

## 10A DATA LINE CONCENTRATOR (DATREX\*)

### DESCRIPTION

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LINE AND SWITCH MODULE . . . . .	3	● Provides uniform computer port usage
TRUNK MODULE . . . . .	3	● Provides the ability to tandem concentrate trunks, thereby increasing the overall efficiency of the concentrator system in certain situations
CONTROL MODULE . . . . .	3	● Transmits a repetitive signal to stations that request service when all trunks are busy and places these stations in a queue. A station in queue is connected automatically when a trunk becomes available.
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SWITCHING MATRIX . . . . .	10	1.03 The 10A Data Line Concentrator is a space division switching system and uses a ferreed matrix for interconnecting lines and trunks. A metallic path is provided between the station terminal lines and the port trunks. The switching system is totally insensitive to data signal format, code, and bit rate. The station need only go off-hook, by depressing a key, to request service from the concentrator.
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4. REFERENCES . . . . .	19	(b) The computer turns off the data terminal ready lead (CD) to the trunk-side data set
		(c) A loss of carrier is detected on the loop.
1. GENERAL		1.06 A station requesting service when all trunks are busy receives a repetitive signal (camp-on)
1.01 The 10A Data Line Concentrator (Fig. 1) allows users of time-shared multiaccess data processing systems to share private line transmission facilities and computer ports.		
*Service Mark of the Bell System.		
1.02 The main features provided by the data line concentrator are as follows.		
● Uses low cost data transmission schemes		

