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Traffic Service Position System No. 1:

Operator Training Facilities

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The evolution of operator training facilities for TSPS No. 1 has involved the development of new program-controlled positions which have much greater flexibility and reliability than preceding training equipments. These PROCON-controlled positions and associated facilities are now the standard means for training TSPS operators. Coincident with the development of these facilities, a minicomputer system for generating master training tapes was designed to facilitate the generating of new training tapes and modifying existing ones to add new operating features.

Since the beginning of telephony, there has been a need to train switchboard operators in the procedures required to handle and complete telephone calls. These procedures started with "on the job" training and gradually improved over the years to specialized training facilities to give the trainees the ability to handle calls before they sat down at a switchboard handling traffic.

With the advent of the crossbar tandem Traffic Service Position in 1961, a new specialized training facility (100A trainer) was designed to train operators in the basics of handling traffic on this new type of switchboard (Fig. 1). This consisted of an operator position with two equipment cabinets. One of the two cabinets contained a paper tape reader, a magnetic tape player, power supplies, and racks for tapes. The second cabinet contained densely packaged electromechanical and solid-state circuitry which performed the necessary trainer functions under control of information on the magnetic and paper tapes.

Customer calls were simulated by verbal passages on the magnetic tapes which also provided synchronizing tones to start the paper tape reader. The paper tape reader and the magnetic tape player were

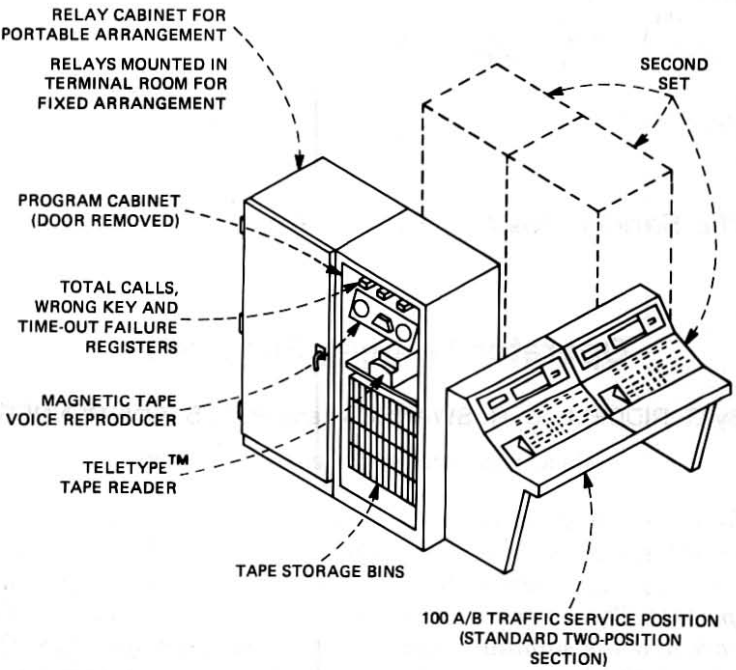

Fig. 1—Operator training equipment.

additionally controlled by the trainee sitting at the training position responding to simulated calls.

In effect, the training system was a simulator which could duplicate nearly all types of calls handled by a TSP. Different types of calls were simulated by different input tapes which were loaded by supervisory personnel.

With the development of TSPS No. 1, this 100A system was modified to provide added capabilities and was classified as the 100B trainer. Essentially, however, the basic operating principles and the physical appearance of the new trainer remained the same. This system has been used to train operators on TSPS call-handling procedures since its first application in 1969. However, as new features have been added to the TSPS, corresponding equipment modifications have been required in the relay circuitry. As there are over 2000 of these trainers in the field, this is a significant problem. In addition to this, the design of these changes becomes more difficult as control logic becomes more complex and as precise operating characteristics of the trainers is required.

To overcome these problems, a new programmable 100C trainer system was designed. Programmability enables new TSPS features to be introduced to the simulator quickly with few or no hardware

modifications. This system also provides a supervisory function not available on the 100B trainer. Furthermore, it uses standard 100C operator positions which can also handle regular traffic when not used as trainers.

