Physical Design

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Traffic Service Position System (TSPS) No. 1 is designed to make toll customer service and operator call handling more efficient. This equipment is designed to give improved and dependable service. Connectorization is added to permit more efficient shop testing, installation simplification and a ready means to effect quick growth in a working environment. The switchroom equipment and operator facilities are specially designed for pleasing proportion and harmonious color schemes.

I. INTRODUCTION

The Traffic Service Position System (TSPS) No. 1 (see Fig. 1, which shows a portion of a chief operator unit, Miami, Florida) utilizes modular design that enables customers to order equipment orderly and economically as needed. Frames in modular multiples of 1 foot, 1 inch in length permit a highly standardized floor plan arrangement. This in turn makes possible a higher degree of connectorization. In TSPS close to 90,000 interframe and intraframe leads are connectorized in a maximum sized office.

The TSPS development was undertaken with the intent to use as much "in production" apparatus, wired equipments and frameworks as possible. In addition to existing conventional electromechanical hardware, basic No. 1 ESS apparatus such as the semiconductor circuit packs and mountings, ferreed switches, ferrod sensors, bus transformers and terminal strips were used. Also adopted with minor modifications were power distributing, master scanners, signal distributor, central pulse distributor, tone and distributing frames, sheet metal frameworks, cable racks, fuse panels, filter units, and control panels.

The adoption of this hardware offered considerable advantages: (*i*) reduced development effort, (*ii*) immediate availability, (*iii*)

Fig. 1—Portion of a chief operator unit, TSPS No. 1.

established prices, (*iv*) economics inherent with large scale production, (*v*) increased standardization of product, and (*vi*) training and experience of Western Electric people for manufacturing, testing, and installation.

The equipment schematic, Fig. 4, depicts TSPS equipment components and their association. Equipment in dotted outlines constitute the No. 1A Stored Program Control (SPC), while those in solid line outline the TSPS. The heavy interconnecting lines represent transmission paths and the lighter lines emanating from the SPC 1A frames and the Communication Bus Translator are the communication bus paths that permit communication with the SPC 1A circuits, as well as the peripheral circuitry. Both local and remote operator units are shown, and these are known as position subsystems.

The typical floor plan arrangement as shown in floor plan Fig. 5 represents a maximum size office. Variables that affect the office arrangements are:

(*i*) Number and location of operator units equipped local, semi-remote, or remote.

(*ii*) Maximum number of trunks equipped.

(*iii*) Number of store frames equipped.
(*iv*) Location of transmission facilities—especially in 4-wire offices.
(*v*) Limiting conductor conditions.

II. CONNECTORIZATION AND NEW FRAMEWORKS

2.1 *Connectorization*

Connectorization of interframe cabling and some intraframe wiring is provided to simplify growth additions in working offices, installation of equipment and shop testing. In most cases cables have one end hard wired to frames and the other end terminated on plugs or connectors. These are joined to mating fixtures on connecting frames. In the case of communication bus cable pairs, they must be terminated at each end with a 100-ohm resistor to provide characteristic impedance. These Bus Terminating Resistors (BTRs) are mounted on small printed wiring boards which in turn can be mated to connectors, as shown in Fig. 2.

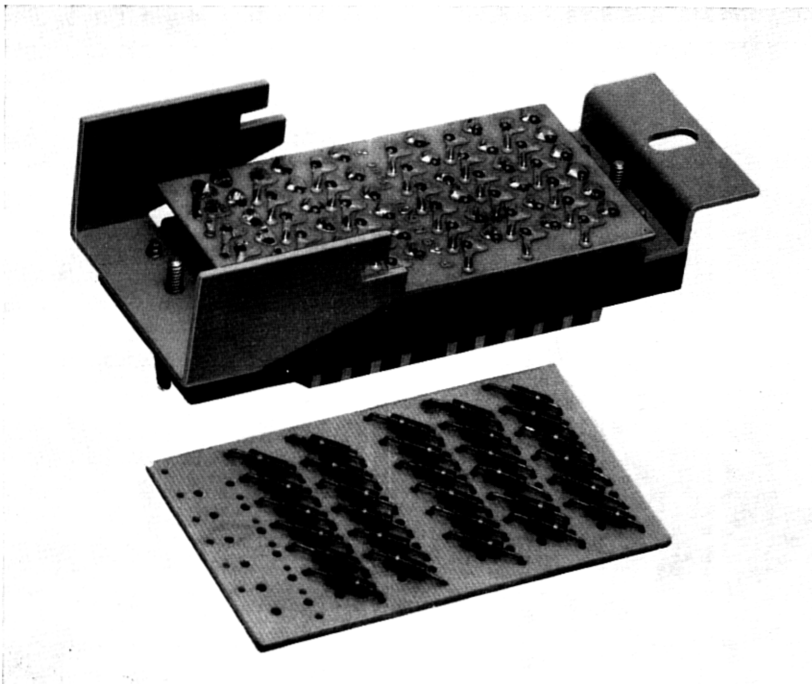


Fig. 2—Bus Terminating Resistors mounted on printed wiring board, and connector.

2.1.1 *Hardware*

Figure 3 shows a plug (at left) and a connector (at right). They are provided with 60, 66 and 72 terminals and include cable clamps and screw-down spindles which mate into associated locking hardware. The connector terminals are of a brass alloy and have a base coat of hard gold finish. Superimposed over the entire terminal is a soft gold finish. The plug terminals are of phosphor bronze stock with a coating of commercially pure tin.

2.1.2 *Application*

Connectorization is provided for all store frames. Each frame is equipped with bus switchboard cables approximately 7 foot long hard wired to transformers and terminal strips located at the top of the frame. The other end of this cable is terminated on connectors. There are also short bus local cables hard wired to transformers and terminal strips with the other end terminated on plugs. During the installation of a frame, the connectors of the switchboard cable are mounted on the cable rack above the adjacent and preceding store frame. The plugs from that preceding frame are mated to these connectors. Should

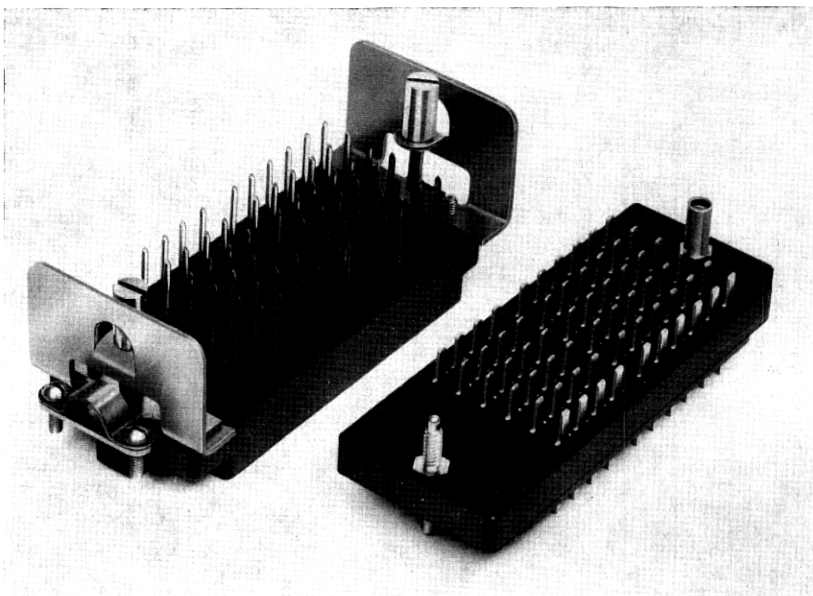


Fig. 3—Plug (left) and connector.

