AUSTRALIAN POST OFFICE

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TECHNICAL TRAINING PUBLICATION

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INTRODUCTION TO

AUTOMATIC DISTURBANCE RECORDING EQUIPMENT

1. INTRODUCTION.

1.1 Automatic Disturbance Recording equipment (ADR) is provided in ARF exchanges, to automatically supervise the operation of common control equipment and alarms. Whenever a disturbance occurs in the exchange equipment, the ADR senses the disturbance and automatically causes a print-out, to indicate the nature of the disturbance.

1.2 The ADR system has advantages over other systems (such as the Centralograph in the ARM system) in as much as it records more details about the disturbance, and the output information is produced in telegraph code (International Telegraph Code No. 2), which can be transmitted to and stored (on tape or printer) at any desired location for analysis.

1.3 This paper describes the general facilities offered by the ADR and ADX equipment, the principles of signalling used, and an outline of the operation of the equipment.

2. GENERAL.

2.1 ADR -MAIN FUNCTIONS. The main functions of the ADR equipment are:-

- Extraction of supervisory information.
- Sorting of this information into urgent (action) and non-urgent (non-action) categories.
- To direct the sorted information to the required different destinations.
- To provide sufficient sensitivity to detect minor equipment failures.
- Provision of comprehensive information to facilitate the location of faults.
- Presentation of this information in a form suitable for machine processing.
- To receive, interpret and act upon commands received.

2.2 TYPES OF INFORMATION. The information transmitted by the ADR is classified as either "ACTION" or "NON ACTION" information.

- ACTION INFORMATION. This is information which requires immediate attention, and is directed to the Action or Control Station teleprinter.

The control teleprinter can be at any desired location, for example, a staffed exchange. The control station can be altered by means of a command to the ADR, which alters the routing of the call.

- NON ACTION INFORMATION. This is information which does not require immediate attention, for example, information about a marker time-out.

This action is directed to a non-action teleprinter, which may be at a staffed exchange, or the Network Performance Analysis Centre.

Non Action information can be switched to the action line if required by means of a command to the ADR. Under severe exchange failure conditions the ADR can be arranged to automatically reroute this information to the action line. This extra information received by the action control station may assist in the localisation of the fault.

Under these severe conditions, if the non action traffic attempts to monopolize the ADR equipment, this traffic can be blocked to the ADR by means of a command to the ADR.

2.2 SERVICE CONTROL RACKS (SCR). The detailed printout available from the ADR on exchange alarms has brought about an alteration to the displays available on the Service Control Racks (SCR).

For exchange equipment which initiates Non Action printouts, the need for facilities to connect this equipment to Fault Counters disappears.

For equipment which does not initiate printouts, but merely causes a Service Alarm, the need for Fault Counter connection facility remains.

The Main Alarm Lamps still remain on the SCR. Alarm appearances which are to disappear are:

- Route Alarms Lamps. These alarms are to cause an Action Printout.

- Service Alarms Lamps. These alarms are to cause an Action Printout.

- When the RKR is connected to the ADR system, it's lamps will be removed from the SCR.

In Reg-LP exchanges, the need for Fault Counters will decrease, and only 20 Fault Counters will probably be provided instead of 40.

3. ADR EQUIPMENT.

3.1 SURVEY Fig. 1 shows how ADR equipment is connected to the exchange equipment.

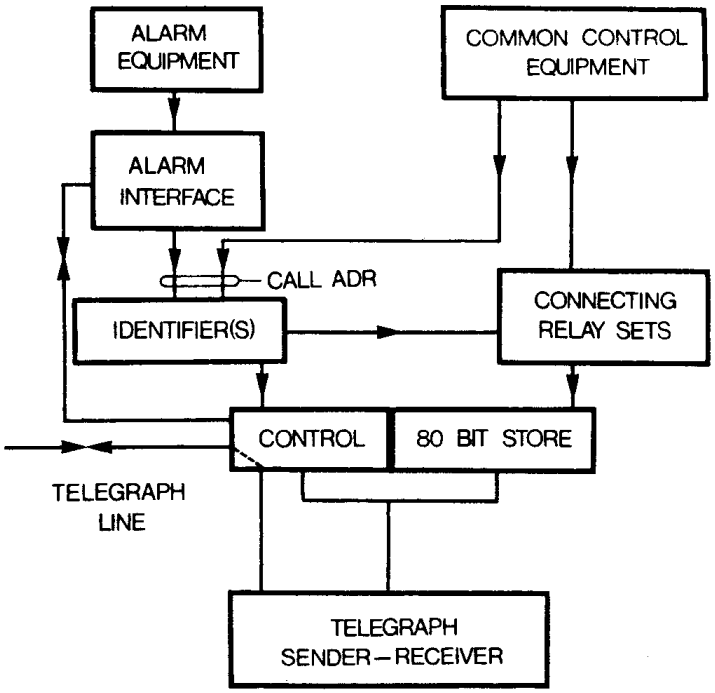

FIG. 1. ADR SYSTEM SURVEY.

The ADR provides interface equipment for converting the exchange alarm equipment information into a form suitable for the ADR to handle it.

The Identifiers, which enable the ADR to determine which piece of equipment is calling, are of the fixed priority type.

A connecting relay set is also provided to allow the ADR to be connected to any piece of common control equipment, allowing the extraction of supervisory information by the ADR in a manner similar to that used for Lampset operation. The information is stored in the ADR on relays. A maximum of 80 relays is provided to store a maximum of 80 bits of information.

