGRAPH SERVICES.

6.1 General. As previously mentioned in para 2.4, services of this type are for persons or organisations who require telegraph communication between two or more points on a full time basis.

Private-wire leased services are a large percentage of the total telegraph services in Australia. Commercial firms often discover that "bottle-necks" develop in their organisations, particularly when information needs to be quickly imparted to, or received from, other branches or affiliated firms. Distances separating these points may vary from a hundred yards to hundreds of miles. Telephone messages may not be adequate for business purposes in these circumstances, because of the chance of phonetic errors, and lack of confirmation.

To overcome these problems, direct point-to-point machine telegraph circuits are often used for fast distribution and receipt of information in a form acceptable for business transactions. Networks of point-to-point private wire telegraph circuits terminating at a common control point are often used for the collation and integration of information from several separately located branches.

The telegraph lines and machines are leased by the subscribers, the machines being located at the subscribers' premises and operated by their staff.

Some examples of the type of work handled by private wire networks are described in para 1.3 of this paper.

A block diagram of one of the larger private wire telegraph networks with a total of 74 services throughout Australia is shown in Fig. 27. The bracketed numbers are the number of individual services connected in each State.

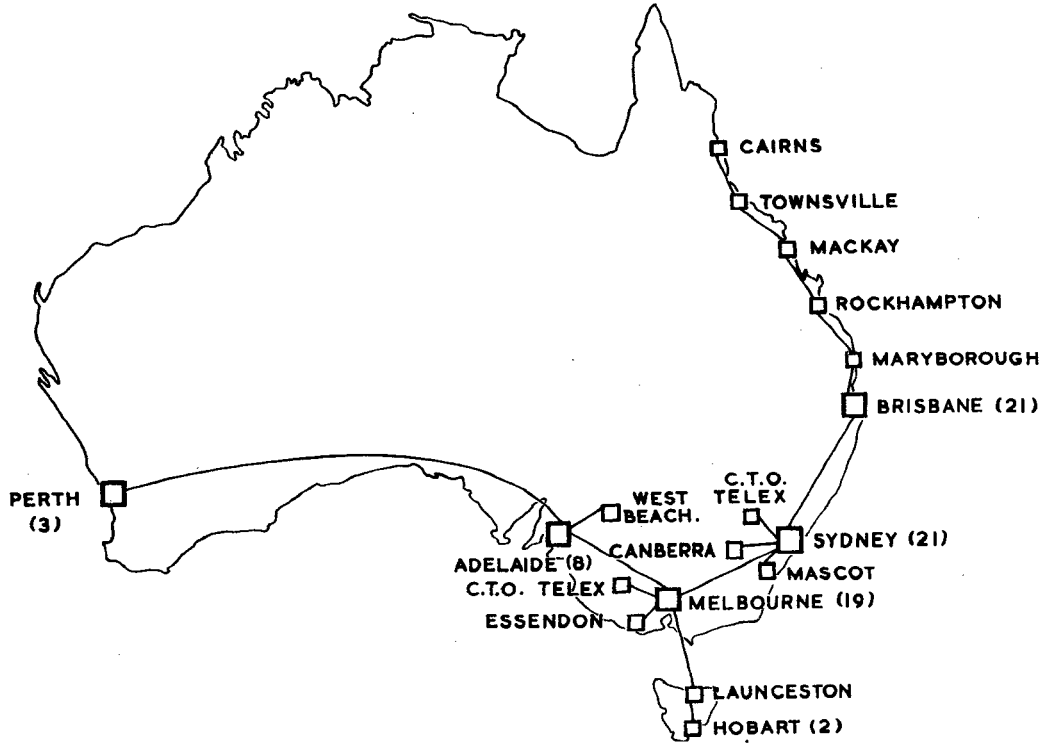
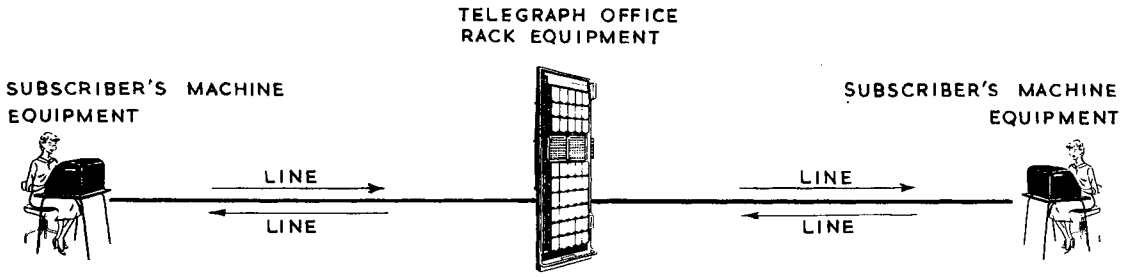


FIG. 27. LARGE PRIVATE-WIRE TELEGRAPH SERVICE NETWORK.