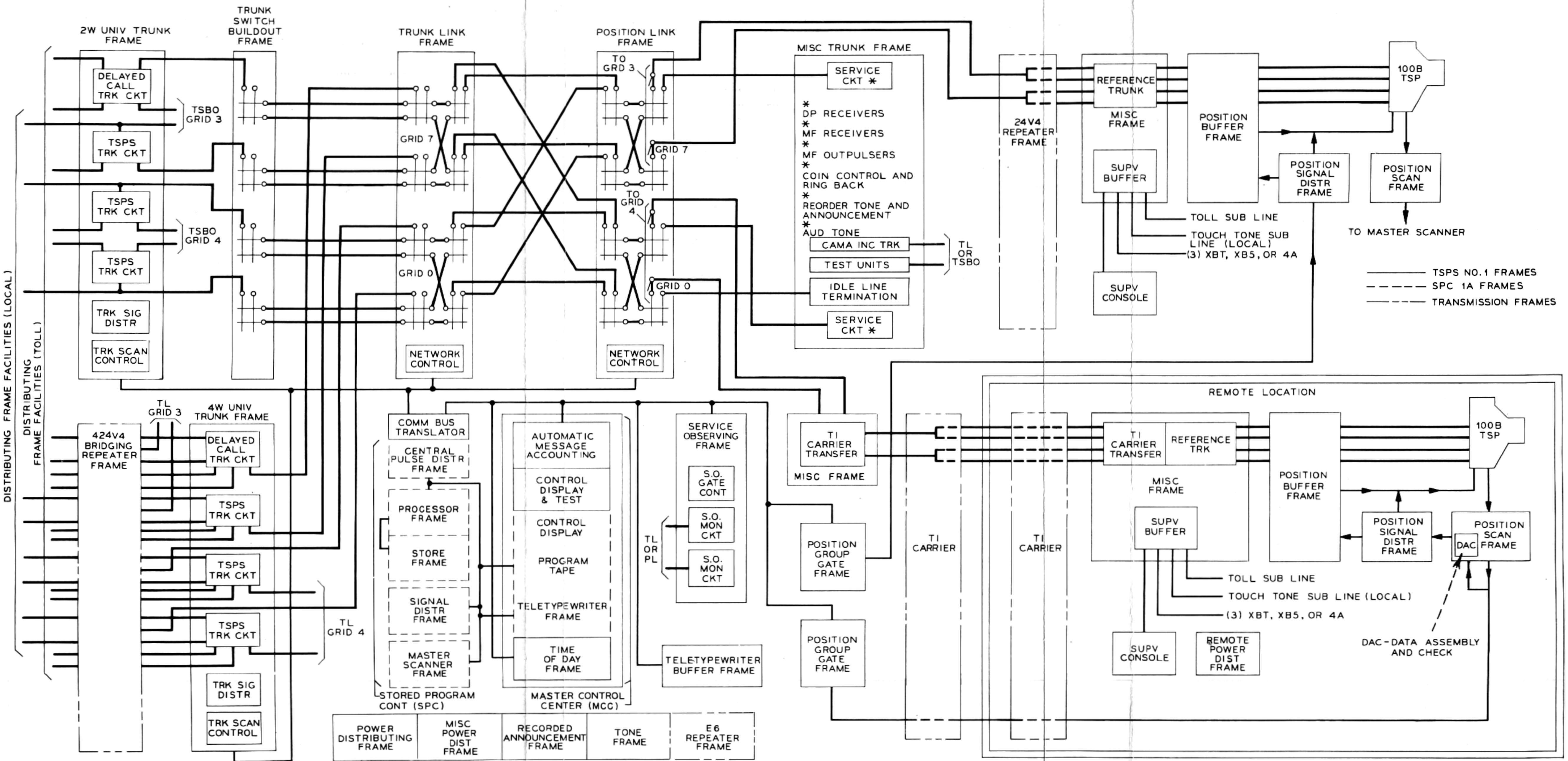
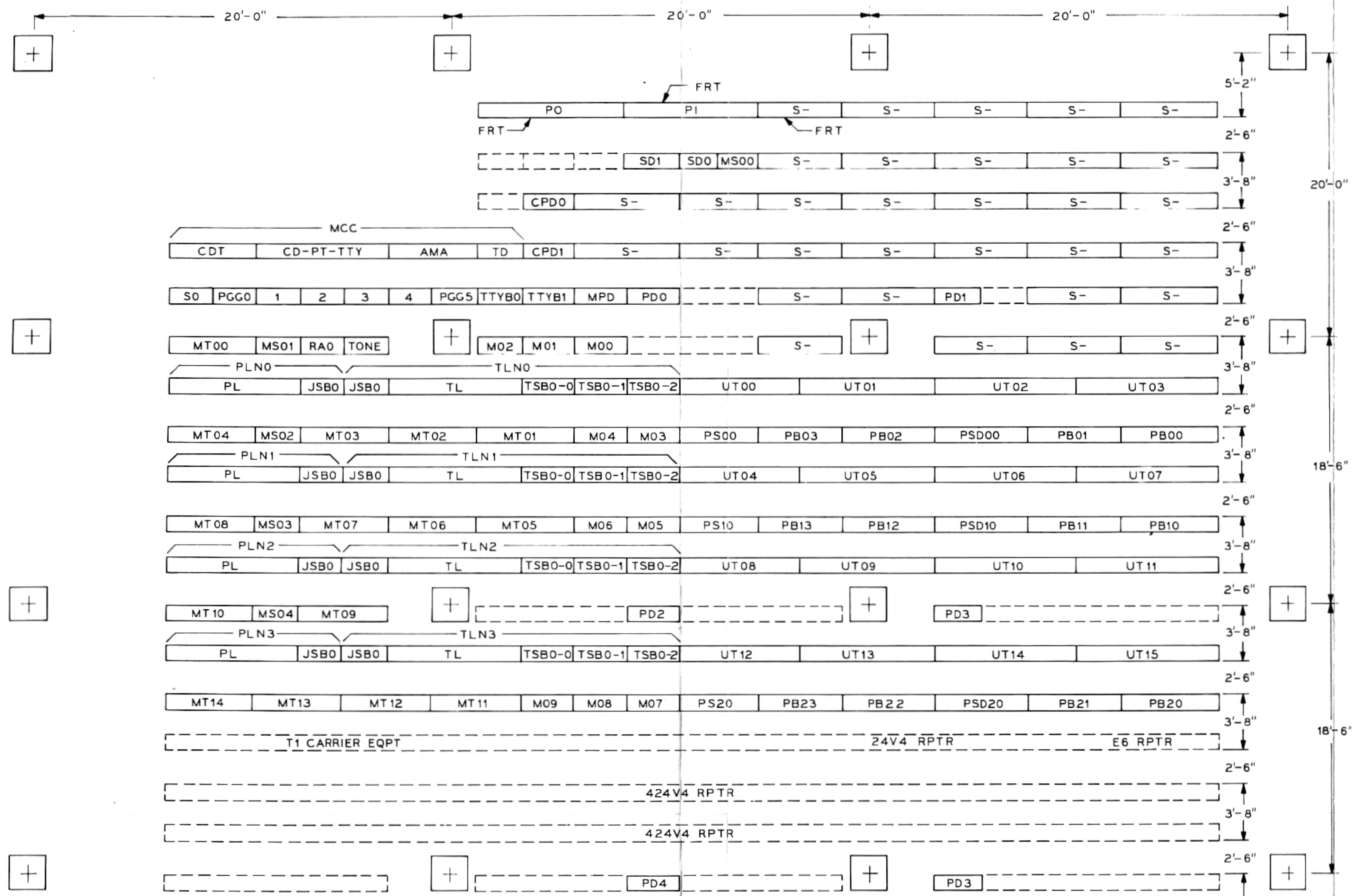
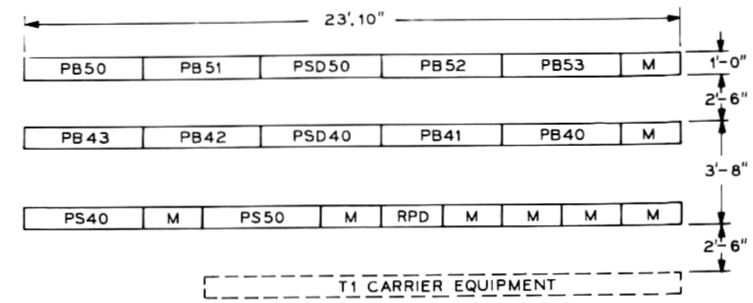


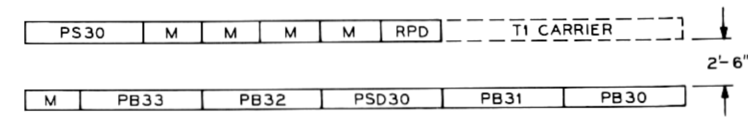
Fig. 4—TSPS No. 1 equipment schematic.