The Control Equipment basically provides facilities similar to a register, and is used to control the routing of the call, transmission of information, and so on.

The Telegraph Sender/Receiver provides the facilities for providing 50 baud telegraph signalling, for the transmission and reception of information.

3.2 ADR TRANSMISSION. The ADR signalling system uses the International Telegraph Code No. 2 and double current signalling (Section 4).

Transmission of information can occur on one of three telegraph lines:

- ADX LINE. This is a line connecting the ADR to an ADX switching centre and consists of:

  (i) Send Leg. This leg is used for transmitting information to the ADX, to indicate to the ADX the destination of the call.
  At the completion of a call via the ADX, Time and Date information is added by the ADX.

  (ii) Receive Leg. This is used for receiving commands via the ADX.
  The potential on this line is monitored in the ADR.

- LOCAL CONTROL LINE. There is no provision for the insertion of routing characters or Time and Date information when the call is switched to this line.

The Send Leg is used for transmission of information to the Local Control Centre.
The receive Leg is used for the reception of commands from this centre.
There is no supervision on either of these lines for loss of polarity.
The teleprinter connected to this line may be at the same position as the ADR or at a remote locality.

The switching of a call originated by the ADR to the ADX line or the Local Control Line is determined by analysis in the ADR after identification. The ADR then internally switches to the required line.

- DROP COPY LINE. This consists of a one wire (SEND) circuit only, and allows the monitoring of all outgoing transmissions.

3.3 MESSAGE CONSTRUCTION. ADR messages are formed from two sections of information.

- PREAMBLE, which contains the exchange prefix and identification number of the calling device.

- CADENCE, which contains the remainder of the messages relating to the state of the device identified in the preamble section. The cadence section of an ADR message may take the format of figures or letters.

The cadence section of an ADR message from Alarm Equipment is presented in a figure format, and on a message from a Marker Unit is presented in a letter format in one of two forms:

- Ten letters forming two five letter "words".

- Twenty letters forming four five letter "words".

A description of typical ADR messages is given in E.I. TELEPHONE Exchanges M 7052 and M 7053.

3.4 CALL ROUTING. Two basic types of routing are possible on any originated message:-

- Internal switching within the ADR to a teleprinter (or similar) connected to the Local Control Line.
- Internal switching within the ADR to the ADX line, which is connected to a remote ADX.

These messages may be preceded by one or two routing characters, or alternatively, no routing characters are required. The routing characters are designated the "A" & "B" routing characters respectively. If only one routing character is required, the "A" character is suppressed and only the "B" character transmitted.

Calls from different supervisory devices can be routed to different destinations by causing the transmission of "A" and/or different "B" route characters.

If the ADXs are used solely for concentrating traffic, then the two routing characters are suppressed.

4. TELEGRAPH SIGNALLING.

4.1 Telegraph signalling involves the transmission and reception of electrical impulses called signal elements. One of two electrical conditions can apply. One condition is called "Mark" and the other "Space" (Fig. 2).

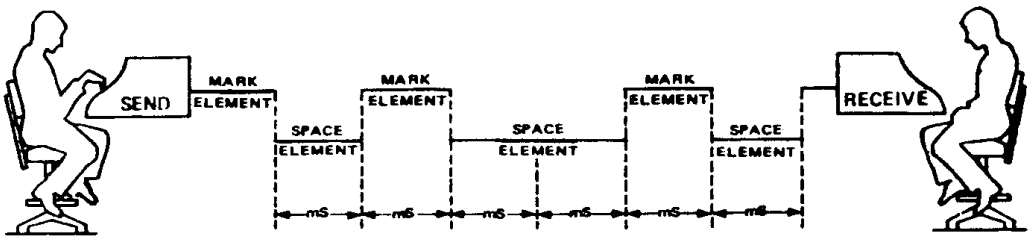

FIG. 2. SIGNAL ELEMENTS.

There are two main methods of telegraph signalling used by the Australian Post Office.

- Single Current.
- Double Current (sometimes called Polar Signalling).

Telemetering of information from the ADR and Commands or Queries to the ADR utilizes Double Current signalling.

4.2 DOUBLE CURRENT SIGNALLING. Double current signalling uses the principle of two different electrical conditions being applied to the equipment. It is the direction of the current that is important as the current flows in one direction for one condition and in the opposite direction for the other condition.

4.3 TRANSMISSION. Transmission is achieved by the use of two power supplies of opposite potential connected to transmitter contacts as shown in Fig. 3. Double Current transmission is achieved by the movement of the centre contact. The position of this contact determines the polarity of the voltage and therefore the direction of current flow. In the ADR the contacts of the Clare relay perform this function.

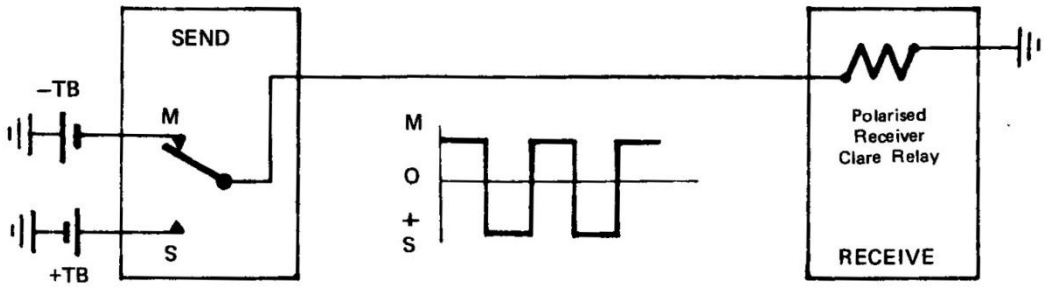

FIG. 3. DOUBLE CURRENT SIGNALLING.