This new trainer system shown in Fig. 2 consists of a maximum of eight training positions and one supervisory position. Each position can be switched to handle normal traffic. These positions can also be dedicated for training only and supplied on a stand-alone basis requiring no association with any chief operator group or TSPS No. 1 System. A photograph of a training position is shown in Fig. 3.

A standard 100C position is converted to a trainer by a wiring option added to the existing local cable wiring, and an applique column (Fig. 4) added to the rear of the position. This column contains a microprocessor called the programmable controller (PROCON) (Fig. 5), which provides the necessary control functions for the trainer. In addition to this, translator and temporary memory boards, voice and tone detectors, tone generators, I/O logic control circuitry, diagnostic indicators,

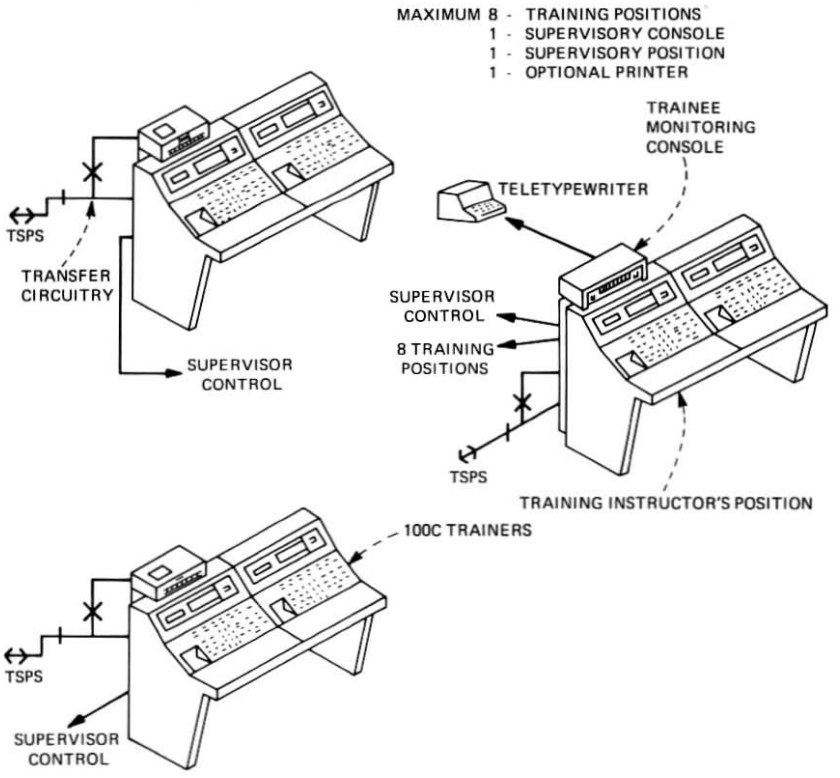

Fig. 2—100C training system.

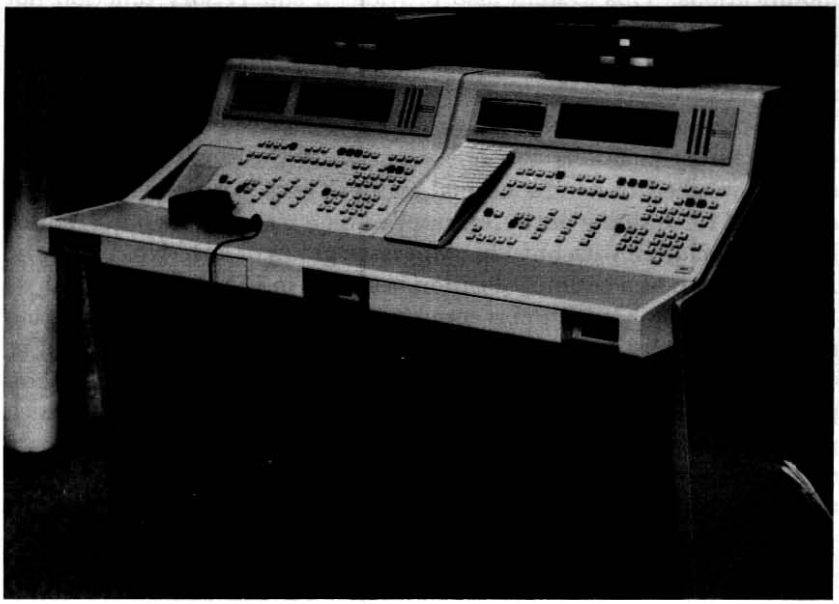

Fig. 3—100C training position.

switching circuitry, supervisory interface control, and isolation circuitry are all contained in the column (Fig. 6).