NOTE:
1. TYPICAL FLOOR PLAN FOR TSPS NO. 1 EQUIPMENT AT REMOTE LOCATION FOR TWO CHIEF OPERATOR UNITS (124 POS MAX).



2. TYPICAL FLOOR PLAN FOR TSPS NO. 1 EQUIPMENT AT REMOTE LOCATION FOR ONE CHIEF OPERATOR UNIT (62 POS MAX).



3. IN BUILDING WITH 19'-6" COLUMN SPACING, WIRING AISLES TO BE INCREASED TO 2'-0".

Fig. 5—Typical floor plan arrangement, maximum-size office.

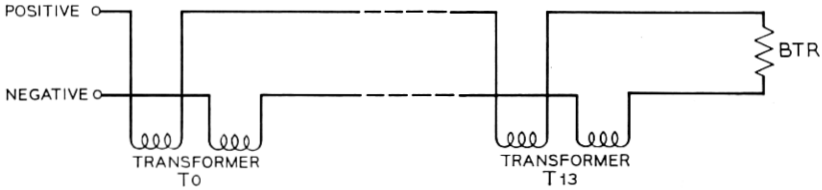


Fig. 6—Hardwired bus, setup 1.

the added frame be the last frame on the bus, BTR equipped connectors will be mounted on the cable rack and the local cable plugs of the added frame mated to these. A total of 5 connectors, 5 plugs and 512 bus leads constitute the bus connectorization at each store frame. Another 3 connectors, plugs for 273 master scanner, signal distributor and miscellaneous leads are also furnished. Where it is necessary to connect other than adjacent in-line frames, connectorized patch cables are used to provide the additional length. Metal covers are used to protect those plugs and connectors that lay in the cable racks.

The processor frame is connectorized similar to the store frames except they must accommodate twice the bus plugs, connectors and leads per frame since each processor must serve the 0 and 1 buses.

Connectorization is also provided for the trunk link, position link, universal trunk and position buffer frames.

2.1.3 *Tests*

Tests were conducted to determine the effect of connectors on the pulses sent over a simulated system bus. The following hardwired and connectorized bus setups were prepared.

2.1.3.1 *Hardwired Bus.* In setup 1, Fig. 6, two twisted wire pairs are each connected serially through 14 transformers (cable receivers) to simulate a store address bus and are terminated with a bus terminating resistor (BTR).

In setup 2, Fig. 7, one twisted wire pair running to 24 terminal

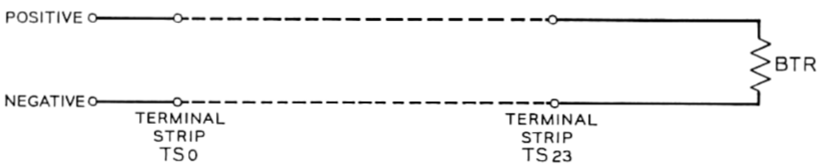


Fig. 7—Hardwired bus, setup 2.

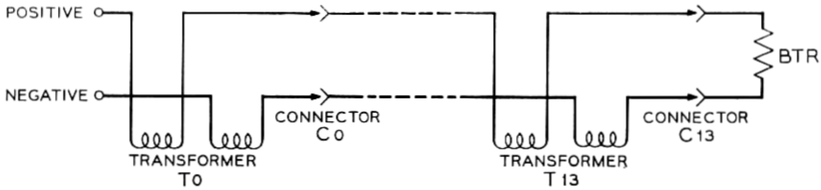


Fig. 8—Connectorized bus, setup 3.

strips to simulate a store answer bus was wired and terminated with a BTR.

2.1.3.2 *Connectorized Bus.* In setup 3, Fig. 8, two twisted wire pairs, each connected serially through 14 transformers and through 14 connectors and plugs, were wired and terminated with a BTR.

In setup 4, Fig. 9, one twisted wire pair, running to 24 terminal strips through 24 connectors and plugs, was wired and terminated with a BTR.

Setups 1 and 2 had bus lengths of 84 and 100 feet, respectively, while setups 3 and 4 were 144 and 186 feet, respectively.

A 1/2 microsecond pulse was generated and measurements were made at selected points along each bus as well as at each terminating resistor. It was found that each of the hardwired and connectorized buses had virtually identical pulses. Comparison of the pulses showed no appreciable attentuation or distortion of the pulse and no added noise on the bus. The only significant difference was the time delay between pulses of the hardwired bus and the connectorized bus. This is the result of the increased bus length due to connectorization. The maximum bus length of 100 feet per leg will accommodate 10 store frames on each of the right and left legs of a bus or, considering full duplication of buses and stores, a total of 40 connectorized store frames. This is considered a satisfactory limitation.

2.2 *Framework*

A new 3 bay frame 6 feet 6 inches long was introduced to accom-

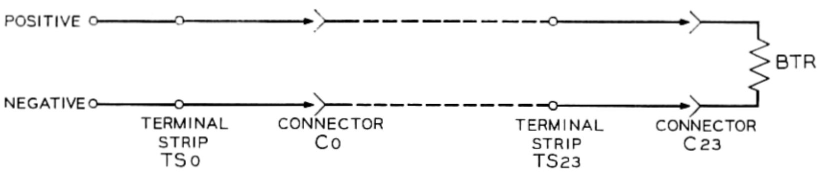


Fig. 9—Connectorized bus, setup 4.

modate large circuits. The new frameworks are used for the processor, universal trunk, trunk link, position link, and control display-program tape-teletypewriter frames. These comprise approximately 22 percent of the total frames in the basic TSPS office. The use of the new framework reduced field testing, cabling and wiring.

2.2.1 *Tests*

Initial stress calculations showed that the 3-bay frame was theoretically sound for the proposed applications. Mechanical tests simulating loading, shop handling, and field installation were also conducted and stress measurements at critical frame areas supported previous theoretical conclusions.

2.2.2 *Cable Rack Covers*

New cable rack covers were designed to reduce the number of parts and simplify installation. They are shown in Fig. 10. The covers are visually attractive and offer coverage of all connectors and plugs mounted on the cable racks. The covers (new or old) do not affect the electrical characteristics of the cable rack arrangement, as verified by considerable testing, and are furnished primarily for appearance.

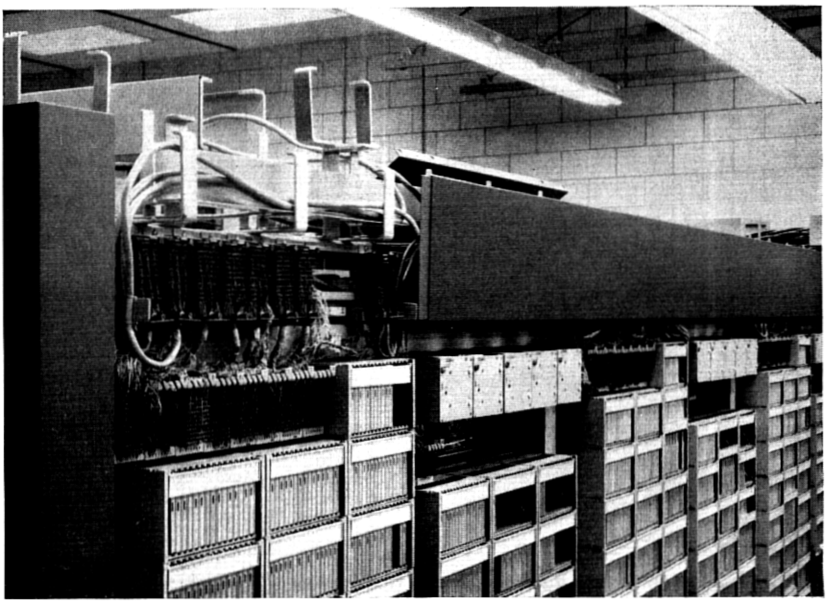


Fig. 10—New cable rack covers.