4.4 RECEPTION. During reception of the signals current flows in both directions of the circuit (Mark or Space conditions). A polarised relay such as the CLARE is used to detect the direction of current flow. The relay in effect is detecting a mark or space signal.

4.4 STANDARD LINE CONDITIONS. The electrical condition of the Line circuit is referred to as Marking or Spacing, and is determined by the prevailing current condition in the circuit at a particular point in time.

The normal (at rest) condition for ADR/ADX circuitry is spacing.

4.6 SIGNALLING SPEED. The "Baud" is an international unit of signalling speed (named after one of the pioneers of Telegraphy, Baudot) and represents the number of shortest signal elements in one second. With a signal element of 20 ms length divided into 1 second, a signalling speed of 50 bauds results.

Characters per minute is another way of expressing signalling speed and can be calculated as follows. Allowing 20 ms for the "start" signal and 30 mm for the "stop" signal, the total time taken for the transmission of one five-unit start-stop code character is therefore 150 ms. Dividing this time into one minute ($\frac{60 \times 1000}{150}$), a signalling speed of 400 characters per minute results.

4.7 CONSTRUCTION OF A TELEGRAPH CHARACTER. A complete telegraph character comprises a "Start" element, five "intelligence" elements and a "Stop" element. The "Stop" element is a minimum of 30 ms duration whilst the other elements are each of a 20 ms duration. The addition of the "Start" and "Stop" elements is necessary for the correct functioning of the telegraph machine. Fig. 4 shows the standard telegraph signal.

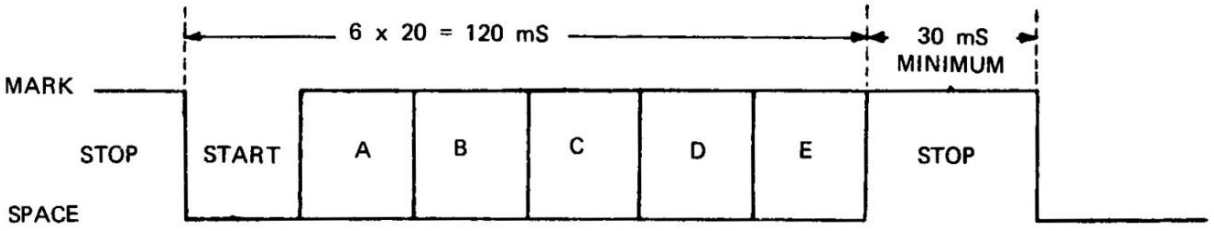

FIG. 4. STANDARD TELEGRAPH SIGNAL.

4.8 THE FIVE UNIT CODE. Intelligence can be conveyed by using the alphabet and numbers with suitable punctuation.

To transmit this form of information by telegraph signalling, it is necessary to convert the letters, figures and punctuation into code. This code, called the Five Unit Code, consists of the two signalling elements of mark and space grouped together in units of five to form each code combination. Using this construction a total of 32 combinations is possible.

A total of 26 combinations are used for the alphabet, the remaining 6 combinations being used for "machine" functions. By use of "Letters Shift" and "Figures Shift" combinations, a total of 52 different character selections is available.

A.P.O. START STOP MACHINE ALPHABET									
CODE COMBINATION No.	LETTERS	FIGURES	NUMBER OF IMPULSES						
			START	1	2	3	4	5	STOP
1	A	—	S	M	M	S	S	S	M
2	B	?	S	M	S	S	M	M	M
3	C	:	S	S	M	M	M	S	M
4	D	NOTE 1	S	M	S	S	M	S	M
5	E	3	S	M	S	S	S	S	M
6	F	%	S	M	S	M	M	S	M
7	G	$	S	S	M	S	M	M	M
8	H		S	S	S	M	S	M	M
9	I	8	S	S	M	M	S	S	M
10	J	BELL	S	M	M	S	M	S	M
11	K	(	S	M	M	M	M	S	M
12	L	)	S	S	M	S	S	M	M
13	M	.	S	S	S	M	M	M	M
14	N	,	S	S	S	M	M	S	M
15	O	9	S	S	S	S	M	M	M
16	P	0	S	S	M	M	S	M	M
17	Q	1	S	M	M	M	S	M	M
18	R	4	S	S	M	S	M	S	M
19	S	'	S	M	S	M	S	S	M
20	T	5	S	S	S	S	S	M	M
21	U	7	S	M	M	M	S	S	M
22	V	=	S	S	M	M	M	M	M
23	W	2	S	M	M	S	S	M	M
24	X	/	S	M	S	M	M	M	M
25	Y	6	S	M	S	M	S	M	M
26	Z	+	S	M	S	S	S	M	M
27	CARRIAGE RETURN		S	S	S	S	M	S	M
28	LINE FEED		S	S	M	S	S	S	M
29	LETTERS SHIFT		S	M	M	M	M	M	M
30	FIGURES SHIFT		S	M	M	S	M	M	M
31	WORD SPACE		S	S	S	M	S	S	M
32	BLANK		S	S	S	S	S	S	M
NOTE: M = MARKING SIGNAL S = SPACING SIGNAL									

NOTE 1: "Answer Back" facility, if fitted.