To provide the necessary combined data and voice inputs to the new trainer, a special cassette tape reproducer was required. This reproducer is largely based on conventional technology in the audio/visual and training fields. The prerecorded tape is in the standard Phillips cassette stereo configuration. However, several special features were required in this application:

(*i*) A precise high speed reverse to enable the trainee to return to the beginning of a call pattern on the tape (called the "repeat" mode).
(*ii*) Remote and local control functions customized for TSPS.
(*iii*) Power supplied to external interface circuitry.
(*iv*) Enclosure designed and stylized for a mounting location on the position accessible to the trainee.

The reproducer is manufactured for the Bell System by an outside supplier. The prerecorded cassette training tape contains the voice and data associated with a maximum of 30 minutes of simulated calls. The tape contains two tracks, one for voice and the other for control tones (Fig. 7). In a position being used for training, the PROCON processes the cassette control tones, operator-keyed actions, and verbal responses to simulate actual calls. The operation of the player is under

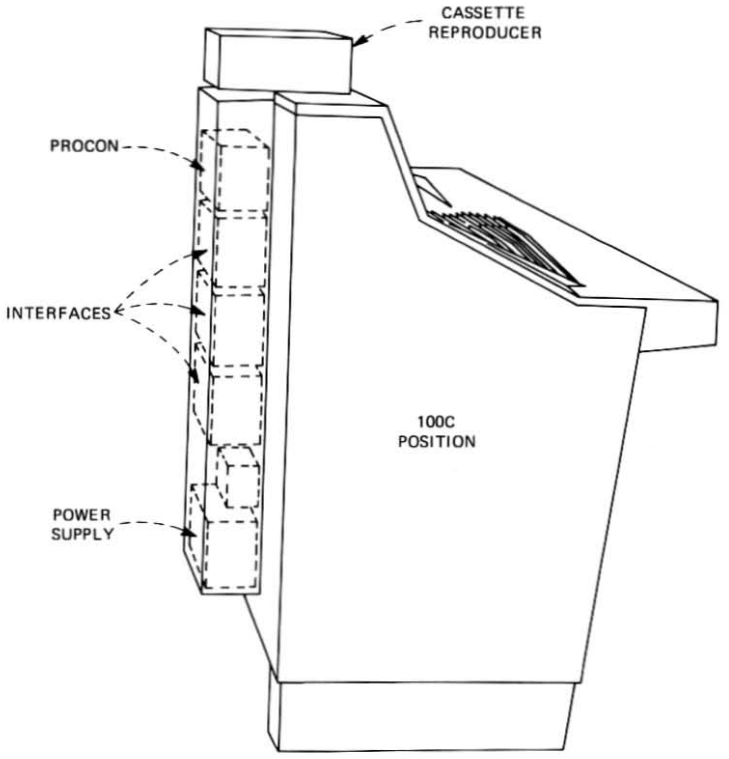

Fig. 4—Conversion of position to trainer.

control of the PROCON, although the trainee has some manual override capability. The trainee now has the ability to load the cassette and initiate and pace the training session, which was not possible in the previous system.

The control of the various components is shown in Fig. 8. The trainee inserts a prerecorded cassette in the reproducer and operates the play button. The cassette advances beyond a point where data, representing a TSPS lamp display, has been presented to the PROCON. A proper response by the trainee (either a key operation and/or verbal response) causes the PROCON to continue reading the tape.