III. NEW EQUIPMENT DESIGNS

3.1 *Processor Frame*

The processor frames shown in Fig. 11 provide control for the system and execute program instructions from the stores. Each instruction requires from 1 to 10 processor cycles of 6.3 microseconds in length. To perform its duties the processor requires approximately 1780 circuit packs, mostly of the low level logic (LLL) type, and about 40,000 interconnecting leads.

In normal operation, the duplicated processors (P0 and P1) work in parallel, although only one is active and controlling the peripheral equipment. In order to insure that the processors are doing exactly the same job, a dc matching facility is used. This facility is capable of providing three matches per 6.3 microsecond cycle. It is necessary to keep wire length between matching circuits as short as possible to minimize propagation delays. Since the matching circuitry is located in the rightmost location on the frame, the two frames are placed adjacent to each other and in a front-to-back manner. This places the

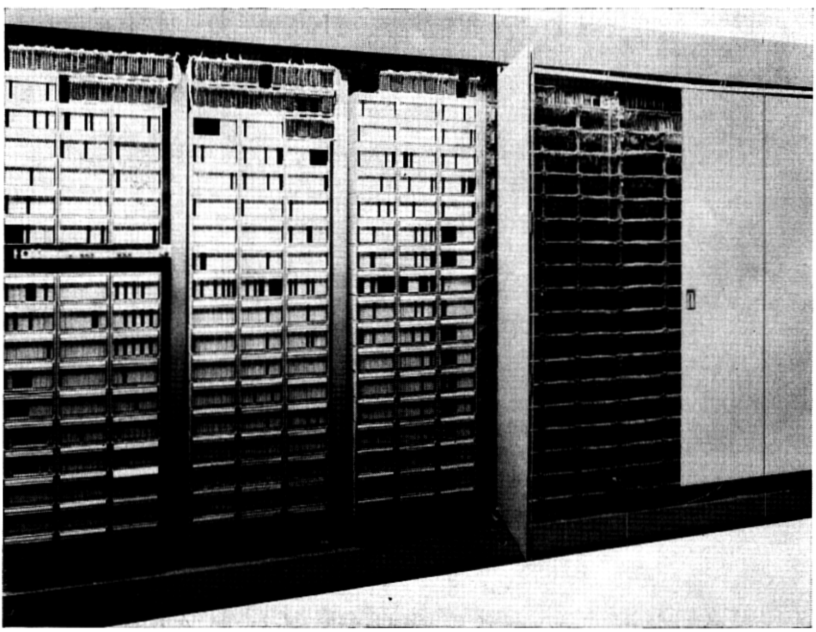


Fig. 11—Processor frames.

matching circuitry of one processor immediately adjacent to the matching circuitry of the mate processor thus avoiding the need for a duplicate mirror image processor. The use of through type terminal strips along the rightmost frame upright permits direct interframe wiring. Metal folding doors are provided to enclose the wiring side of each processor frame.

The high speed at which electronic circuits operate and their sensitivity to noise pickup along parallel lead runs required that the equipment design for these circuits be completed with careful attention to the problems and solutions involved. The design of the SPC 1A processor frame, encompassing three bays, required extreme care. The optimum location of circuit packages, correct assignment of logic gates, examination of critical leads and, in some cases, recommendations for circuit changes to reduce lead length or avoid inductive problems were considered.

3.2 *Networks*

The TSPS trunk link and position link network frames make possible the full access of any trunk to any one operator position or service circuit. This full accessibility inherently provides relatively high traffic handling capacity since all operators can be utilized as one large team. It also alleviates the need for facilities for the distribution of junctors such as a junctor grouping frame.

In the trunk and position link networks, 2 wire metallic connections are switched through four stages of ferreed switches. As many as four networks may be provided for maximum capacity. Figure 12 shows the frames, their floor plan relationship and the wiring arrangements for gaining full access of any trunk to any one operator position or service circuit.

3.2.1 *Trunk Link and Trunk Switch Buildout Frame*

The three bay trunk link frame contains the ferreed switches and trunk path selection unit, ferreed junctor switches, junctor selection path unit and other control units for 256 trunks and 512 each of "A" and "B" links. Up to three additional trunk switch buildout frames may supplement this frame depending on traffic calling rates.

3.2.2 *Junctor Switch Buildout Frame*

A one bay junctor switch buildout frame is used to extend the 512 "B" links to other trunk link networks. A similar frame is used to

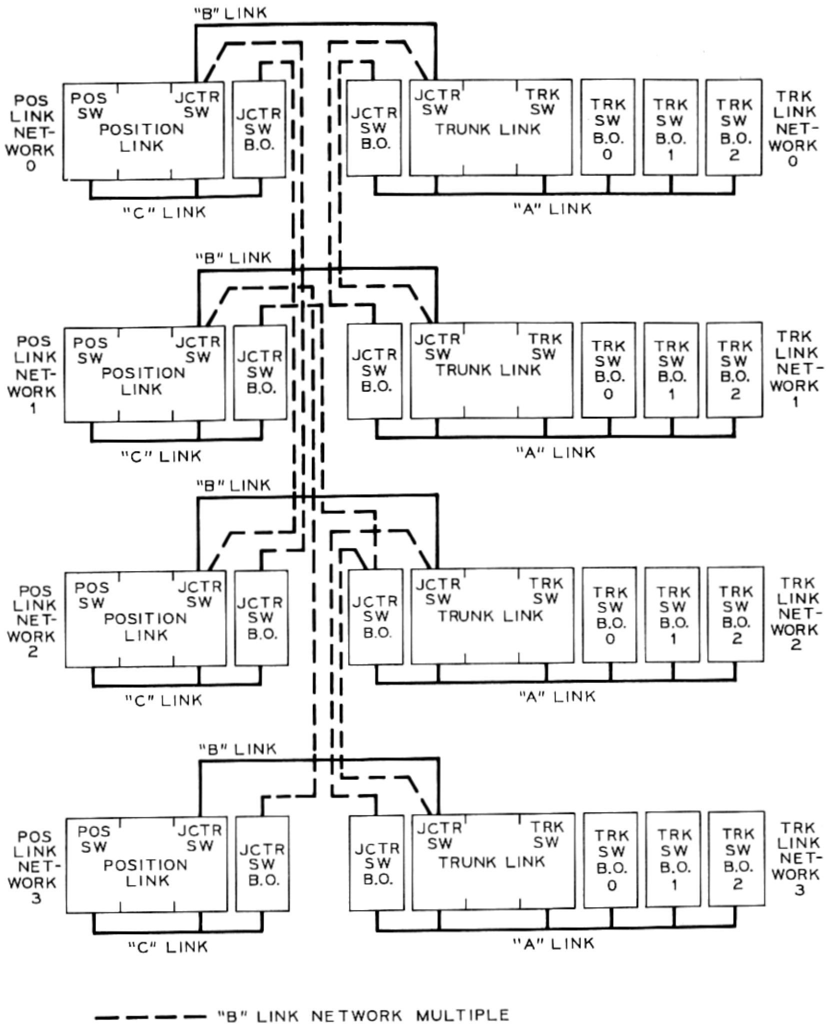


Fig. 12—Trunk and position link frames, floor-plan relationship, and wiring arrangements.

provide a full access pattern for the "B" links associated with the various position link networks.