FIG. 5. A.P.O. START-STOP MACHINE ALPHABET (FIVE UNIT CODE).

Characters received subsequent to the transmission of the "Letters Shift" character, are interpreted by the receiving machine as letters, whilst characters received subsequent to the transmission of the "Figures Shift" character are interpreted as figures, various punctuations and other symbols.

4.9 PRINCIPLE OF OPERATION. Transmission of a complete character involves the generation of the 20 ms Start element (Space) followed by the generation of the 5 Intelligence elements, each of 20 ms duration (which may be either a Mark or a Space), and a Mark Stop element of minimum duration of 30 ms. These elements are then combined to form the complete character signal and transmitted to line.

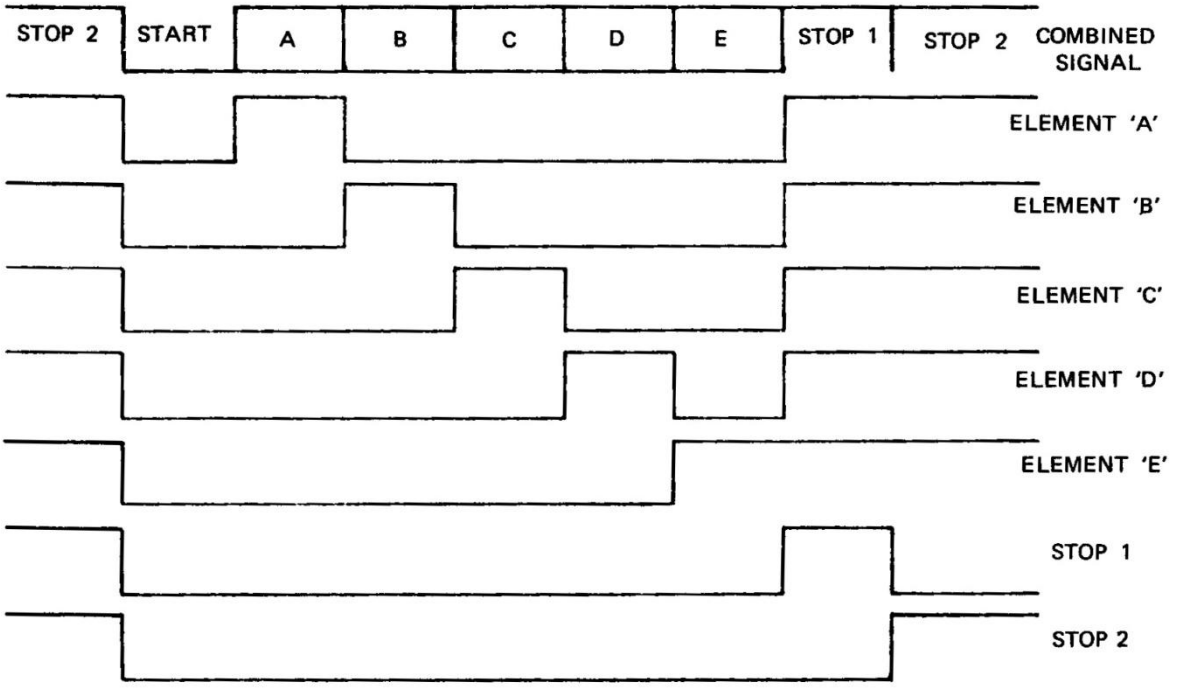

FIG. 6. ELEMENTS OF A TELEGRAPH CHARACTER.

Assuming that the pulses shown in Fig. 6 result in a Mark transmitted to line, the combination of these pulses results in the transmission on a character with all elements A-E Marking (Letter Shift). Any other desired character can be transmitted by suppressing one or more of the Intelligence elements as required.

Note that in ADR working the stop pulse is constructed of two "Mark" elements, Stop 1 and Stop 2.
The combination of these two elements produces a "Stop Element" of 40 ms duration.

4.10 RECEPTION. Reception of a telegraph character is initiated by detection of the beginning of the Start element. The mid point of element 'A' (Fig. 7) occurs 30 ms later, and the mid point of the remaining intelligence elements follow at 20 ms intervals.

Character reception therefore involves the detecting of the commencement of the Start element, and then sensing whether the receive line is Marking or Spacing 30 ms later, and at 4 subsequent 20 ms periods.

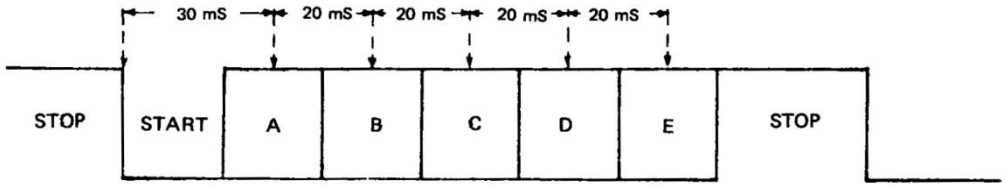

FIG. 7. ELEMENTS OF RECEIVED TELEGRAPH CHARACTERS.

Correct character reception occurs provided the receive line is of the correct polarity as transmitted at the instant of sensing.