The control data on the cassette are formatted in a 5-bit baudot code representation. Each bit is represented by a different frequency on the tape. A coded 5-bit character is represented by combinations of one to four frequencies simultaneously. These frequencies are present for 80 ms as the tape advances at 1⅞ inches per second (Fig. 7). A 20-ms interval is provided between consecutive characters as the tape advances. An instruction to the trainer generally is provided by two

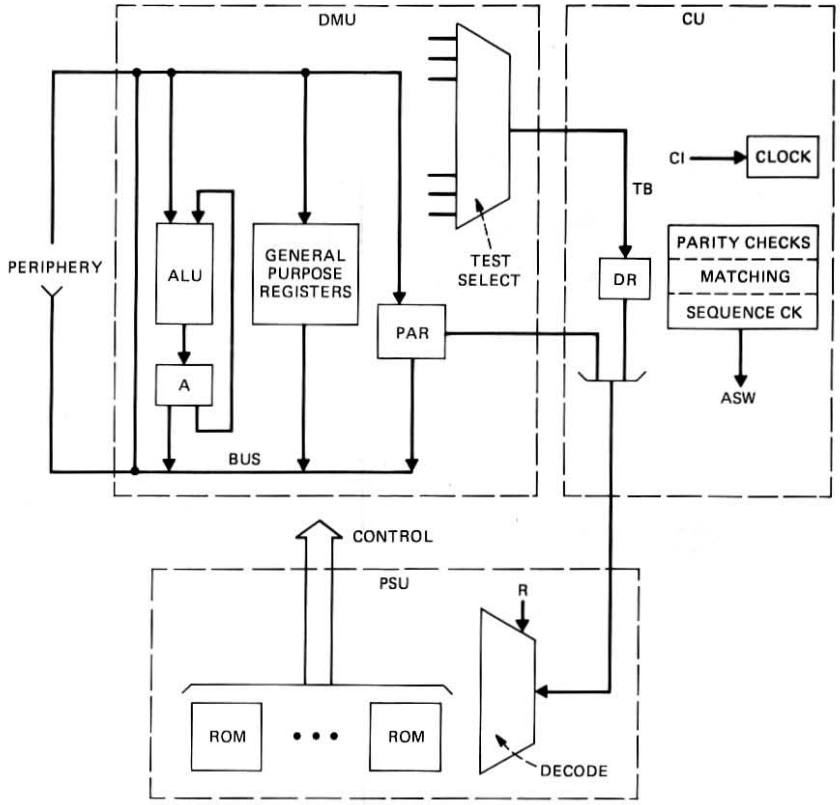

Fig. 5—Architectural overview of PROCON.

successive baudot characters although there are exceptions requiring only one. The data inputs are paired by PROCON and translated into a control function. For digital displays, telephone numbers are stored in the translator memory. There are standardized numbers for all trainees to use regardless of their location in the country. With this technique, a 10- to 12-digit display requires only a 2-character code. In addition, numbers keyed by the operator are stored in temporary memory. Both types of numbers can be displayed, when required, by operation of the corresponding display key at the operator's console. Other digital displays, for example, time and charges, are pre-coded and can be displayed on demand.

Operation of the time display key will produce a time-of-day display. When a position is powered up for the training function, the time is initialized to 8 o'clock. If desired, this can be changed by keying in the desired time on the keyset.

Operation of a key on the console generates one of the 84 possible ⅞

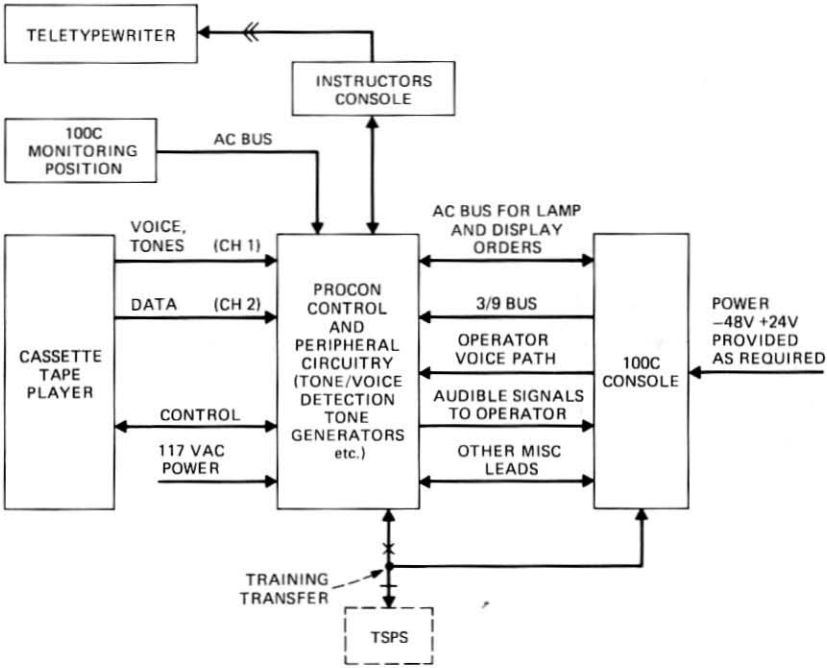

Fig. 6—100C operator training system.

