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PHILIPS TELEGRAPH SWITCHING SYSTEMS

By

E. R. MacMILLAN

NORTH AMERICAN PHILIPS COMPANY, INC.

THE RADIO CLUB OF AMERICA, INC.

11 West 42nd Street ★ ★ ★ New York City

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The Radio Club of America

ORGANIZED FOR INTERCHANGE OF KNOWLEDGE OF THE RADIO ART, THE PROMOTION OF GOOD FELLOWSHIP AMONG THE MEMBERS THEREOF, AND THE ADVANCEMENT OF PUBLIC INTEREST IN RADIO

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PHILIPS TELEGRAPH SWITCHING SYSTEMS

By

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NORTH AMERICAN PHILIPS COMPANY, INC.

INTRODUCTION

A general description and application of modern control concepts with particular reference to the U. S. Department of State Communications Center installation.

In view of the importance of maintaining constant access to telegraphic channels, the matters of flexibility and reliability were primary objectives during the design of this Store and Forward Message Switching System. The Philips' design philosophy achieved these paramount objectives and, consequently, is able to concentrate upon special features required by users. Flexibility, or the ability to mold the system to meet unique needs of users makes it a true asset rather than another factor simply proving Parkinson's Law.

When any new communication facility is established, and its existence becomes known, the traffic will increase at a rate depending on the ease with which that new system accepts information to be transported. To make their system easily extendable the Philips' switching concept leans heavily on modular construction, utilizing a combination of electronic and electro-mechanical devices, with emphasis on electronic control and computer techniques. The modular approach permits semi-automatic torn-tape systems (ES 1) to be incorporated in concentrated (ES 2) or fully automatic (ES 3) systems, as expansion may require. Progressive steps from semi-automatic to semi-automatic/concentrated, concentrated/fully automatic or a fully automatic system can be readily accomplished. In fact it is found that most users elect to install combinations of systems to attain optimum performance. Philips has handled many installations which reflect this philosophy:

COUNTRY	NO. OF SYSTEMS	ARRANGEMENT
Holland	2	ES 1
Belgium	1	ES 2
Switzerland	1	ES 2
Italy	1	ES 1 / ES 2 / ES 3
Sweden *	2	ES 0
France **	2	ES 1 / ES 3 and ES1
Colombia, S.A.	1	ES 1 / ES 2
United States	2	ES 1 and ES 2/ES3
Great Britain	4	ES 0, ES 1 and ES 2
Canada	7	ES 2
Egypt	1	ES 1
Hong Kong	1	ES 1 /ES 2

* ES 0 refers to a Semi-Automatic System with no Forward Storage (in operation since 1956).

** The ES 1 system installed in Paris, the largest Philips system, is equipped to handle 12,000 messages per busy hour over 188 full-duplex trunks.

The economies of a flexible approach are quite apparent; however, there are further economies realized by the concentration of equipments, avoiding unnecessary duplication and providing low maintenance.

Electronic receiving and transmitting distributors reconstruct characters, receivable with distortion up to 47% and retransmit them with distortion held to less than 3%. All internal transmission paths and external circuit connections are constantly scanned and sampled by the Common Line Guarding Equipment. An analysis of this sampling, whether the circuit be idle or busy, establishes that the proper potentials exist within certain fixed limits or, if this is not the case, the maintenance staff is alerted. The alarm system virtually pinpoints the trouble spot so that immediate maintenance action may be taken. Further, all major units are provided with hot automatic fall back. The plug-in construction permits the "swap now - fix later" maintenance procedure, thus assuring minimum down time of faulty units.

Some of the standard equipment included in the systems are the Electronic Combined Receiving Transmitting Units, the Common Line Guarding Equipment, the fully electronic Central Address Memory, the fully Electronic Program Transmitter and for the fully automatic systems the solid state Register.

To achieve the foregoing objectives in a highly professional Telegraph Switching Center, rigid manufacturing specifications have been established, with full attention to simple installation, rugged unit fabrication and accessible and simple maintenance, with due recognition to aesthetic values. A finished installation is not only an efficient functional unit but an attractive one.

Rack rather than cabinet type construction has been adopted. All equipment when assembled is terminated at a common distribution point -- a requirement when a high degree of flexibility is desired. All equipments, regardless of size and complexity, are broken down into a series of small drawers, plug-in units and modules to provide easy, high speed access for preventive and corrective maintenance and ease in shipment and handling. In the construction of these drawers and plug-in units the greater part of the circuit components in these drawers are interchangeable, thus reducing the bulk of spares required. Moreover, maintenance personnel training programs are not overly complicated since the number of circuits the maintainers must learn are held to a minimum.

The equipment is designed to operate at 60, 67, 75 or 100 words per minute although inclusion of special speeds is possible. Another feature of the system is that it will operate in conjunction with any design of terminal or intermediate equipment the user wants in his system.

THE EVOLUTION OF ELECTRONIC CONTROL

The current trend to full electronic operation does not lose sight of the tremendous investments made in accomplishing the present techniques. A gradual introduction of new techniques is the most logical means of assuring the manufacturer that his product will be economically acceptable on the market. The modular construction allows Philips to accomplish this electronic evolution step by step.

At the present time all memories, control circuits, common program units and registers are completely electronic. The 2,000 character Message Memory units, the common Program Memory and the Central Address Memory utilize ferrite cores for information storage. Where requirements for storing messages that are over 2,000 characters long are encountered Philips makes use of a magnetic tape storage unit with a memory capability of 40,000 telegraph characters.

SECTION 1

SEMI-AUTOMATIC SYSTEM WITH NO FORWARD STORAGE

Each incoming line is terminated at a reperforator. Several of these reperforators are installed on a console, which also provides space for a tandem group of transmitter distributors. The total number of incoming lines terminated at such a single position is inversely proportional to the loading on the individual lines. The number of positions required is, of course, related to the total number of lines terminating and originating at the particular center.