3.2.3 *Position Link Frame*

A position link frame contains the position switch and operator cut-through units, position switch path selection units, junctor switch, junctor switch path selection units and other control units. This frame accommodates as many as 96 operator position via operator cut-through circuits and accommodates 64 service circuits such as multi-frequency and dial pulse receivers, multifrequency outpulsers and coin control trunks.

3.3 *Trunk Equipment*

3.3.1 *Universal Trunk Frame*

Universal trunk circuits in TSPS No. 1 are unusually simple and standardized. Their functions have been limited almost entirely to transmission and supervision. These circuits are arranged as small compact pluggable units as shown in Fig. 13. The universal trunk frame is shown in Fig. 14. The left and right bays are each arranged to mount 64 individual trunk units for a frame total of 128 units or 256 trunks. The two bays of trunks flank a control bay which contains

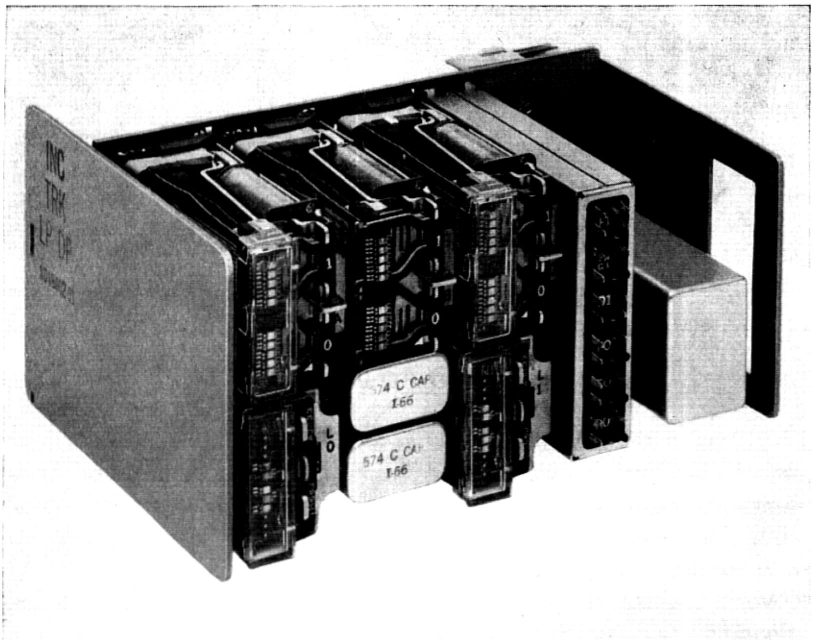


Fig. 13—Pluggable universal trunk circuit.

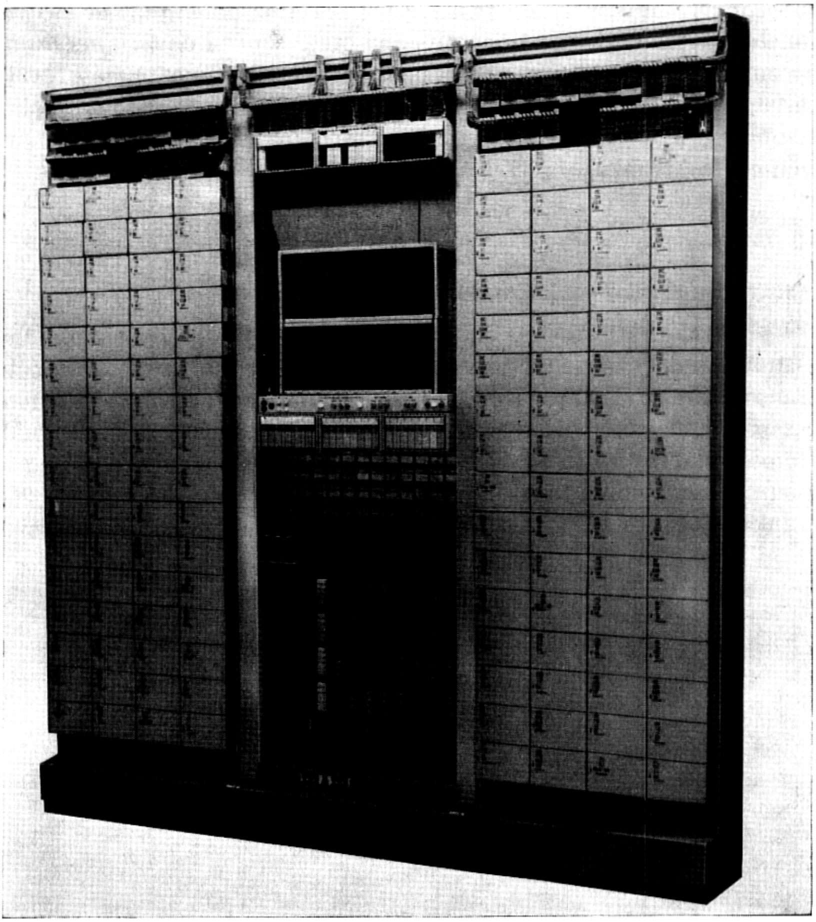


Fig. 14—Universal trunk frame.

the 512 point scanner matrix, signal distributor, and signal distributor controls for both trunk bays. A minimum of four universal trunk frames are required in each office to provide sufficient signal distributor points for service circuits. The minimum of four trunk frames also provides sufficient spread of the individual trunk groups over the network frames to insure maximum service assurance and load balancing.

All universal trunk frames are furnished with connector ended cables which mate with like designated plugs furnished as part of the trunk link network frames. A predetermined cabling pattern between universal trunk frames and network frames eliminates the need for a trunk distributing frame. This fixed and predetermined pattern greatly simplifies the stored program data table as the trunk equipment location and its network appearance have a fixed relationship for all trunks in all offices. In this manner, bulky data tables dependent upon job conditions are not necessary. Trunk maintenance busy indicators are furnished with the universal trunk frames to aid the maintenance personnel in removing the pluggable trunk units from the frame.

3.3.2 *Miscellaneous Trunk Frames*

Trunks providing audible signals, digit reception, ringing, coin control, etc. are provided by small specialized groups of service circuits which the SPC No. 1A processor connects under program control to the trunks via the network only at times when their functions are needed. These service circuits (including outpulsers, receivers, reorder tone and announcement trunks, coin control and ringback trunks, etc.) are designed on conventional mounting plates and are mounted on miscellaneous trunk frames.

3.4 *Position Frames and Operator Console*

3.4.1 *Position Subsystem Description*

Position frames are those frames used in the flow of information from the SPC No. 1A processor to the 100B console operator and in the collection of information from the console.

There are three different modes of communicating with 100B consoles in TSPS. Their designation is indicative of the location of the position frames and the chief operator unit in relationship to the base unit. The modes of operation are:

3.4.1.1 *Local.* Position frames and chief operator unit located in the same building as the base unit.

3.4.1.2 *Semiremote.* Position frames and chief operator unit located in a distant building up to 4 cable miles (1200-ohm loop) from the base unit. Cable pairs are provided for transmission and for data exchange.

3.4.1.3 *Remote.* Position frames and chief operator unit may be located in a different office up to 50 cable miles from the base unit. Remote operation employs the use of a T1 carrier system to carry voice and data transmission between offices.

3.4.2 *Position Group Gate Frame*

The position group gate frame contains the equipment for one group gate and the teletypewriter buffer for the traffic teletypewriter and for the remote position maintenance teletypewriter. One frame is required in the base unit for each operator unit. When positions are remote, a maximum cable length of 150 feet is allowed between the D1C bank bay of the T1 carrier system and the position group gate frame.