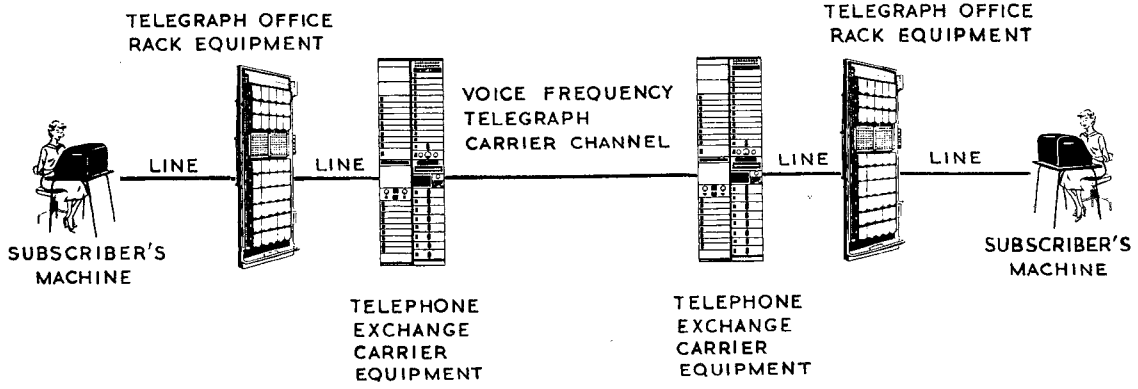
6.2 Layout. A local point-to-point private-wire service is shown in Fig. 28. The lines from the subscribers' machines are connected together at the telegraph office, which is equipped for testing lines, location and repair of faults. Signalling apparatus can be located either at the subscribers' premises, or at the telegraph office.



LOCAL POINT-TO-POINT PRIVATE-WIRE TELEGRAPH SERVICE.

FIG. 28.

Private-wire services are often provided over long distances, between metropolitan country, and interstate centres. These services use open-wire lines, or country or interstate telegraph channels, which are connected at the telegraph office to local telegraph lines for extension to the subscriber's machine, as shown in Fig.29.



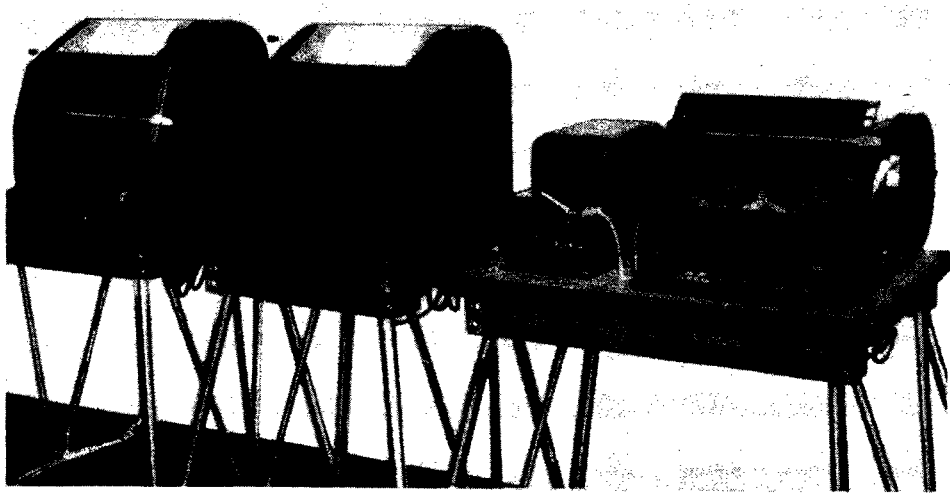
LONG DISTANCE POINT-TO-POINT PRIVATE-WIRE TELEGRAPH SERVICE.