The outgoing tandem transmitters are controlled by a single push-button panel or message director that is common to each transmitter. When a message is received, it is torn off the reperforator by the operator and placed directly into an outgoing transmitter distributor. The operator then depresses a non-locking type button associated with the specified direction (or directions) and the priority of the message. This action is cross checked by observing lights on the push-button panel associated with the addresses and priority, which are illuminated when the buttons are depressed. If an improper selection has been made, a cancel button is then depressed, and the procedure of making the correct selection is made.

With the proper selections made, the operator pushes a start button associated with the particular transmitter selected. Each transmitter has its own start button.

Once the operator has pushed the start button, the information stored in the push-button panel is transferred to a memory that records the information, thus freeing the push-button panel for another transmitter. This operation extinguishes the lights on the push-button panel and in so doing acknowledges that the center has recorded the fact that a message is waiting for some particular destination.

The operator can then tear off another tape or another incoming reperforator and place it into another transmitter distributor head, repeatedly using the same push-button panel in a similar manner, and send messages as long as a transmitter distributor is available.

Since there is no storage associated with this system, the operators might apply for the same outgoing line at the same time. In these cases, the address memory unit associated with each particular transmitter holds the information pertinent to the message awaiting transmission and sends it as soon as the line becomes free, with no further action by the operator.

In the case of multiple-address messages, when some lines selected are not free at the moment of transmission, the operator is notified by a green light on her panel at the end of the transmission. While the green light is on, the operator places the same tape in the same transmitter and tries restarting. No new routing indicators need to be inserted since the addresses and priority information are retained in the address memory common to that transmitter. This procedure is continued until the green lamp is finally extinguished, indicating that all multiple-address requirements have been satisfied.

The foregoing functions are controlled by a unit of common equipment, known as the Marker, that

is constantly checking all lines and connecting circuits, noting a busy or free condition. Thus any transmitter used in conjunction with a push-button panel is not associated with a particular outgoing line but has the ability to send on any of them. This system is not limited by any special format requirements, so that operators may relay messages just as received.

SECTION II

SEMI-AUTOMATIC SYSTEM WITH FORWARD STORAGE

Fundamentally, this type of system operates in the same general manner as described in Section I, but with an intermediate message storage bank added and with a Central Address Memory replacing the individual position address memory units.

From the variety of systems Philips had to offer, the State Department found that the Semi-Automatic version would best meet their requirements, since the majority of their telegraph traffic is of the terminal rather than the relay type. This requires a considerable amount of message handling. The Semi-Automatic system reduces the workload of the operators. Other labor saving features include an automatic group count device, routing line segregation, electronic message numbering, electronic generation of parts of messages and multiple-address facilities.

When concentrated receiving operation is necessary each receiving circuit is connected to a common group of line finders which have the ability to direct any incoming message to any free receiving position. When several receiving positions are used and a low traffic load is anticipated or experienced, certain receiving positions can be blocked so that incoming traffic is concentrated at only one or two positions, allowing a temporary reduction in operating personnel. The blocked positions may be reactivated as required.

According to average calculations, each one of these positions is able to handle approximately 300 messages per hour. Each incoming position is equipped with a pair of page printers. A common push-button director panel permits selection of any page printer desired by the operator.

When an indication is detected that a message is detected that a message is going to be received, the common equipment immediately connects an Electronic Combined Receiving Transmitting Unit to that incoming line. At the same time, one of the page printers on the concentrated position is connected, which prints out the information simultaneously as it is being recorded in the storage device. The size of these storage devices is dependent upon the type of traffic which is to be handled. After routing information and priority has been received on the page printer and recognized by the operator, she pushes buttons on the directing panel in accordance with the destinations (or destination) and the priority. When she has made and checked her selections a release button associated with the page printer from which she has taken the direction information is pushed. This action automatically disconnects the page printer from the line freeing it to receive another message. The memory device, acting as a buffer storage, proceeds to send messages into the system in accordance with the routing and priority information as if it were simply a message being sent normally from a transmitter distributor.

The Marker and Central Address Group then directs this message to the outgoing line or, if the outgoing line is busy, to intermediate storage. If this line is free, it is interesting to note that a message can be on its way from the center before it has been completely received.

In a system of this type, it is essential that an end of message indicator be incorporated as part of the message.

Other special requirements of a particular user can be included, such as: full print out of the message on the page printer, alarms indicating conditions that are unusual to normal system operation, and incoming number sequence checking. Other details of this system are given in Section IV.

SECTION III

FULL AUTOMATIC TELEGRAPH MESSAGE SWITCHING SYSTEM

By means of a selector all incoming telegraph channels are connected to a line circuit which switches the incoming line to a group of common connecting circuits. Each incoming circuit is associated with an Electronic Combined Receiving Transmitting Unit, which functions as a temporary storage for incoming messages to allow repetition of its preamble after a decision has been made concerning possible further routing and priority assignments. This decision is determined by the register, which is made up of a central translator that is common to several individual registers (directors). Each of these individual registers scans the information contained in the preamble of any message and presents its interpretation to the central translator. This in turn passes the routing and priority to the Marker. The number of these individual registers needed is determined by an analysis of the traffic figures figured so that the message delay is only that time required to read the address line.

The significant telegraph characters of the preamble are presented in parallel form to the central translator. The translator takes less time to make

its decision than required to transmit one character. Therefore a single central translator is capable of working in conjunction with several registers.

The incoming channel identity, the message number and the message priority in addition to the routing indicators, or indicator, are scanned and stored until the end of routing indication is received. The decision is then made as to which outgoing channels the message must be sent and which of the routing indicators directed to these channels can be disregarded because of actions taken by previous switching centers.

When this information for a specific message is established, it is transferred from the register to the marker, and the register is released and free to be seized by another incoming message. The Marker is now in full control of the situation and messages are handled in a manner to be described in Section IV.

A very important operational feature of the Philips automatic system is that when a message is received destined for a free outgoing circuit (or circuits), the only delay experienced is that time required to make a decision as to how the particular message is to be handled, i.e. destination (or destinations) and priority. The incoming message is retransmitted within a few milliseconds after receipt of the end of address line indicator mark. Of course, if the circuit is busy, the delay encountered is dependent on the message in progress and on the priority and waiting time of messages already in storage.