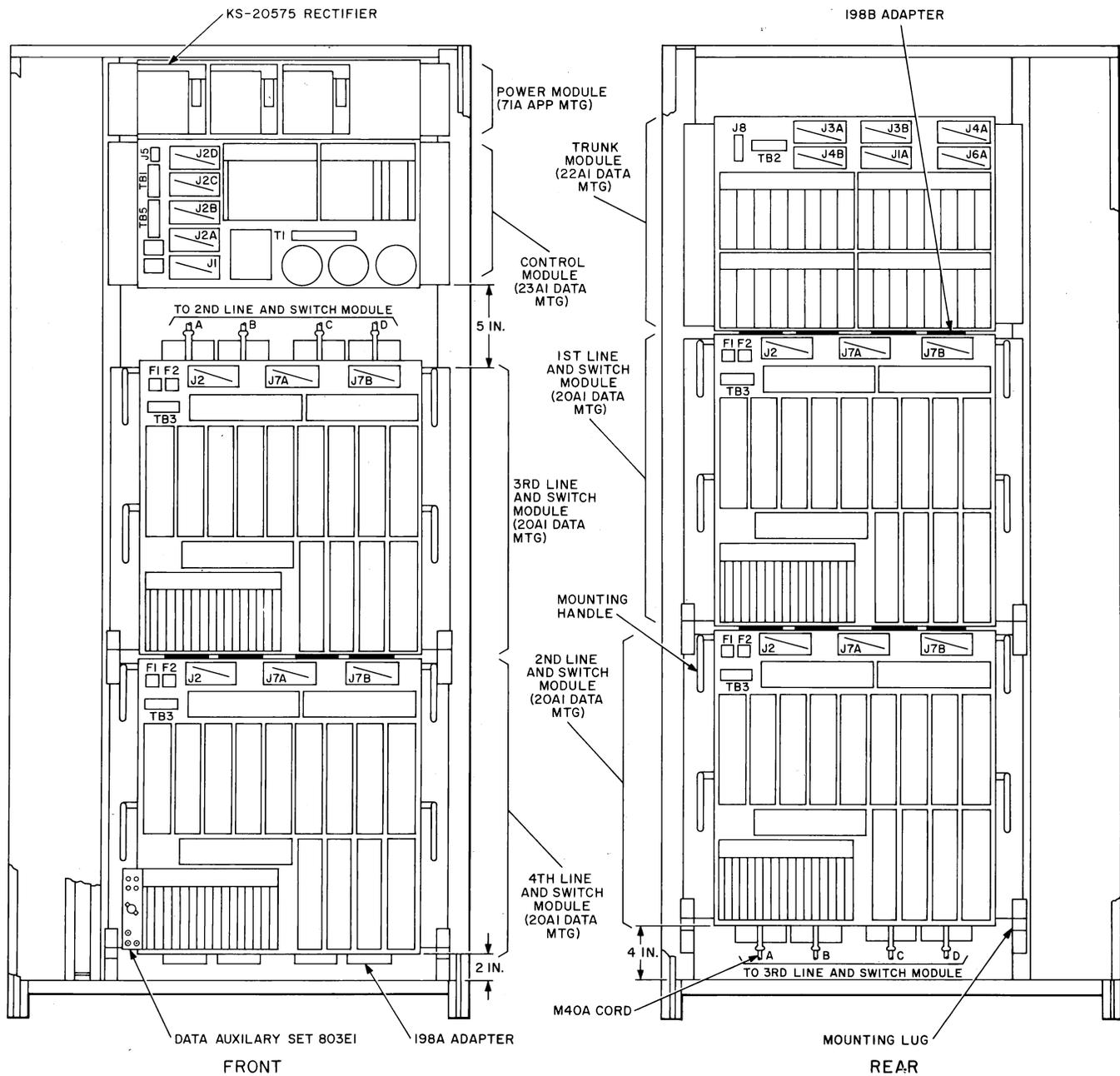


Fig. 1—10A Data Line Concentrator (128 Lines/32 Trunks)

to acknowledge its request for service. Camped-on stations are automatically connected as trunks become idle. Selection of camped-on stations is in equipment order so that no station in queue will be denied service while another is served twice.

monitored point is provided with an individual alarm indication in the concentrator. These alarms are collectively connected to a master alarm relay which makes two sets of transfer contacts available for remote alarm indications.

**1.07** Major concentrator operating points are monitored for alarm conditions. Each

**1.08** The 10A Data Line Concentrator is designed in a building block form to be assembled

modularly into a unit of specific maximum capacity ranging from the smallest of 32 lines and 8 trunks to the largest of 128 lines and 32 trunks. This allows a wide range of concentration ratios to fit any particular requirement.

**1.09** In the following text, the 10A Data Line Concentrator will be referred to as the concentrator. The word "module" refers to a functional unit such as a data mounting equipped with circuit packs.

## 2. PHYSICAL DESCRIPTION

**2.01** The 10A Data Line Concentrator is composed of several modules which mount on 23- or 25-inch relay racks such as in central office (CO) or in a cabinet such as the KS-20093-L1.

**2.02** The apparatus comprising a complete 10A Data Line Concentrator is as follows:

- Line and switch module
- Trunk module
- Control module
- Power supply module
- Manual test equipment.

### LINE AND SWITCH MODULE

**2.03** The line and switch module is a data mounting equipped with a ferreed switch matrix and an apparatus mounting. The apparatus mounting accepts up to 16 AR365 circuit packs (line circuits). Each circuit pack provides two line circuits. The data mounting comes in three sizes: 32 lines/8 trunks (18A1), 32 lines/16 trunks (19A1), and 32 lines/32 trunks (20A1). Up to four line and switch modules of the *same* trunk size can be connected to obtain larger line groups (up to 128 lines).

**2.04** The 18A1 Data Mounting (Fig. 2) with its associated circuit packs will accommodate up to 32 lines in an 8-trunk concentrator. The 18A1 Data Mounting measures 9 inches high, 25 inches wide, and 11 inches deep and weighs 42 pounds.

**2.05** The 19A1 Data Mounting (Fig. 3) with its associated circuit packs will accommodate up to 32 lines in a 16-trunk concentrator. The 19A1

Data Mounting measures 15 inches high, 25 inches wide, and 11 inches deep and weighs 73 pounds.

**2.06** The 20A1 Data Mounting (Fig. 4) with its associated circuit packs will accommodate up to 32 lines in a 32-trunk concentrator. The 20A1 Data Mounting measures 22 inches high, 25 inches wide, and 11 inches deep and weighs 128 pounds.

**2.07** The AR365 circuit pack used in all line and switch modules contains two complete line circuits. Therefore, only one AR365 circuit pack is required for every two lines served by the concentrator. Each line and switch module need only be equipped with enough line circuit packs to serve the required number of lines.

### TRUNK MODULE

**2.08** Two different trunk mountings are available for use in the concentrator. The number of trunks to be served by the concentrator determines which trunk mounting to use.

**2.09** A 21A1 Data Mounting (Fig. 5), equipped with circuit packs, provides a trunk module capable of serving up to 16 trunks. The 21A1 Data Mounting is used in combination with either the 18A1 or 19A1 Data Mounting. The 21A1 Data Mounting measures 8 inches high, 25 inches wide, and 10 inches deep and weighs 23 pounds.

**2.10** A 22A1 Data Mounting (Fig. 6), equipped with circuit packs, provides a trunk module capable of serving up to 32 trunks. The 22A1 Data Mounting is used in combination with the 20A1 Data Mounting. The 22A1 Data Mounting measures 16 inches high, 25 inches wide, and 10 inches deep and weighs 42 pounds.