The position group gate is the one unit in the position subsystem which connects to the peripheral address bus, central pulse distributor and master scanner. Thus it is the one unit communicating intimately with the SPC No. 1A and all subsystem orders must first pass through it. In the local case it acts primarily as a translator and time buffer to accept high-speed binary information from the address bus and deliver expanded information (in the form of 1 out of 8 codes) at slower speed to the next subsystem unit, the position signal distributor. In the remote case a T1 carrier system and a special checking circuit (Data Assembly and Check Circuit) are interposed between the group gate and the signal distributor. In this case the group gate does not modify the binary data received from the bus but still acts as a time buffer and additionally provides certain control signals needed by the T1 carrier.

The teletypewriter buffer, which is mounted on the position group gate frame receives high-speed data from the processor and transmits time buffered signals to control the teletypewriters associated with the chief operator units. Traffic TTY machines are furnished for all chief operator units regardless of location while the remote position maintenance TTY machine is optionally furnished only at remote or semiremote chief operator units.

3.4.3 *Position Signal Distributor Frame*

A position signal distributor frame is arranged to mount the equipment for the positional signal distributor circuit. One frame per chief operator unit is provided.

The position signal distributor receives data from the position group gate at the local, or semiremote installation. Information from the data assembly and checking circuit is received at a remote installation. The data is used to select a particular set of cut-through relays on the position buffer frames and also select a particular output path through these cut-through relays. The outputs, in turn, operate or release the relays of the position buffer or the position signal distributor applique. The outputs of other cut-through relays control the digital displays at the operator positions.

3.4.4 *Position Buffer Frame*

The position buffer frame is arranged for 16 operator positions. A minimum of two and a maximum of four frames may be equipped in each chief operator unit. The first buffer frame accommodates the equipment for the first 14 position buffer circuits, the position signal distributor applique circuit, and other equipment common to the chief operator unit. Other buffer frames contain 16 position buffer circuits. The position buffer frames are located adjacent to their associated signal distributor frame.

Associated with each position are miniature wire-spring relays mounted on pluggable printed circuit wiring boards as shown in Fig. 15. These boards, mounted on the position buffer frame, provide the means to light lamps on a particular operator position or control other circuits associated with the position. The relays are either magnetic latching or nonmagnetic latching.

Ten of the A-type circuit packs containing a total of 68 relays are furnished for each position. For a large office of 280 positions, 2800 circuit packs containing a total of more than 19,000 relays are provided. This application is the first large-scale use of miniature wire spring relays.

3.4.5 *Position Scan Frame*

The position scan frame is arranged to mount the following circuits: (*i*) position scanner and gate, (*ii*) alarm sender, (*iii*) data assembly and checking (for remote operator units).

The main function of the position scanner and gate circuit is to transmit signals to the master scanner and in turn to the SPC whenever a key at any operator position is depressed. The transmitted signal identifies both the key depressed and the position at which the key is located. The equipment for this circuit occupies about 35 percent of the 2-bay framework.

The alarm sender circuit provides a means by which alarm and maintenance indications from circuits which comprise a chief operator

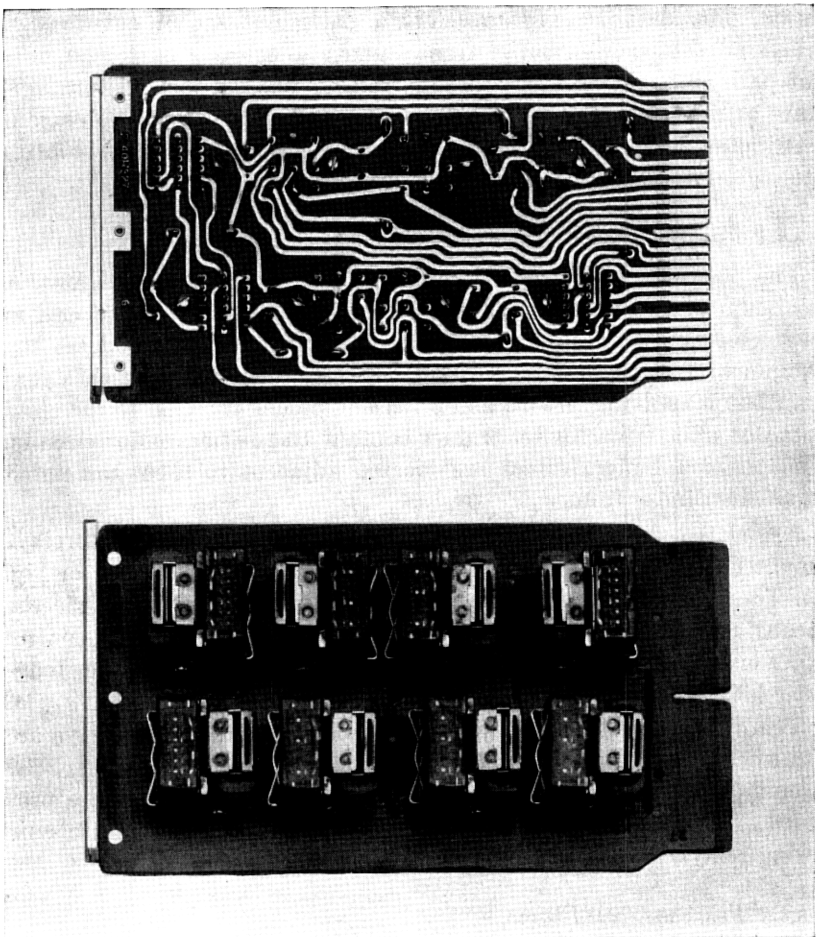


Fig. 15—Miniature wire-spring relays mounted on pluggable printed circuit wiring boards.

unit can be transmitted to the stored program control. It also provides input circuitry connected to a 10-position, 5-module thumbwheel switch for the maintenance person to send maintenance diagnostic requests to the SPC. The equipment for this circuit occupies about 30 percent of the 2-bay framework.

The purpose of the data assembly and check circuit, and T1 carrier facilities is to provide a data path from the group gate to the remote position signal distributor frame. The data assembly and check circuit receives the information from the T1 carrier, checks for a valid transmission, and translates the word to 1 out of 8 codes before passing it on to the position signal distributor.

3.4.6 *100B TSP Console*

The 100B operator console, as shown in Fig. 16, was modeled after the 100A Traffic Service Position used in Crossbar Tandem. The section (2 positions) framework is designed specifically as a support for the keyshelves, cable rack, and equipment mountings required at each position. The basic section is an all-welded steel frame finished with textured vinyl. A completely welded assembly is composed of a rear panel, two-end frames, a lockrail assembly and a cable rack. The major items fastened to the welded frame are a keyshelf assembly, end covers, floor supports and foot rests. The keyshelf assembly is the most important and intricate portion of the overall framework as-

Fig. 16—The 100B operator console.

sembly and consists of a die casting with an aluminum mask that is also finished with textured vinyl. A total of 116 round universal mounting holes for keys or lamp sockets are cast into the shelf as well as other rectangular holes for mounting ticket boxes and a digital display housing. The keyshelf mask conforms precisely to the top surface of the die casting. Square holes are located at only positions equipped with keys or lamp sockets.

A numerical display unit assembly is used for various number displays, i.e., "calling number, called number, coin calls time and charges, time-of-day and special billing number." The assembly consists of a printed wiring board, a plastic shield and a plastic housing. Figures 17 and 18 show the board and the shield mounted on the rear of the board.

3.5 *Master Control Center*

3.5.1 *Maintenance Center* (see Fig. 19)

Inasmuch as the TSPS system uses the SPC No. 1A as a component part of the system, provisions have been made to supplement the SPC-1A CD-PT-TTY frame with three frames of the TSPS design to provide a unified master control center. At this single location these frames allow for the monitoring of system status, for communicating with the system and for the performance of routine test functions.