With this Fully Automatic Telegraph Switching System, message formats must be strictly conformed to. Any deviations from a specified format will cause complications in the processing and handling of messages.

SECTION IV

THE U. S. DEPARTMENT OF STATE INSTALLATION

Due to the high percentage of terminal traffic handled by the telegraph facilities in Washington, the Semi-Automatic version of the Philips Telegraph Message Switching System was adopted.

A combination of a Teletype Model 28 Typing Reperforator and a Page Printer is used to terminate all incoming lines, to allow the messages to be received in a form that can be readily processed, reproduced or relayed.

Three types of originating positions are used in the communications center: a Transmitter Distributor (Single Contact Type), an Automatic Send/Receive Set with Single Transmitter Distributor and an Automatic Send/Receive Set with Dual Transmitter Distributor. These various input equipments are necessary due to the methods by which messages must be introduced into the system.

The single contact transmitter distributor is used in a position called a Special Purpose Position, which so far is unique to the State Department installation. It was designed to reduce the effort required of operators when introducing messages requiring a group count. This position also has a director panel. Since procedures require that the group count number precede the coded text, it is never known when preparing a message for transmission how many groups are in the text until after it has been completely processed. It is, therefore, a difficult and time consuming situation for the operator to insert this group count number after the message has been fully prepared. This problem is handled as follows:

After the message has been processed the group count number is punched into the group count panel by means of the push buttons. The number selected is displayed on a panel which permits visual inspection of the number. At a given place in the message format a non-registering code function is introduced, which is electronically detected in the switching equipment and used to open a clutch circuit of the transmitter distributor, thus stopping transmission. Immediately the group count number is read from the group count number memory and inserted. This action closes the clutch circuit of the transmitter distributor and the transmitter continues with the group count number inserted in the proper place.

When this number is read from the group count memory store, the lights on the visual read-out panel are extinguished. This notifies the operator the number has been properly inserted.

The above mentioned director panel is an arrangement of push buttons that allows the operator to select the direction (or directions) and priority of a message leaving the center. In addition, there is a cancel button and a start button. When a cer- direction or priority button is depressed, the light directly under it is illuminated, permitting the operator to scan the selections and make sure that she has followed the correct procedure as directed by the routing and priority indicators of the telegram she is about to send. If the selections are wrong, she pushes the cancel button. If they are right, she pushes the start button. This signals the center to seize that particular sending position and connect it either to an intermediate store or directly to a line, depending upon conditions at that particular instant.

The other two types of sending positions are Automatic Send/Receive Sets. One type of Automatic Send/Receive Set is equipped with a single

head transmitter. The other type of Automatic Send/Receive Set is equipped with a dual head transmitter with flip-flop control.

The single head Automatic Send/Receive Sets are used for originating messages that must be punched completely from beginning to end. The dual head Automatic Send/Receive Sets are used for originating messages which only require punching of the message preamble, since text punching has been previously accomplished. In this latter case the operator punches the preamble on the inside transmitter distributor and inserts the prepared text in the outside transmitter distributor. Transmission from the inside transmitter distributor precedes transmission from the outside transmitter distributor and the total message appears as a no-break transmission at the receiving station.

The Supervisor's Position is also equipped to handle traffic. Various other transmitting and receiving devices are at the Supervisor's disposal. In addition to jack fields and other facilities, which enable the Supervisor to have full control over traffic moving through the center, provisions are included to allow instantaneous readout of the last number sent on any circuit and to either reset the circuit message count to zero or to correct it to any pre-selected message number. All of the readout and change functions performed by the Supervisor are recorded on a page printer associated with that position so that the possibility of an undetected mistake is eliminated because hard copy records of action taken are available.

The Supervisor can route automatically in the event certain channels go down for any reason. Indicator lights on the supervisory control desk indicate when storage units are occupied, how long they have been occupied and when they are approaching their limit of capacity. All of these indicators enable the Supervisor to take action to assure a continued flow of traffic without interruption of operations at the originating positions.

The system operates strictly in accordance with ACP-127B, wherein routing line segregation procedures must be followed. Routing line segregation is attained through an automatic device popularly known as "the Skipping Device", which allows only those addresses assigned to certain circuits to pass over those circuits. If other addresses appear in the routing line they are "skipped".

Top line monitoring is also a part of the State Department Switching System. All outgoing circuits transfer the pertinent preamble information to eight page printers. This reduces manual effort in pulling details from reams of unimportant information.

Another aspect of the system that reduces message preparation time is the Automatic Number Name Programmer, which using computer techniques, generates all standard portions of messages to be transmitted (for instance, pilot line, message numbering, transmission times, storage identifications and special code sequences).

The heart of the Philips Store and Forward System is the Marker and the Central Address Memory. The Marker constantly monitors the condition on all transmission paths within and connected to the center so that it may advise the various positions upon their indication that they have a message ready for transmission, and whether the particular message in question should go to storage or directly to the outgoing circuit. This same criterion also applies for multiple-address traffic. In other words if a message with two addresses is ready at an originating position and both circuits are free, the message will be sent simultaneously to the two outgoing circuits. Here no temporary storage is required and the originating position is virtually connected directly to the outgoing circuits.

In the event one of the aforementioned circuits is busy at the time of request for transmission the Marker assigns a storage unit to the originating position in addition to connecting the free circuit. At the same time the transmission is going out on the free circuit the storage unit will be recording the transmission destined for the busy circuit. Since the output of a storage unit is independent from the input, retransmission of the message is accomplished immediately after the message starts to enter the storage unit. This holds retransmission delay to a minimum.

The decision as to where this particular message is stored, the circuit to which it is destined and the priority of the message is recorded in the Central Address Memory. This device only comes into play when a message enters storage. It assures handling of all traffic on a first-in, first-out basis within the specified levels of priority, recognizing all multiple-address responsibility.

SUMMARY

The Philips' approach to the design and construction of Telegraph Switching System utilizes a combination of electronic and electro-mechanical devices, using building block techniques. This approach is possible since equipment utilized in "torn-tape" systems can also be incorporated in fully automatic systems. Thereafter progressive steps can be taken from this "torn-tape" system to a semi-automatic, to semi-automatic/concentrated, to concentrated/automatic or to a fully automatic system. The economies of such an approach are quite apparent. Even more economies are realized in the concentration of certain equipments, thus eliminating excessive duplication.