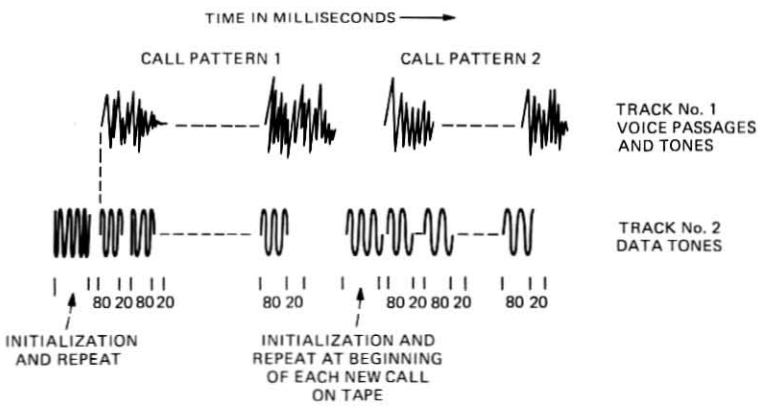

Fig. 7—Training tape information content.

key codes. These ⅜ codes are identified by PROCON through its associated position interface circuit, and appropriate action is taken to control the cassette player, and light, flash, or extinguish lamps on the trainer console.

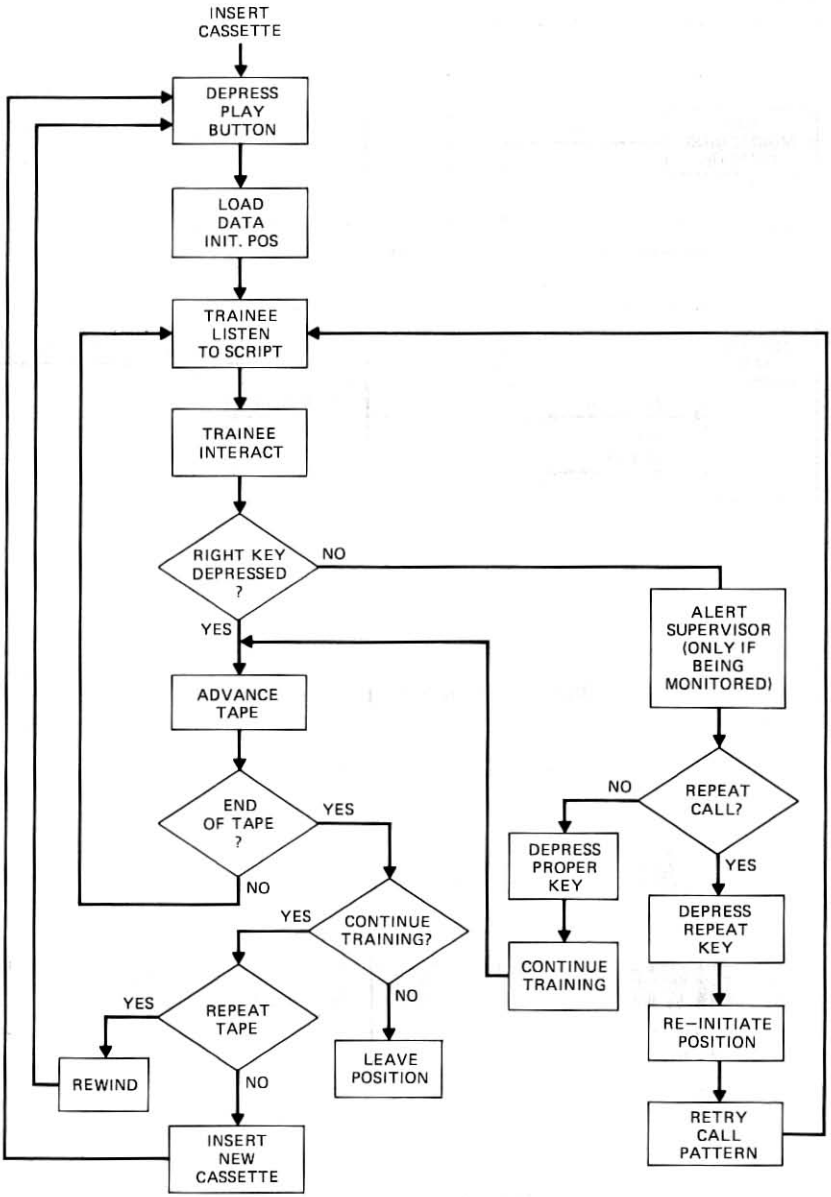

Fig. 8—100C trainer operations.

Verbal responses of the trainee are detected by a voice detector and forwarded to PROCON, which permits the call to progress to the next voice passage or group of data on the cassette tape.

In addition to lamps and display data, the cassette tape data also

control tone signals (ziptone, audible ring, busy) to the trainee. These tones can be present for indeterminate time periods. For these types of signals, tone generators are provided under PROCON control. In general, these tones are initiated or terminated by the trainee key actions.

The standard 100C operator position requires a 24-bit serial data word for each instruction to light a lamp or display pairs of numerical digits. In the 100C trainer, these 24-bit words are identical to those used on the standard 100C position but are generated by PROCON. As the trainee operates keys at the console, the ⅗ codes generated are translated and matched against expected results. If the correct response is made, the cassette is advanced to present new data. If a match is not made, the trainer does not respond, forcing the trainee to question his/her actions and give the correct responses. A flowchart of the operations of the 100C trainer is shown in Fig. 8.

The 100C operator training system also includes an instructor's console with an associated *DATASPEED* ® 40 printer to provide a record of trainee keying actions. The instructor's console provides a means to supervise trainees while they are learning to handle TSPS traffic. It permits the instructor to monitor the simulated calls and the trainee's responses. As keys are operated by the trainee, the corresponding lamps light on the instructor's console. Incorrect key actions by the trainee cause the corresponding lamp to flash at the instructor's console.

The instructor can select any one of eight positions to monitor. While this one position is being monitored, all other seven positions are also being checked to determine if the trainees are making excessive errors in their responses. Excessive errors generated at a training position cause a corresponding position number lamp to flash at the instructor's console.