The displacement of each received intelligence element from its true position, as measured from the detected commencement of the Start element, may vary practically ± 10 ms and be tolerated. Correct reception under conditions of severe distortion is possible with this type of receiver.

5. ADR EQUIPMENT – BLOCK DIAGRAM.

5.1 Fig. 8 shows the Block Diagram of the ADR equipment and the interconnection of the relay sets.

5.2 OPERATION – ADR-L CALL.

- When an alarm occurs, it calls the ADR-L relay set if required. If required, the alarm may occur and not initiate a call; it would however, be included in subsequent ADR-L transmissions.

- ADR-L identifies the calling alarm, and calls ADR-LP.

- ADR-LP identifies the calling ADR-L and calls ADR-ID.

- ADR-ID identifies the ADR-LP, and calls ADR-P.

- ADR-P identifies the calling ADR-ID, which informs ADR-P as to the type of printout required (in this case, 'LP' type). A 90 second supervisory period is also started when the ADR-P is seized.

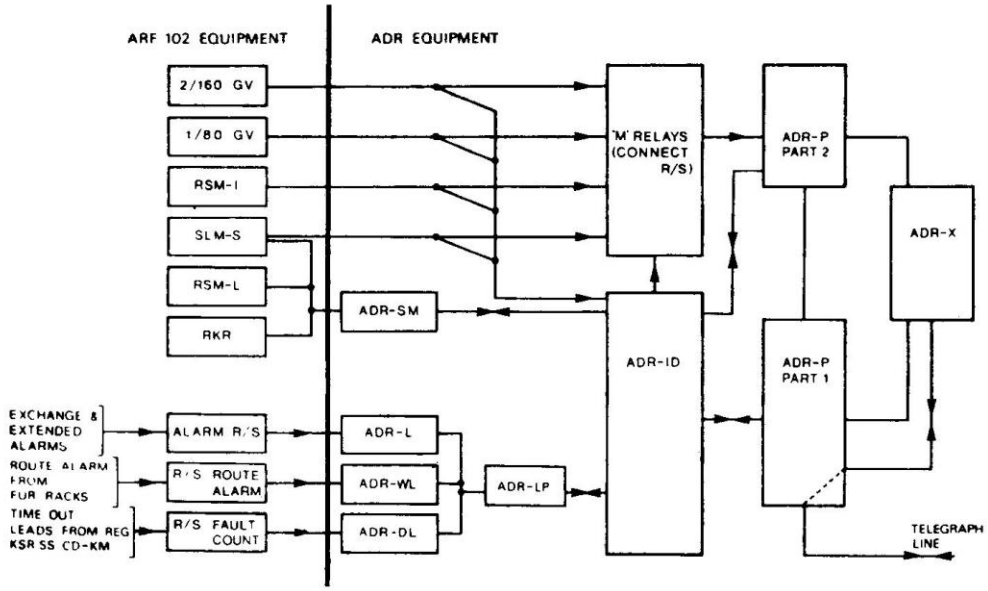

FIG. 8. BLOCK DIAGRAM - INTERCONNECTION OF RELAY SETS.

- Since ADR-ID knows which ADR-LP is calling, and ADR-LP knows which ADR-L is calling, a transmission path can now be established between ADR-P and the calling relay sets.

- ADR-ID also indicates routing information to the ADR-P.

- ADR-P calls the distant terminal by transmitting a Mark on the Send leg.

- When the distant terminal is ready, it returns a Mark to the ADR, where it is received in the ADR-X and transferred to ADR-P.

- If the call is via one or two ADXs, ADR-P now transfers either one or two routing characters (one at a time) to ADR-X, which causes their transmission in 5 Unit Code. ADR-P then changes over to prepare for Preamble Pulse transmission.

- If no routing Characters are required, ADR-P bypasses this function and immediately prepares for Preamble Pulse transmission.

- The Preamble pulse transmission consists of the following information:

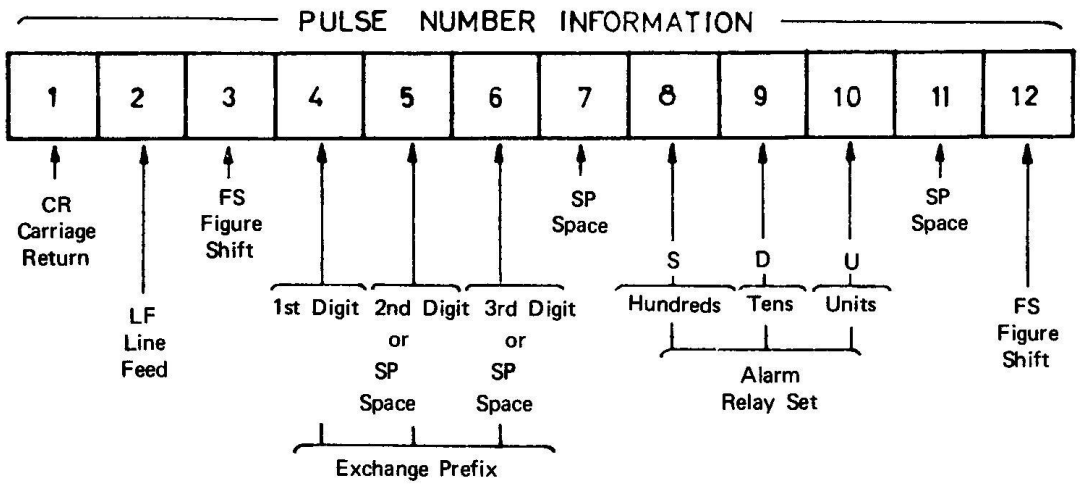

FIG. 9. PREAMBLE PULSE TRANSMISSION - ADR-L CALL.