The special features included as standard items are Electronic Combined Receiving Transmitting Units (CRTU's), Common Line Guarding Equipment, a fully electronic Central Address Memory (CAM) and a fully electronic Common Program Transmitter using computer techniques. The U. S. Department of State applied the semi-automatic system approach in view of the fact the bulk of their traffic was terminal rather than relay. The State Department system has been operating on a full-time basis since July 1960 with no interruption in overall system operation.

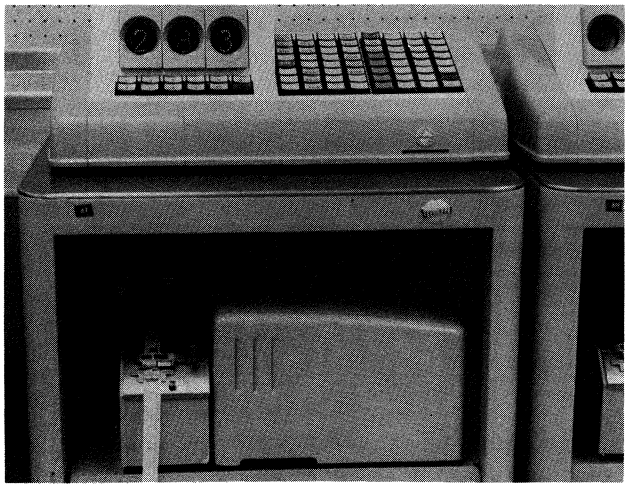
GLOSSARY OF TERMS NOT DESCRIBED IN TEXT

1. MARKER - controls the automatic crossoffice switching functions according to the instructions received from the routing directors, the concentrated operation positions or the torn-tape positions.

2. CENTRAL ADDRESS MEMORY - stores the routing instructions for messages destined for busy circuits. In conjunction with the Market, this equipment will permit message processing on a first-in/first-out basis within the specified levels of priority.

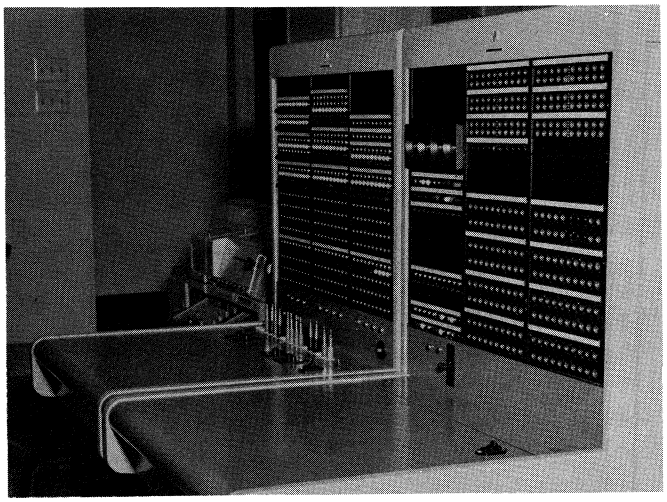
3. ELECTRONIC COMBINED RECEIVED TRANSMITTER UNIT (CRTU) - ferrite storage facilities for 5 unit telegraph information - (1000 and 2000 characters per unit for incoming and intermediate storages respectively).

Model 28 Receive-only Page Printers used to produce hard copy of messages received from points all over the world.

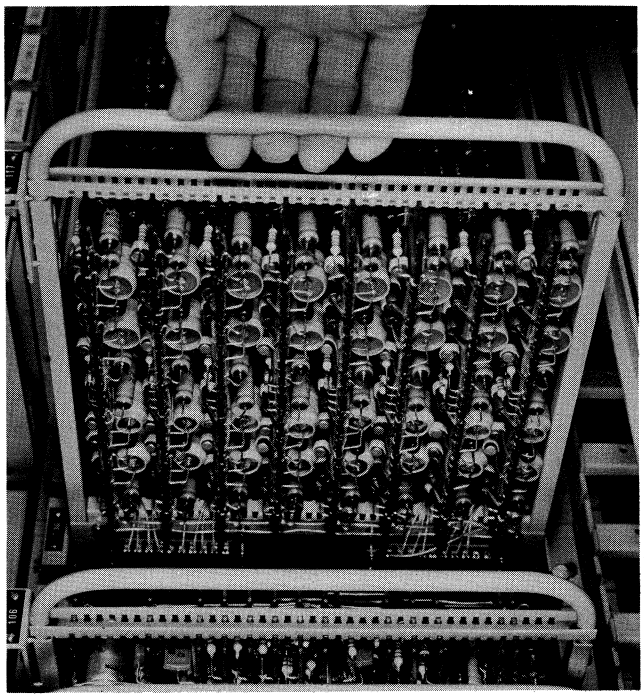


Special Purpose Position with group count panel.