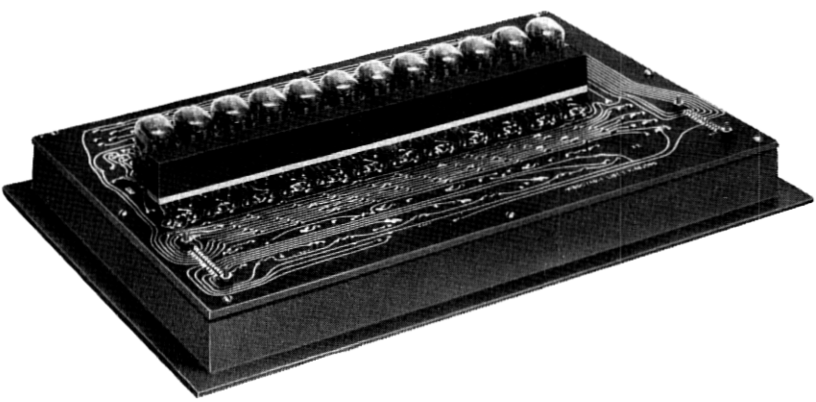


Fig. 17—Printed wiring board of the numerical display unit assembly.

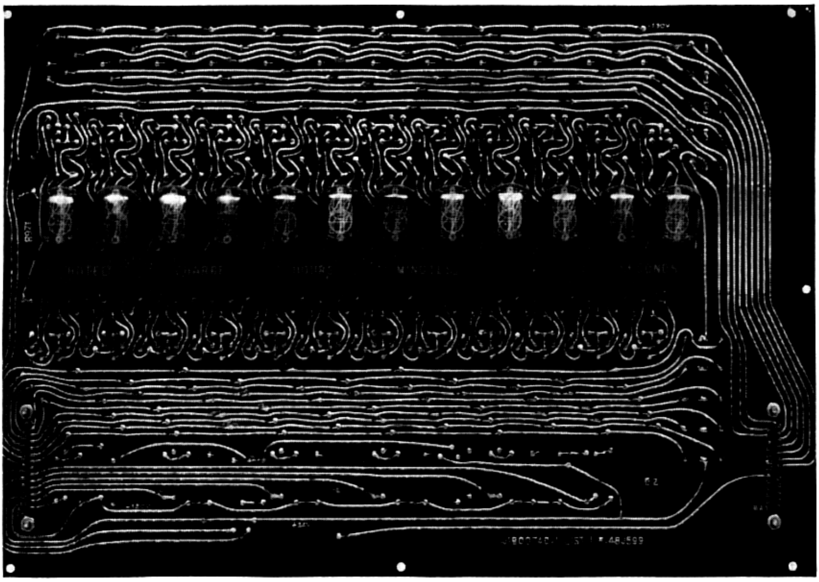


Fig. 18—Shield mounted on the rear of the numerical display unit assembly.

3.5.2 *Control Display-Program Tape-Teletypewriter Frame*

The control display-program tape-teletypewriter frame accommodates the equipment for the program tape unit used in loading the programs, the maintenance teletypewriter used for communicating and manually influencing the program, and a display panel showing the status of equipment units. Keys for emergency actions form a part of the control-display panel.

3.5.3 *Control, Display, and Test Frame*

The major functions of the control, display, and test frame are to test trunks and positions and to display system status. Trouble conditions are displayed for the peripheral frames which are common to the office and for those which are specific to a chief operator unit. Transmission noise and voltmeter tests are made on individual trunks and traffic service positions that are in trouble. Other frame component units are mounted below the writing shelf on the right hand bay. A removable cover is located in front of these units to protect them from damage. A telephone set unit mounted below the writing shelf on the left-hand bay provides equipment for connecting a telephone set which

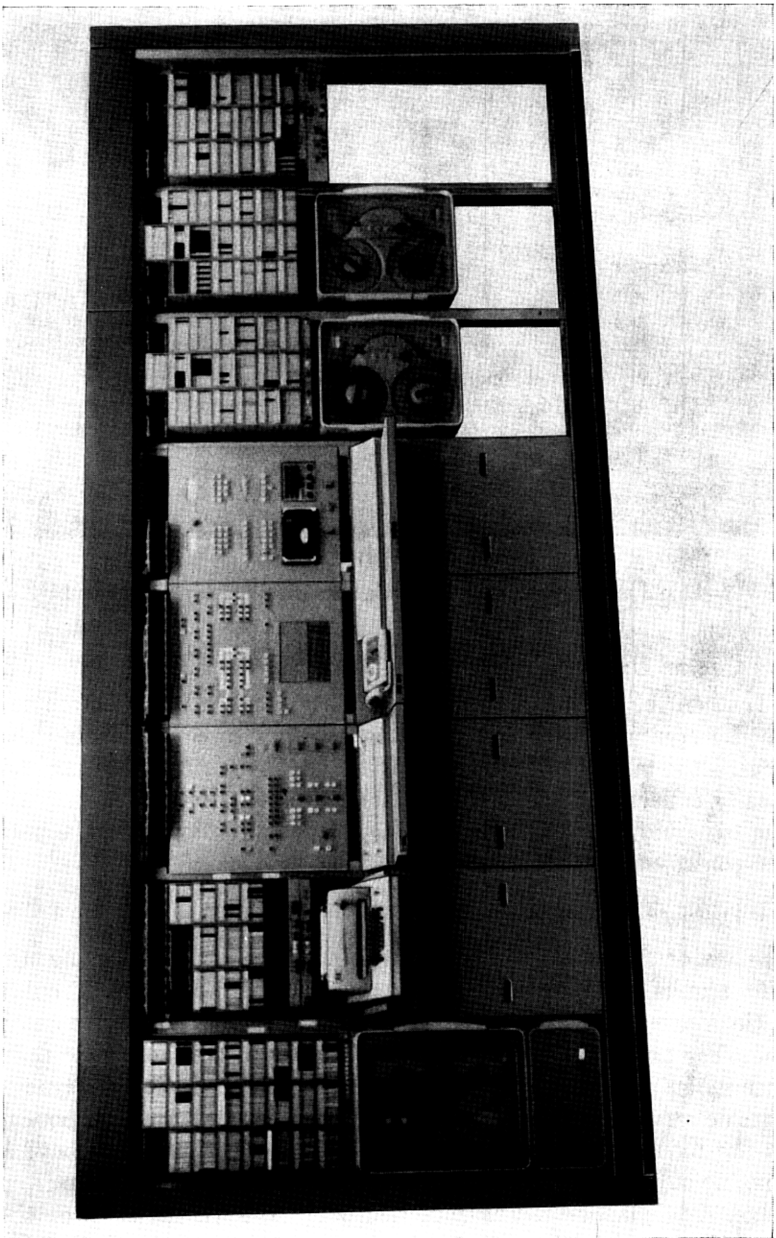


Fig. 19—Maintenance center.

is located on the writing shelf. The control display and test frame is arranged to connect this telephone set to a 1A2 key telephone system.

3.5.4 *Automatic Message Accounting Frame*

The automatic message accounting frame is a component frame of the master control center. This frame includes the 9-track AMA circuit and 2-tape transports, one in each bay.

The tape transport reel can accept up to 2400 feet of 1/2 inch magnetic computer tape and continuous billing information for one day for all but the most heavily loaded offices. The transport has 9-track write and read heads and a write-read tachometer head for measuring tape speed. An erase head removes all previously recorded data to ensure a clean record. A photocell detects the end of a tape reel and three microswitches monitor tape tension.

3.5.5 *Time-of-Day Frame*

The time-of-day frame derives tenths of seconds, seconds and minutes from the 60-cycle 120-volt ac line. This information is transmitted in binary form via the communication answer bus to provide time-of-day information for the AMA recorders, for displays in the 100B traffic service positions and to the SPC processor.

The time-of-day frame contains redundant clock circuits and a control panel. The latter contains a clock control and readout unit consisting of switches, keys, lamps and a visual readout that indicates the time-of-day when activated by a readout switch.