A *DATASPEED* 40 printer produces a record of the numbers keyed by the trainees. This can be done on a position-by-position basis by operation of a print key on the console. These records provide information on keying accuracy, as no actual matching of keyed numbers is provided in the 100C trainer programs.

These trainers also require support facilities to provide training tapes. The production of these training tapes require the coordinated efforts of Bell Laboratories, AT&T, Western Electric and general trade suppliers. Initially, the efforts of BTL and the AT&T operator services organization are used to determine the correct operator actions and console displays required on calls. Once this has been determined, data codes required for new features are designed by BTL, and the information is provided to the operator training groups at AT&T. The necessary data patterns are then determined by the operator training

group and entered into the data base of the minicomputer-controlled support system used to produce master training tapes.

To put both the data patterns and voice passages on master tapes, the support system called Automatic Data Entry Console (ADEC) was designed (Fig. 9), and two custom-built systems were provided to the AT&T training organization. This system has the capability of editing tapes and synchronizing the recording of voice and data to accurately simulate actual calls. It is updated and modified as required to provide new features. In order to produce master tapes, a narrative script is provided by the AT&T operator training organization to a professional recording studio which in turn produces a voice master tape. The voice master tape is used by the ADEC to generate the combined master tape consisting of voice passages and data tones on separate tracks. The generating of these tapes can call for several revisions to achieve realistic simulations (Fig. 10).

The combined master tape provided by this system is then transmitted to Western Electric for quality control. Commercial suppliers provide cassette copies of the master tapes for use by the telephone companies. Tight specifications on the generation of the master tape and on the cassette duplication process are required to provide adequate operating margins in the use of audio cassette technology for the basic input to the control system.