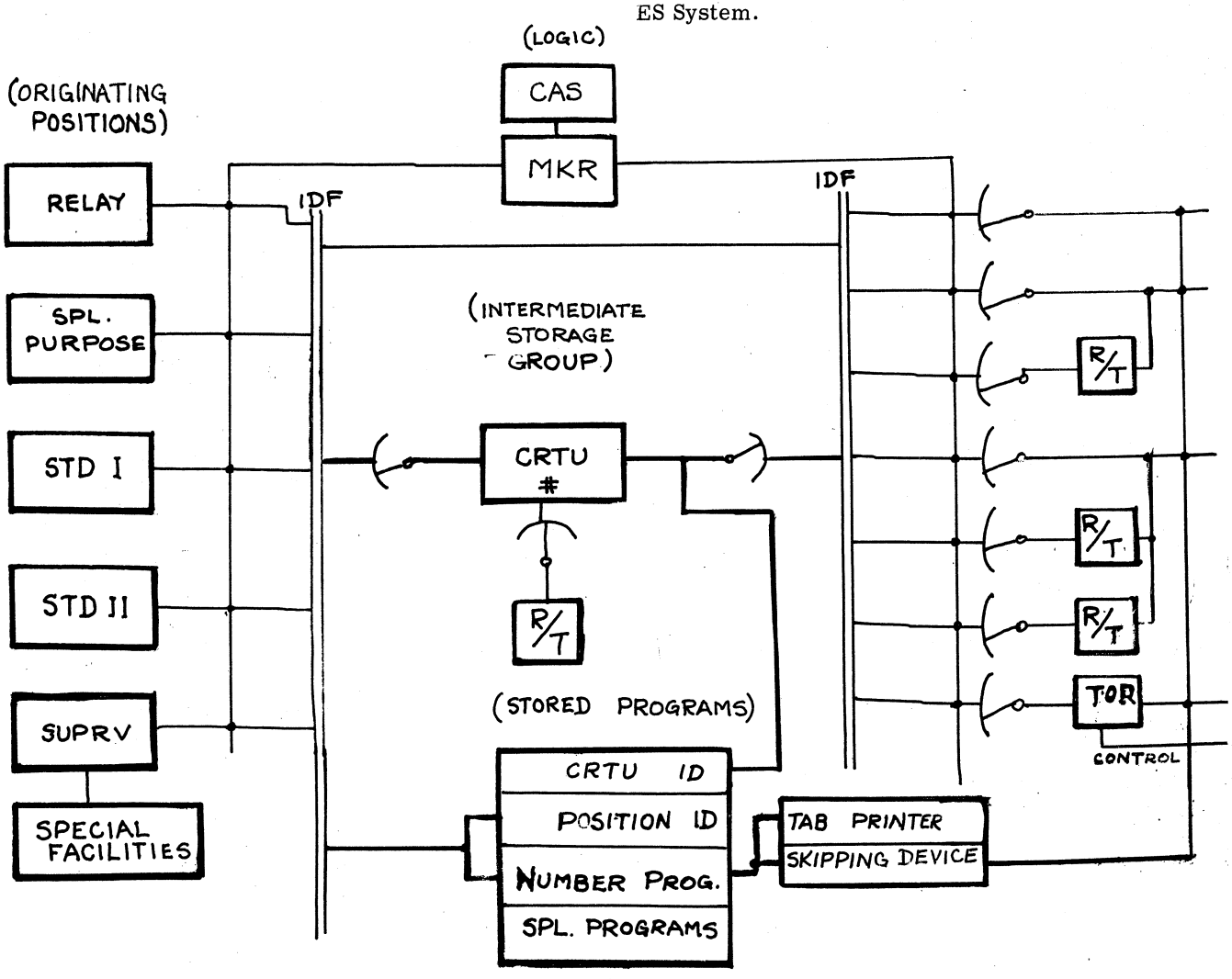
Some Model 28 ASR sets used to originate and introduce messages into the system for distribution on outgoing circuits. Each position has the ability to send to any outgoing circuit. This is accomplished by the operator depressing any one or combination of direction buttons and a priority button before pushing the "go" button. The system receives messages from these positions and routes the information according to priority and addresses to the proper circuit or circuits.



Supervisor's console providing monitor, blocking, break-in and intercept facilities. The console is equipped with indicators so that the supervisor may maintain full control of the traffic entering and leaving the system. Other facilities allow for record keeping and message traffic analysis.



Typical electronic plug-in module used in the ES System.



JAMES R. DAY

Vice-President,
Radio Engineering Laboratories, Inc.

James R. Day, vice president of research and engineering at Radio Engineering Laboratories, Inc., died July 28th at Doctors Hospital in New York at the age of 52. Mr. Day joined REL seventeen years ago, was appointed vice president in 1949, and was named to the board of directors in 1959. Recently, he was named a vice president for technical planning for the Dynamics Corporation of America, the parent company of REL.

Mr. Day pioneered in modern communications techniques known as tropospheric scatter radio and was the inventor of the Serrasoid FM Modulator. Mr. Day presented a paper on the Serrasoid Modulator to the Radio Club on September 23, 1948 which was subsequently published in the Proceedings of the Radio Club of America, Inc. in 1949. He was responsible for developments with the common cathode diversity combiner, delay FM detectors and two-path FM threshold extension.

Mr. James Day was an associate of the radio pioneer, the late Major E. H. Armstrong, inventor of FM radio, and worked with Armstrong at the Columbia University Laboratories in the field of frequency modulation from 1936 to 1942. Prior to that, he worked for the Hayden Planetarium in New York City.

During World War II, James Day was associated with Johns Hopkins University where he was instrumental in the development of the proximity fuse and other military devices for the Office of Scientific Research. Mr. Day also was involved in microwave development at RCA Laboratories from 1943 to 1945.

Mr. Day is a graduate of Massachusetts Institute of Technology with a BS degree in Mathematics and Stuyvesant High School, New York City. He is survived by his wife, the former Louise Overton, two sons, and a daughter, to whom we express our sincerest sympathy.

Members of the Club will remember his Serrasoid paper and other important developments that he brought to the Club's attention during his active and interesting life.