- ADR-P changes over to Cadence Pulse transmission, which is the remainder of the message.

- The characters to be transmitted are indicated to ADR-X, which converts them to the telegraph code for transmission.

- At the completion of transmission, if the call is via an ADX, the Timer circuit at the ADX is called and Date and Time is added to the message.

- The ADR-L, LP, ID, P and X are now released and the ADR is free for use on another call. If the call is routed via an ADX, the connection to the ADX is maintained for 6-10 seconds, and if no follow-on call occurs for this route within this time, the ADX connection is released.

- If a follow-on call occurs during this 6-10 seconds period, the routing instructions of this call are compared with those in the ADR from the previous call, and if they are the same, the call is transmitted. If they are different, the ADX connection is released, and a new call established.

- If the call is via the Local Control Line, at the completion of the message, the ADR and the telegraph line are released.

5.3 OPERATION – ADR-WL, ADR-DL CALL. A call from either of these relay sets is similar to that for the ADR-L, except that the identifying relays in ADR-LP would be different, to allow the identification of the calling relay set and the connection to it for the transmission of the correct alarm information.

5.4 OPERATION – CALL FROM A MARKER.

- When the time supervision period of a Marker expires, the supervisory unit in the Marker calls ADR-ID.

- ADR-ID identifies the calling Marker and operates 'M' connecting relays, in relay sets ADR-M, to connect the Marker relay contacts to the 80-bit relay store in ADR-P. The condition of the Marker relays at time-out is stored on these ADR-P relays.
Included in this information is a 'check' bit to ensure the message is complete.
During the transfer of information, a second supervisory period in the Marker is controlling its release. If this supervisory period expires before the information transfer is complete, the message is incomplete and therefore useless.
This is the function of the 'check' bit. If the Marker's second time period does not expire before the information is transferred, the 'check' bit will be present, to indicate to ADR-P, 'message complete'.
If the Marker times out before the information is transferred, the 'check' bit will be missing, and this indicates to ADR-P, 'message incomplete' and the call is aborted.

- The remainder of teh call is now similar to the ADR-L call, except that the 12th Preamble Pulse is Letter Shift (LS) not Figure Shift (FS).

- ADR-P now changes over to Cadence Pulses. This time the Cadence Pulse transmission is the result of scanning the 80-bit relay store, and transmits its condition as 4 'words' of 5 letters each.

- At the completion of transmission of the Cadence Pulses the ADR equipment releases.

A typical transmission is:-

49 111 VHEAZ SEEEA EEEEE EEEEZ 9 JUL 72 0920

49 is the Exchange identity; 111 is the identity number of the Marker calling; VHEAZ is the 1st 'word'; SEEEA is the 2nd 'word'; EEEEE is the 3rd 'word'; EEEEZ is the 4th 'word'. Date/Time is added if the call is via an ADX.
'Words' 1-4 are the Cadence pulse transmissions resulting from the scanning of the 80-bit store relays. It is this method which is used to indicate to the distant control, the condition of the Marker key relays at the time of release.

The use of the 80-bit store for word forming is given in other papers.
If the entire 80 relays are not required for information storage, they may be split, and only 40 storage relays used. If this condition occurs, an indication is given to ADR-P by the relays used to indicate the type of printout required.

6. ADR EQUIPMENT LAYOUT.

6.1 Fig. 10 shows the rack layout for the ADR1, ADR2 and ADR ALARM Racks.

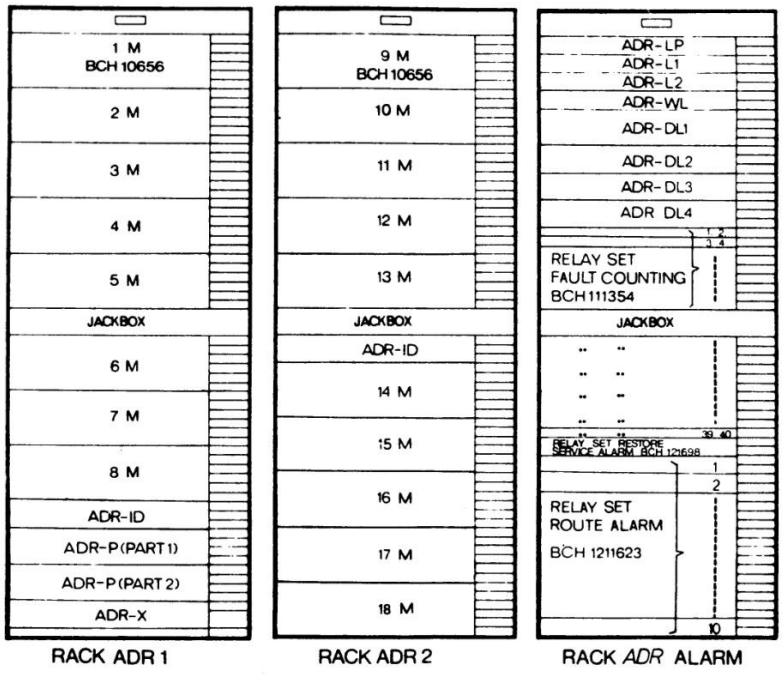

FIG. 10. ADR EQUIPMENT RACKS.