The use of the ADEC system has been beneficial in providing capa-

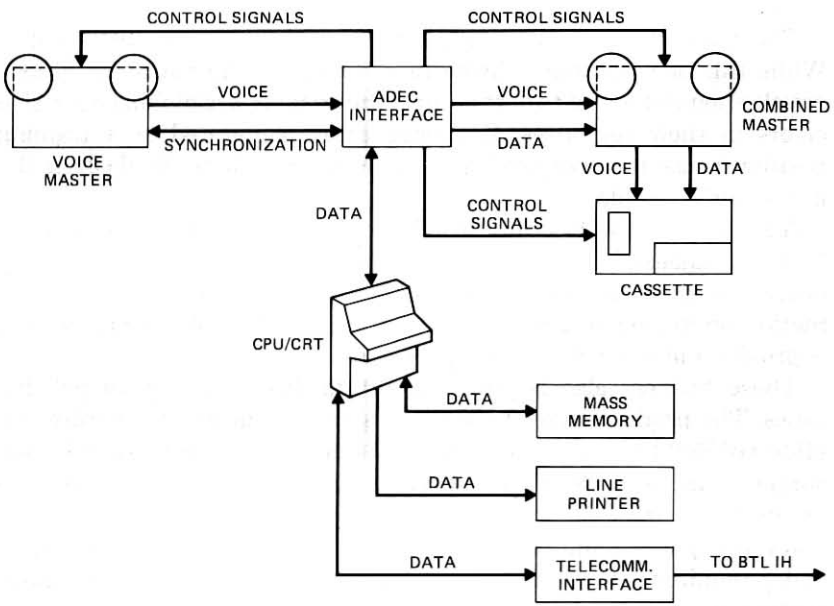

Fig. 9—ADEC system.

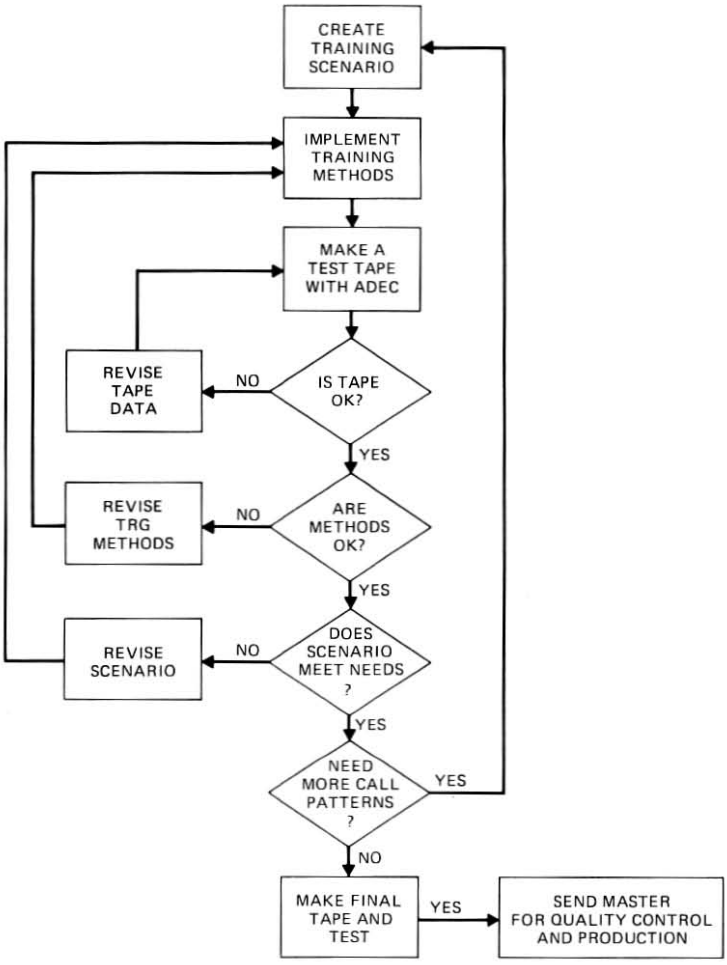

Fig. 10—Procedure for generating combined master tapes.

bilities for modifying and generating new training tapes not previously available with the older trainers. Requirements for training have been expanding continuously, and since the introduction of this system the production of training tapes has greatly improved.

ACKNOWLEDGMENTS

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