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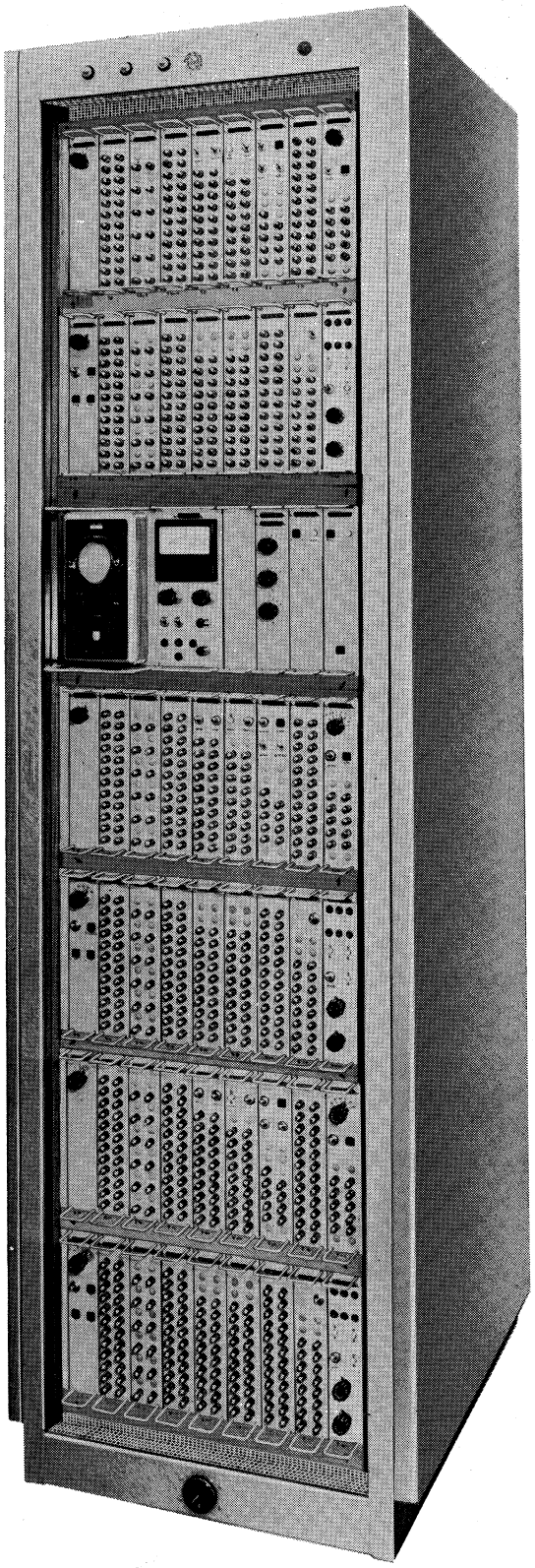
(Continued on page 10)

Norelco® Single Channel 5-Element Automatic Error Detection and Correction Terminal



Features:

Single-Channel
Adjustable Gate for Character Element Check
Automatic Detection and Reset of SYNC
Parity Bit Checking
Fully Electronic
Plug-in Unit Construction
Five Speeds
High Reliability
Remote Operation
Compact

The NORELCO Single Channel 5-Element Automatic Error Detection and Correction Terminal is designed for synchronous operation on HF circuits or landlines. Each channel terminal consists of a transmitter and receiver section. The teletypewriter signals (all 32 characters of No. 2 CCITT code) may be fed to the equipment by either the parallel or the sequential method.

Each character transmitted is protected by a **VERTICAL PARITY CHECK** and a **GATE TEST.** The added vertical parity bit is either negative or positive depending on the preceding elements in the character. The gate test is effected by each element of each character (including the parity element) passing through a receiving gate which checks each element for proper shape (distortion). The threshold of the gate is easily adjustable so that the test may be as critical or as tolerant as the situation may require.

When a single channel NORELCO ARQ terminal is required, it is supplied in a cabinet that includes the common units and a power supply. In addition the cabinet is prewired so that two more channel terminals may be easily added at a later date. This easy expansion to two or three channels is accomplished by the addition of plug-in modules. This modular construction also provides ready access to all components.

Various types of Norelco auxiliary units (including signaling facilities) are available which will permit the connection of either subscriber or telex exchanges.

Norelco TELEGRAPH AND DATA SYSTEMS

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MIllington 7-0655

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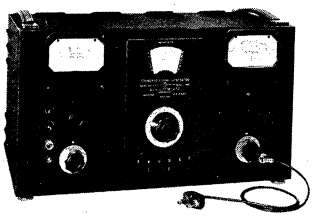
SMALL ADVERTISEMENTS

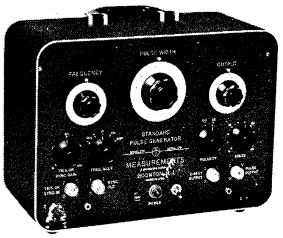
Following up on suggestions made by some of our members that we include space in the Proceedings for a few Professional cards that would permit them to call attention to where special products and services with which they are concerned, could be displayed. We will try this out. To keep the cost down, and to minimize the work of the Publication Board, (which is voluntary, of course) the following plan will be tried: A special section will be added reproducing your regular business card, or other forms having similar shape and content for four issues at a total cost of $12.00. This section might be expanded, following other suggestions, to include equipment items for sale (historical items, unusual pieces, files of magazines, etc.) if this would be a service for the members. Space would necessarily be limited, so the details for handling these items must be carefully worked out. For any of the above, write Ralph R. Batcher, Editor, 240-02 42nd Ave., Douglaston, New York.