3.6 *Test and Evaluation Equipments*

3.6.1 *General*

To facilitate the introduction of TSPS as a new system, a new family of SPC No. 1A and TSPS program debugging and trouble-shooting test sets were devised. Through the extensive use of integrated circuits it was possible to make the test sets portable.

3.6.2 *Transfer Trace Test Set*

A transfer trace test set as shown in Fig. 20 makes possible recording up to 600 program transfers prior to a significant event. This set can be arranged to follow individual instructions as they are executed by the processor for detailed analysis of program flow. It can also be used to count the frequency of particular effects as they occur in the system.

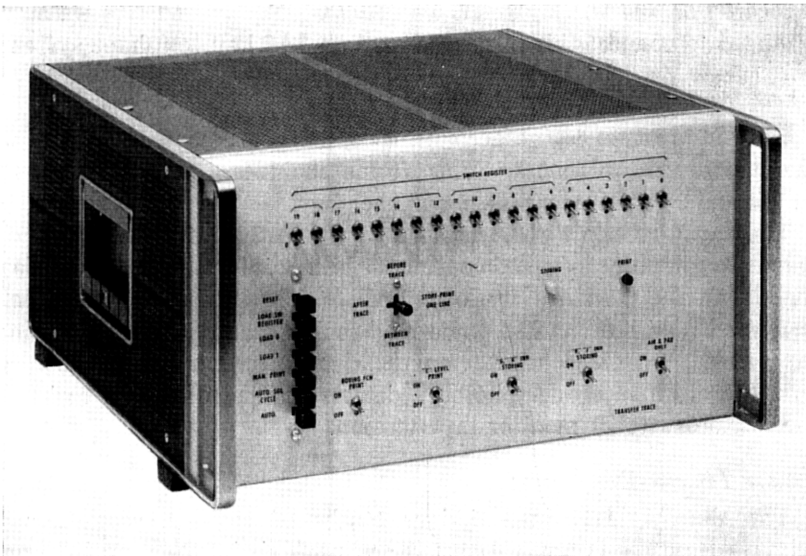


Fig. 20—Transfer trace test set.

3.6.3 *Portable Matcher and an Auxiliary Logic Box*

A portable matcher provides a wide range of matching functions for use in triggering the dump store freeze[3] and/or the transfer trace printout.

The auxiliary logic box supplements the portable matcher logic functions when necessary.

IV. POWER PLANT, DISTRIBUTION AND GROUNDING

4.1 *Power Plant and Distribution*

The −48 volt and +24 volt power from dedicated plants is delivered to two or more power distributing frames (PDF) in the switchroom. There, each battery supply is filtered and the battery and ground pairs are branched through banks of fuses that feed the various frames. At each switch frame served, the battery lead from the PDF is connected to the frame fuse panels through a filter unit.

In remote or semiremote offices similar −48 and +24 volt plants are usually provided although the −48 volt power may be supplied from an existing power plant in a remote building. A remote power distributing frame (RPDF) is provided and has a 135 ampere peak capacity for each voltage and serves a maximum of two chief operator units.

A +130 and −130 volt dc supply converted from a −48 volt power supply is used for coin control, NIXIE® lamp displays, etc. Power from this source is delivered to fuse panels on a miscellaneous power distributing frame (MPDF) or an RPDF and distributed from there to all frames which require this power.

4.2 *Grounding*

Special frame insulating practices are followed in TSPS to avoid electrical interference from stray ground potentials. Switch frames are bonded to the building grounding system at a single point. All frames and cable racks are insulated from the building at other points. The frames are connected together by ground feeders between the frames and the PDFs. In addition, a number 6 copper wire is run in the cable rack to provide a bonding network to all frames. A ground lead is run between the TSPS ground system and the central grounding point for central office building ground.

V. ENVIRONMENT

The TSPS System is designed to operate in the standard central office environment for electronic equipment. This dictates that the normal ambient operating temperature of the office should remain between 40° and 100°F.

Determination that a complete system would operate under emergency conditions was accomplished by subjecting a complete office to a heat test. The main objective of the heat test was to make certain that the TSPS and associated equipment would operate in an ambient temperature of 115°F without major failures.

In cooperation with New Jersey Bell Telephone Company, the first complete TSPS office was operated in ambient temperatures of 100°F and then raised to 115°F. This office is located on the first floor of a multistory building in Morristown, N. J. Two sides of the office were enclosed by outside walls and the other two sides separated, by floor to ceiling asbestos walls, from a crossbar tandem machine. This office had two air duct systems available for use in the heat tests. The one system had access to outdoor air so a heat source was placed at this location and heat was supplied by this duct system. The other duct system with its air-conditioning equipment was used to modulate the temperature of the TSPS equipment. The air distribution within the room was redistributed to reduce the temperature gradient across the office. In this manner of controlling temperature the associated equipment frames were also tested at the higher temperature.

Activation of the TSPS office was accomplished by using load boxes, and records were kept of system performance. Equipment component and room air temperature were automatically measured with 40 thermocouples attached to recorders. Thirty-six (36) thermometers were also used to visually measure other temperatures. Figure 21 depicts the schedule and resultant temperature readings.

Component temperatures indicated that one type of capacitor was operating near its critical temperature. Several hardware problems not previously found by other means of analysis were quickly brought to light by heat testing the complete office. Germanium transistors in circuit packs in the position scan frame were found to fail at about 105°F. These packs were subsequently redesigned with silicon transistors. However, upon reducing the temperature these cards returned to normal operation. Component temperatures ranged from 130°F to as high as 257°F under maximum temperature operations with very few failures during the test.

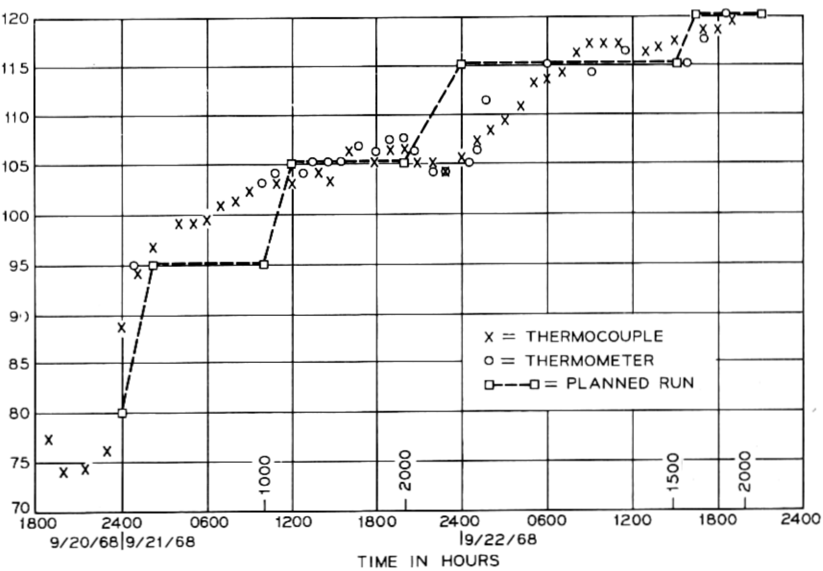


Fig. 21—Schedule and reading for temperature tests.

VI. SUMMARY

The Traffic Service Position System No. 1 physical design has made a sizeable contribution toward the achievement of high performance and low maintenance. TSPS equipment and operating costs are reasonable and therefore will reach a wide market. Many additional, attractive features and improvements, deferred for schedule reasons, are to be added as quickly as possible to further enhance this system.

TSPS No. 1, to an extent, was based on No. 1 ESS designs and this resulted in economies in development time and effort as well as achieving a high degree of standardization in manufactured product. Innovations in the form of new frameworks and connectorization offer ease of installation and facilitate growth in a working environment. These physical designs and new color applications result in harmonious environment which reflects system design intent.

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