6.2 RACK ADR 1. One ADR 1 rack is required per installation. It is a BDH type tack and mounts the equipment shown in Fig. 10.
Rack ADR 1 jackbox contains as well as the normal Test Jacks, Alarm Lamps and Fuses, etc., and 100 ADR Blocking Keys. Using these keys, one or more of the Alarms/Devices connected to the ADR (via relay set ADR-ID) may be blocked from ADR and so allow attention to be given to particular inlets. Care should be taken when these keys are operated, because the apparatus blocked will not be able to insert information into the ADR, and so due attention must be paid to other indicators, such as normal exchange alarms.

6.3 RACK ADR 2. If the ADR needs more than 100 inlets, rack ADR 2 is used. It mounts the equipment shown in Fig. 10.

6.4 RACK ADR ALARM. One rack is usually sufficient for most installations. The quantities of equipment provided are fitted as required. Fig. 10 shows the equipment which may be mounted on this rack.

The ADR-SM, which is an interface relay set and interworks with the ADR-LP on this rack, is to be mounted on the MAR Rack.

7. ADX EQUIPMENT.

7.1 ADXs are automatic telegraph switching centres required for routing and concentration of supervisory traffic from exchange ADRs to the Control and Analysis Centres, and for directing operational commands from Control Centres to the appropriate exchange ADRs.

The equipment layout is shown in Fig. 11.

Note 1 Relay set ADR-X is used in both the ADR & ADX systems.

Note 2 Relay set T is meant to generate date & time, but —

a) It is not used in capital cities where date & time are taken from the Chief Telegraph Office.

b) The design of the relay set, for use in provincial areas, has not yet been completed.

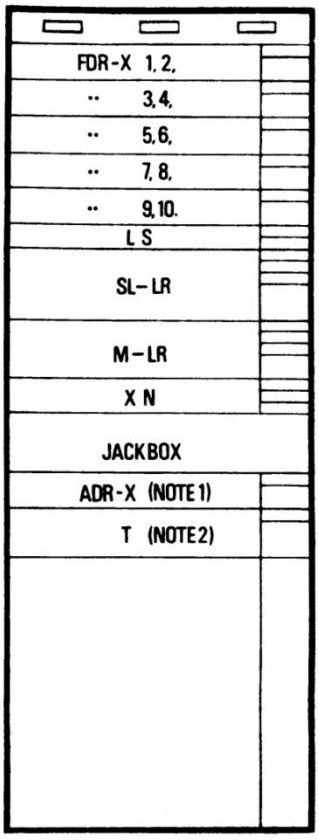

FIG. 11. ADX EQUIPMENT RACK.

7.2 Fig. 12 shows a simplified trunking diagram of a network of ADX switching centres. From Fig. 12 we can see that any ADX can handle the traffic from 20 ADRs.

The ADX has the ability to accept routing digits from any ADR and direct the traffic to the correct destination. When an ADR calls the ADX, and the call is to be set up to one of the Control Centres connected to this ADX, the ADR transmits a routing character to the ADX to indicate which centre is required. The ADX then arranges to set the call to this destination.

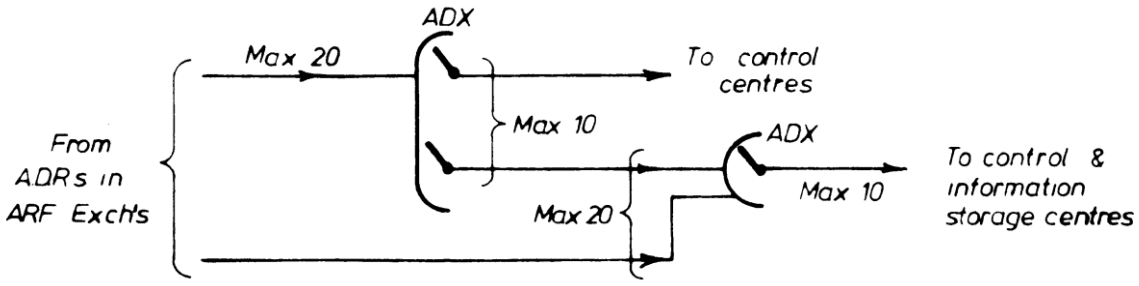

FIG. 12. NETWORK OF ADX SWITCHING CENTRES.

If a call is to be established to one of the control centres off the second ADX, the ADR transmits one routing character to the first ADX, to indicate that a route to the second ADX is required. The first ADX then arranges to switch the call to the second ADX. The originating ADR then transmits a second routing character to the second ADX, to indicate which Control Centre is required.

When ADXs use routing characters, a maximum of two ADXs in tandem may be used.

7.3 ADXs can also be used for concentrating traffic from ADRs. In this case any number of ADXs can be connected in tandem.

8. OPERATIONAL COMMANDS.

8.1 Operational commands can be sent via any control teleprinter (not the Drop Copy teleprinter) to an ADR in the form of a single telegraph character. Any of the 32 standard characters can be allocated to perform any required function.

Table 1 gives a list of typical commands and the characters used for each command. A description of the commands is given in E.I. Telephone Exchanges, M 7052.