MEASUREMENTS Laboratory BOONTON, N. J. Standards

Electronic Instruments for Research, Development and Design

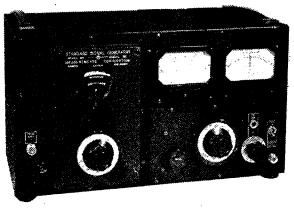


MODEL 65-B
Standard
Signal Generator

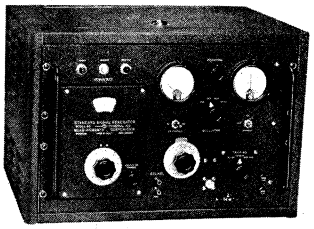


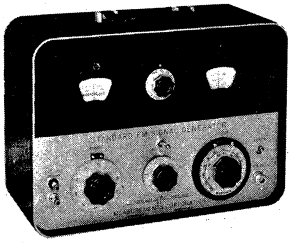
MODEL 179
Standard
Pulse
Generator

MODELS 80 and 80-R
Standard
Signal Generators



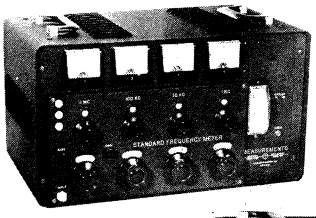
MODEL 95
Fm Signal
Generator



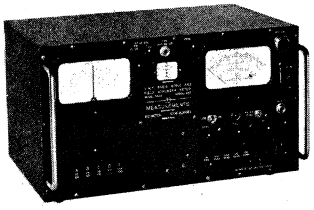


MODEL 210 Series
FM Standard
Signal Generators

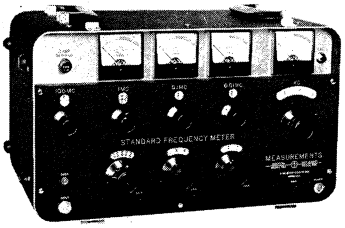
MODEL 700
Frequency
Meter

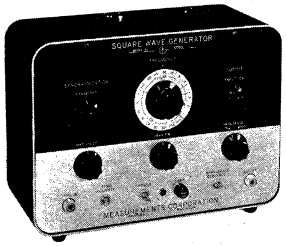


MODEL 58-AS
VHF Radio Noise
and
Field Strength
Meter

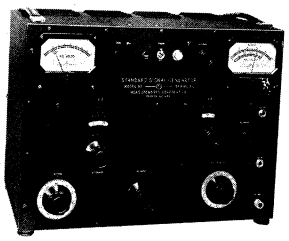


MODEL 760
Frequency
Meter



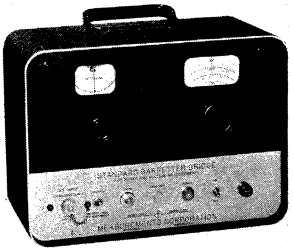


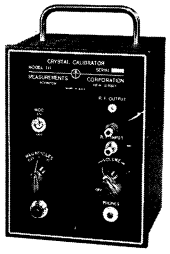
MODEL 72
Square Wave
Generator



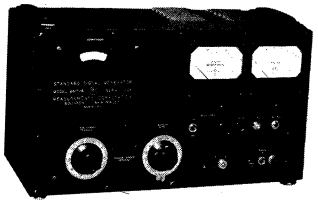
MODEL 82
Signal Generator

MODEL 202-C
Standard Barretter
Bridge





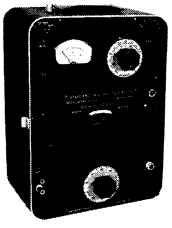
MODEL 111, 111-B
Crystal Calibrator



MODEL 84-TVR
Signal
Generator

MODEL 59
Megacycle
Meter

MODEL 162
Vacuum
Tube
Voltmeter



MODEL 560FM
Signal Generator

MODEL 139
I.F. Test
Oscillator

STANDARD SIGNAL GENERATORS

MODEL	FREQUENCY RANGE	PRICE
65-B	75 Kc to 30 Mc	$875.00
80	2 Mc to 400 Mc	590.00
80-R	5 Mc to 475 Mc	625.00
82	20 Cps to 50 Mc	660.00
84-R	300 Mc to 1000 Mc	1950.00
84-TVR	400 Mc to 1000 Mc	785.00
95	50 Mc to 400 Mc	1800.00
210 Series	25 Mc to 480 Mc	450.00 to 475.00
560FM	Mobile Bands	648.00

FREQUENCY METERS

MODEL	FREQUENCY RANGE	PRICE
700	25 Mc to 1000 Mcs with Range Selectors	1500.00 410.00 ea.
760	Mobile Bands	980.00

PULSE GENERATOR

MODEL	FREQUENCY RANGE	PRICE
179	60 Cps to 100,000	365.00

SQUARE WAVE GENERATORS

MODEL	FREQUENCY RANGE	PRICE
71	60 Cps to 100,000 Cps	195.00
72	5 Cps to 5 Mc.	248.00

MEGACYCLE "GRIP DIP" METER

MODEL	FREQUENCY RANGE	PRICE
59LF	100 Kc to 4.5 Mc	168.00
59	2.2 Mc to 420 Mc	168.00
59UHF	420 Mc to 940 Mc	198.00

BARRETTER BRIDGE

MODEL	FREQUENCY RANGE	PRICE
202-C	2 Mc to 1000 Mc	375.00

VACUUM TUBE VOLTMETERS

MODEL	FREQUENCY RANGE	PRICE
67	5 to 100,000 Cps Sine-Wave	235.00
162	20 Cps to 300 Mcs	180.00

CRYSTAL CALIBRATOR

MODEL	FREQUENCY RANGE	PRICE
111	250 Kc to 1000 Mc	97.50
111-B	100 Kc to 1000 Mc	110.00

I.F. TEST OSCILLATORS

MODEL	FREQUENCY RANGE	PRICE
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VHF RADIO NOISE AND FIELD STRENGTH METER

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58-AS	15 Mc to 150 Mc	925.00

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505		250.00

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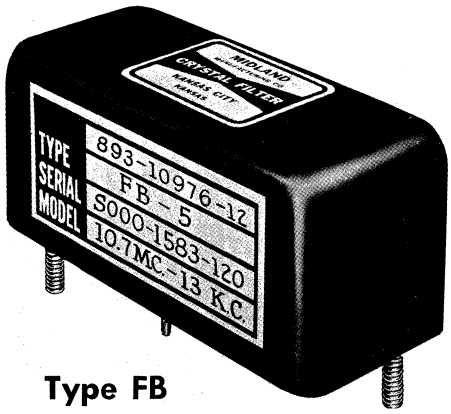
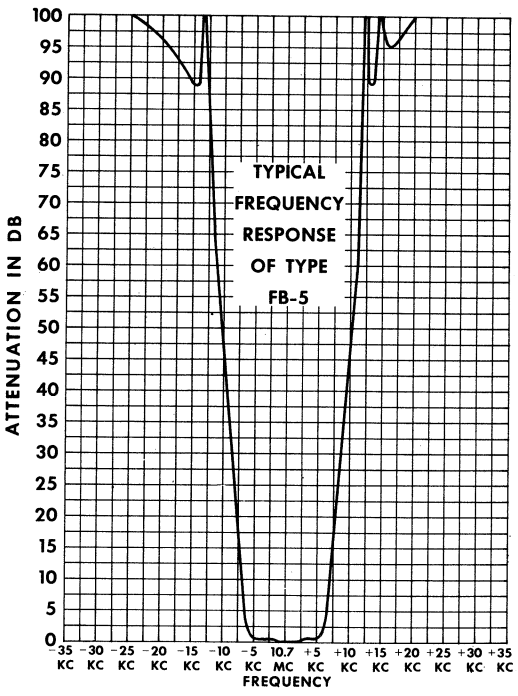
MINIATURE