FIG. 29.

When faults occur on long distance telegraph channels, other channels can be quickly substituted, thus preventing the service from being out of action for longer than necessary. Networks combining both local and long distance connections are often used, the head-office of the organisation frequently being equipped with switching control units which permit connection of the various points as required.

6.3 Subscribers' Equipment. Several standard arrangements of telegraph machine equipment are provided to meet private-wire subscribers' service requirements, which vary from a single page-printer installation to multiple machine installations of both page and tape variety. Power supply and signalling apparatus to suit the installed machine equipment is also provided at the subscribers' premises when necessary.

An example of a typical private-wire tape and page machine installation at a subscriber's premises is shown in Fig. 30.



PRIVATE WIRE TAPE AND PAGE MACHINE INSTALLATION.

FIG. 30.

Machine concentrator and line switching units are frequently used with machine equipment.

These units permit a group of machines to be used either individually, or in various combinations for operation over several lines, and thus increase the flexibility of, and ensure that the facilities offered by the equipment are used to the best advantage.

The units provide facilities to connect machines to -

(i) A local circuit for, inter-office communication, tape-preparation, or conversion of tape to page copy.

(ii) Fixed point-to-point private-wire circuits.

(iii) Teleprinter Exchange Line circuits.

A "Broadcast" facility can also be provided for simultaneous transmission to all circuits connected.

6.4 Telegraph Office Equipment. For private-wire services, the main function of telegraph office equipment is to provide -

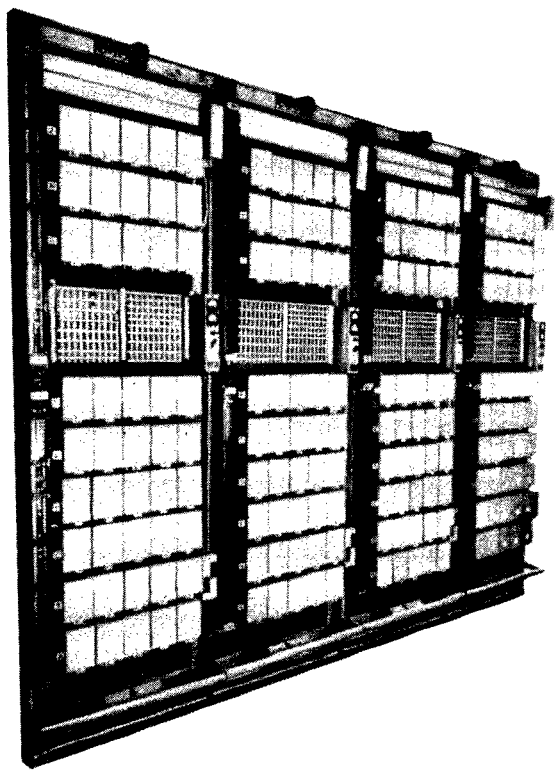
(a) A connection point for the telegraph lines and channels.

(b) An access point for testing, locating, and instituting the repair or replacement of faulty telegraph lines, channels, or machines.

(c) Signal conversion or repeating equipment.

(d) Circuit switching equipment.

Jack fields provide the connection and access points, while signal conversion, repetition, and circuit switching is performed by interchangeable relay sets fitted on the racks - (see Fig. 31).



TELEGRAPH OFFICE EQUIPMENT RACKS.

FIG. 31.

TEST QUESTIONS.

1. Why is Telegraphy used as a means of communication?

2. Give three typical examples of the use of Telegraphy in the community.

3. List the types of telegraph services provided by the Australian Post Office.

4. State briefly the objects of these services.

5. Name the two classes of telegraph machines used.

6. Give the purpose of two different types of tape machines.

7. Sketch the layout of a typical Public Telegraph Service Network.

8. Give two methods of message redirection used in a C.T.O. for public Telegraph services.

9. List the advantages and disadvantages of these methods.

10. Explain the main difference between a Teleprinter Exchange Service and a Telephone Exchange Service.

11. Give the three main functions of the Teleprinter Exchange Service.

12. Describe the basic principles of Automatic Teleprinter Exchange operation.

13. Describe the purpose of an Exchange Line Concentrator.

14. Sketch the arrangement of a typical long-distance private-wire telegraph service.

15. What is the purpose of private-wire telegraph office equipment?

END OF PAPER.