CHARACTER	COMMAND
A	ACTION MESSAGES TO AFTER HOURS CONTROL CENTRE.
B	ACTION MESSAGE TO DAY CONTROL CENTRE (RESETS "A").
C	NON-ACTION MESSAGES TO CENTRALISED SORTING CENTRE: RESETS THE MASTER SERVICE ALARM.
D	NON-ACTION TO DAY CONTROL CENTRE.
E	NON-ACTION TO LOCAL TELEPRINTER.
F	NON-ACTION TO AFTER HOURS CONTROL CENTRE.
G	"ACTION MESSAGES" TO LOCAL TELEPRINTER.
H	RKR – START SERVICE ASSESSMENT TO CENTRALISED SORTING CENTRE.
Q	ALARM QUERY.
S	RESTORE INDIVIDUAL SERVICE ALARM.
U	RINGER CHANGEOVER.
V	REJECT FOR "U".
W	RESET RING FAIL ALARM.
X	RESET HIGH AND LOW VOLTS ALARM.
V	ROUTE ALARM QUERY.
<	BLOCK IDENTIFIER FOR NON-ACTION MESSAGES.
≡	RESET THE "BLOCK IDENTIFIER" COMMAND.

TABLE 1. TYPICAL OPERATIONAL COMMANDS.

9. SORTING OF DATA.

9.1 METHODS. There are two methods of sorting and analysing non-action messages:

- MANUAL SORTING. Manual extraction of information from teletyped non-action messages, to ascertain which items of equipment require attention or investigation. A description on the manual sorting of non-action messages is given in E.I. Telephone Exchanges M 7054.

- COMPUTER SORTING. A system where non-action messages are processed by a computer, to present the information contained in the message into a more usable form.

Non-Action messages are received via ADX equipment and an interface unit into a mini computer. The mini computer performs two main functions.

- CONVERTS and edits messages received into a format suitable for main computer entry.

- RECORDS these messages in the suitable format on magnetic tape in readiness for processing by the main computer.

The magnetic tapes are processed on the main computer weekly and sorted information mailed to each exchange.
The identification file contains address details for despatch of reports and data for weekly and monthly summaries.

9.2 COMPUTER OUTPUTS. To ensure successful usage of the computer programme it is important that as many non-action messages as possible are transmitted to the computer system and that exchange staff rely on computer reports for information rather than manually checking local printouts.

The following reports that concern exchange staff are produced by the system:

- WEEKLY EXCHANGE REPORTS. Produced from the weekly message file and the ADR master file. For each exchange these reports provide information regarding the nature and number of ADR non-action messages transmitted from that exchange during the week.

Four types of reports are produced for each exchange each week:

(a) Exchange Summary Report.

(b) Equipment Summary Report.

(c) Message Data Report.

(d) Invalid Messages Report.

THE EXCHANGE SUMMARY REPORT provides a summary of the number of messages received for each item of equipment in the exchange over the current week and the previous seven weeks. Data for this report is obtained from the ADR master file. This report is used as an indicator of overall equipment performance.

THE EQUIPMNT SUMMARY REPORT provides a summary of fault conditions detected for each item of equipment in an exchange. Items of equipment are grouped into equipment type, and each equipment type is summarized differently. Data for this report is obtained from the ADR master file. This report is used as an indicator of overall equipment performance where an exchange equipment most needs staff attention.

THE MESSAGE DATA REPORT details all valid messages received for an exchange. Messages are sorted according to equipment type and nature of marker time-out. The Message Data Report provides additional information to maintenance staff regarding the nature of a fault and is consulted when the Equipment Summary Report does not provide sufficient information.

THE INVALID MESSAGE REPORT details all messages for the exchange which cannot be analysed because of errors in message format or content. This report is provided to indicate to exchange staff where faults may be occurring in ADR, ADX or mini-computer equipment or in telegraph lines.

- **INVALID EXCHANGE CODE REPORT: Produced each week from the Weekly Message File. The report details all messages in which the "Exchange Code" is invalid, and is forwarded to the ADR Co-ordinator so that system faults causing this type of error can be corrected.**

- **MONTHLY SUMMARIES. Produced every four weeks from data on the ADR Master File, and are identical to the Exchange Summary Reports. Every four weeks duplicate copies of these reports are made and forwarded to, for example, N.P.A.C. Metro/Country or Trunk Service areas and Divisional or Regional Officers. These reports provide exchange controlling bodies with an indication of the performance of exchange equipment for a period of four weeks.**

- **SPECIAL WEEKLY REPORTS. Provided at the request of the ADR Co-ordinator to obtain additional copies of any weekly Exchange Report.**

10. TEST QUESTIONS.

1. State four (4) main functions of ADR equipment.

2. What is meant by the terms:

(i) Action information?

(ii) Non action information?

3. What type of printout is caused by a:

(i) Route alarm?

(ii) Service alarm?

4. Examine Fig. 1 and explain briefly the main function of each block.

5. State briefly the main purpose of the:

(i) ADX line.

(ii) Local control line.

(iii) Drop copy line.

6. What type of information is contained in:

(i) Preamble pulse transmission?

(ii) Cadence pulse transmission?

7. With the aid of Fig. 5 and Fig. 6, draw a timing diagram to show the transmission of the letter 'R'.

8. Examine Fig. 8, State one (1) function of each of the relay sets of the ADR equipment.

9. Explain briefly the main functions of the 'check' bit.

10. State the main function of the ADX equipment.

11. What is an "operational command"?

12. What equipment receives an operational command?

13. Explain briefly the main functions of the mini computer when receiving non-action messages.

14. List four (4) types of report derived from the output of the computer.

END OF PAPER.

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