Narrow Band-Pass Crystal Filters



Type FB

The Midland Type FB Series is a group of hermetically sealed, eight-crystal, narrow-band filters that provide bandwidths in the range of 2 KC to 30 KC @ 6 db, with a center frequency of 10.7 MC. They are designed to operate in the environmental temperature range of −55°C to +90°C with an insertion loss of 4 db max. and an inband ripple of .8 db max. The Type FB narrow-band crystal filter is ideally suited for design in two-way communication systems, telemetry systems, electronic instrumentation equipment and other 10.7 megacycle applications where small fractional bandw dth filtering plus a high degree of selectivity and temperature stability is required. It can be used to best advantage in designing single-signal RF stages to give greater adjacent channel separation and performance reliability, in addition to conserving space and reducing material and manufacturing costs. Midland invites inquiries in assisting with any engineering problem where the use of crystals and crystal filters is proposed.



Specifications

	FB-5
Center Freq.*	10.7±375 CPS
BW @ 6 db Min.	13 KC
BW @ 60 db Max.	23 KC
60 db/6 db BWR Max.	1.8
BW @ 80 db Max.	26 KC
Ultimate Rejection Min.	105 db
Req. Source/Load Resistance (R_o)	1 K ohms
Inband Ripple Max.	.8 db
Insertion Loss Max.	4 db
BW @ 1 db Min.	10 KC

*Center freq is the arithmetic mean of the frequencies at 6 db.

Operating Temp. Range: −55°C to +90°C
Shock: 200 g
Vibration: 15 g to 2 KC
Max. Input Level: +10 dbm

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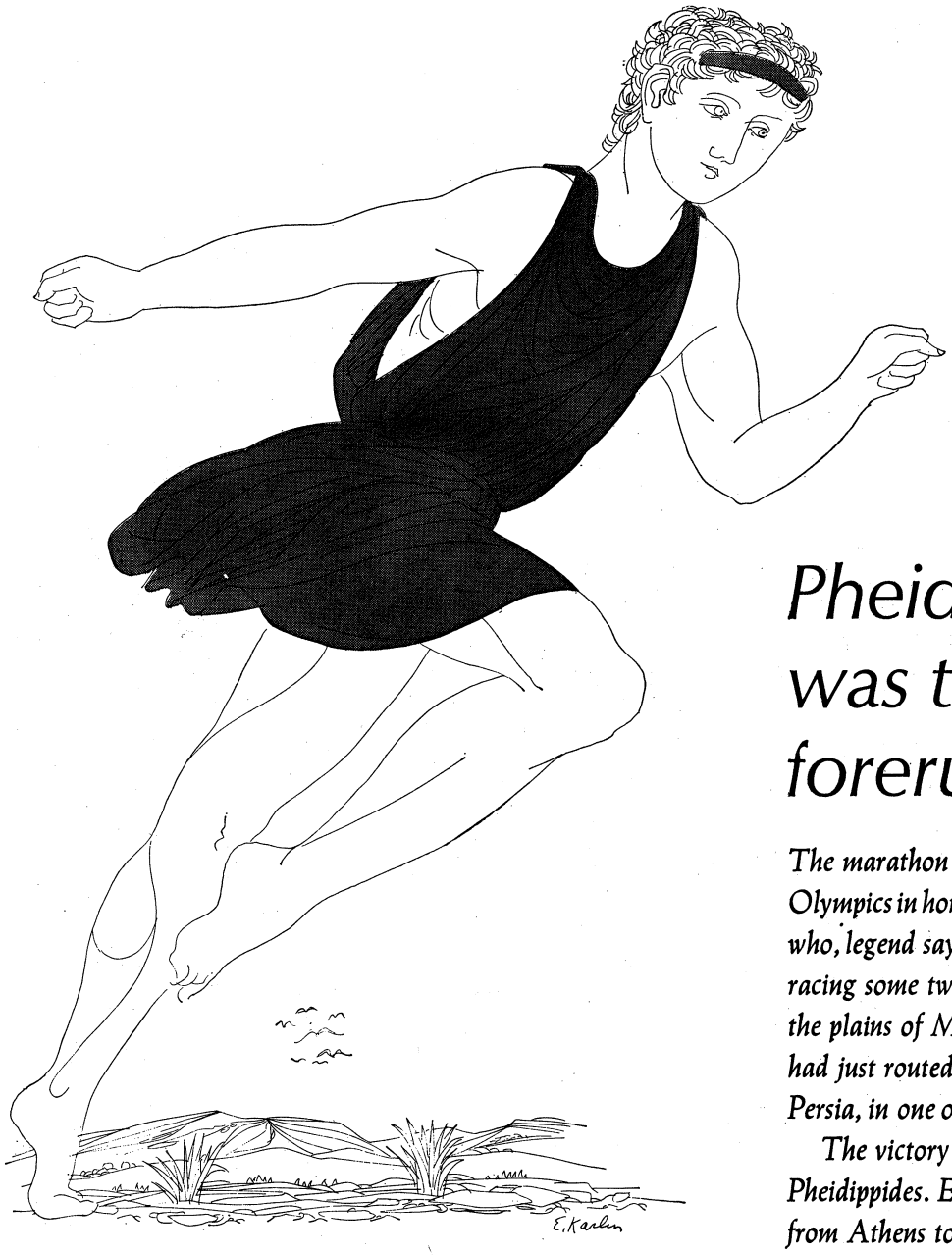

Pheidippides was the forerunner

The marathon was included in our modern Olympics in honor of Pheidippides (or Philippides) who, legend says, died about 490 B.C. after racing some twenty-three miles to Athens from the plains of Marathon. There, the Athenians had just routed the forces of Darius, king of Persia, in one of the decisive battles of the world.

The victory itself was in large part due to Pheidippides. Earlier, he had raced the 150 miles from Athens to Sparta in forty-eight hours to enlist Spartan aid, thereby becoming forever a part of "the glory that was Greece."

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