**2.11** The AR368 circuit pack used in all trunk modules contains one complete trunk circuit. Each trunk module need only be partially equipped, according to the number of trunks to be provided, with trunk circuit packs.

### CONTROL MODULE

**2.12** The control module consists of a 23A1 Data Mounting equipped with the following circuit packs (Fig. 7).

- AR370—Clock and pulser

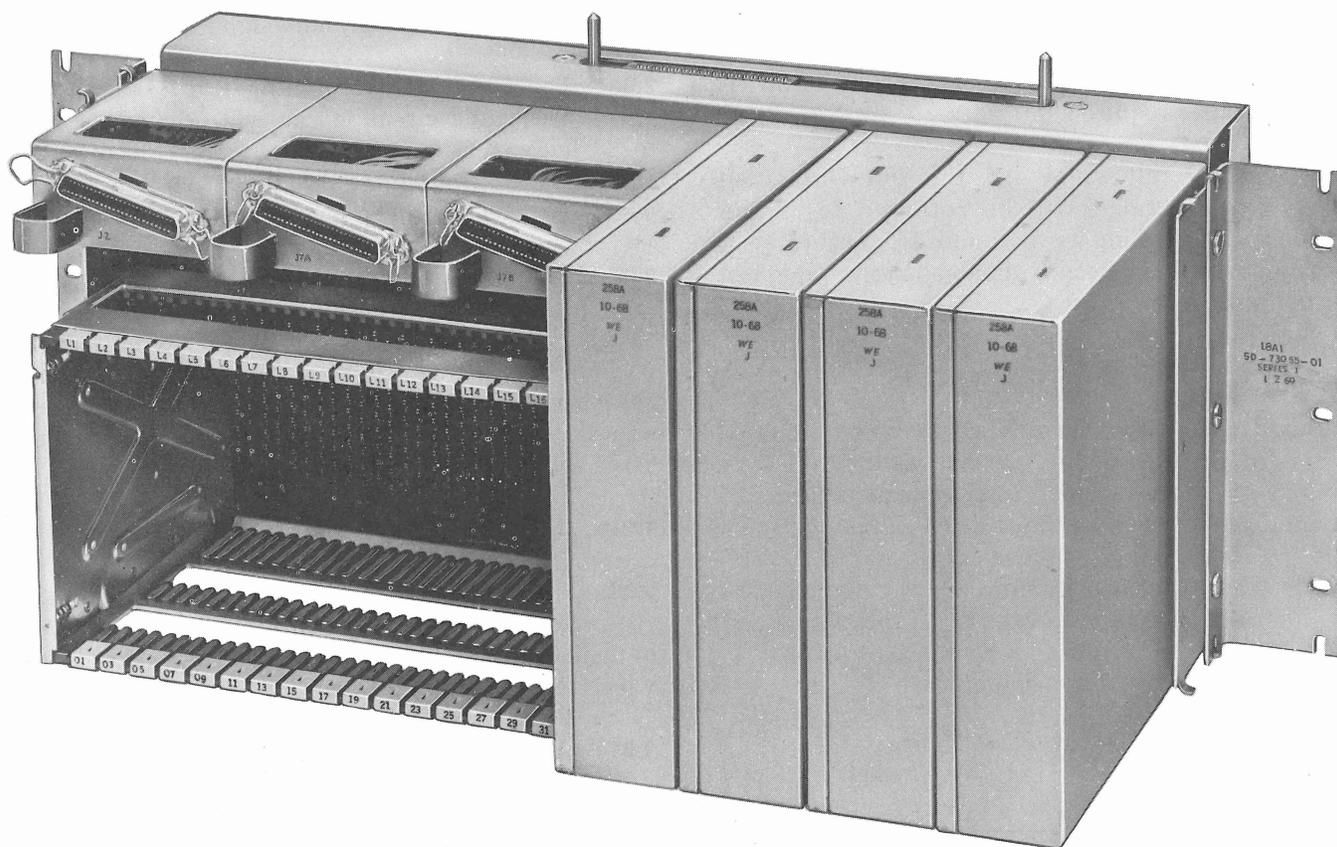


Fig. 2—18A1 Data Mounting

- AR371—Alarms and registers
- AR374—Trunk scanner
- AR374—Line scanner
- AR375—Add-on line scanner (used only when more than 32 lines have to be scanned)
- AR384—Camp-on signal generator
- AR464—Manual test (operates in conjunction with Data Auxiliary Set 803E1).

**2.13** The 23A1 Data Mounting measures 11 inches high, 25 inches wide, and 11 inches deep and weighs 36 pounds.

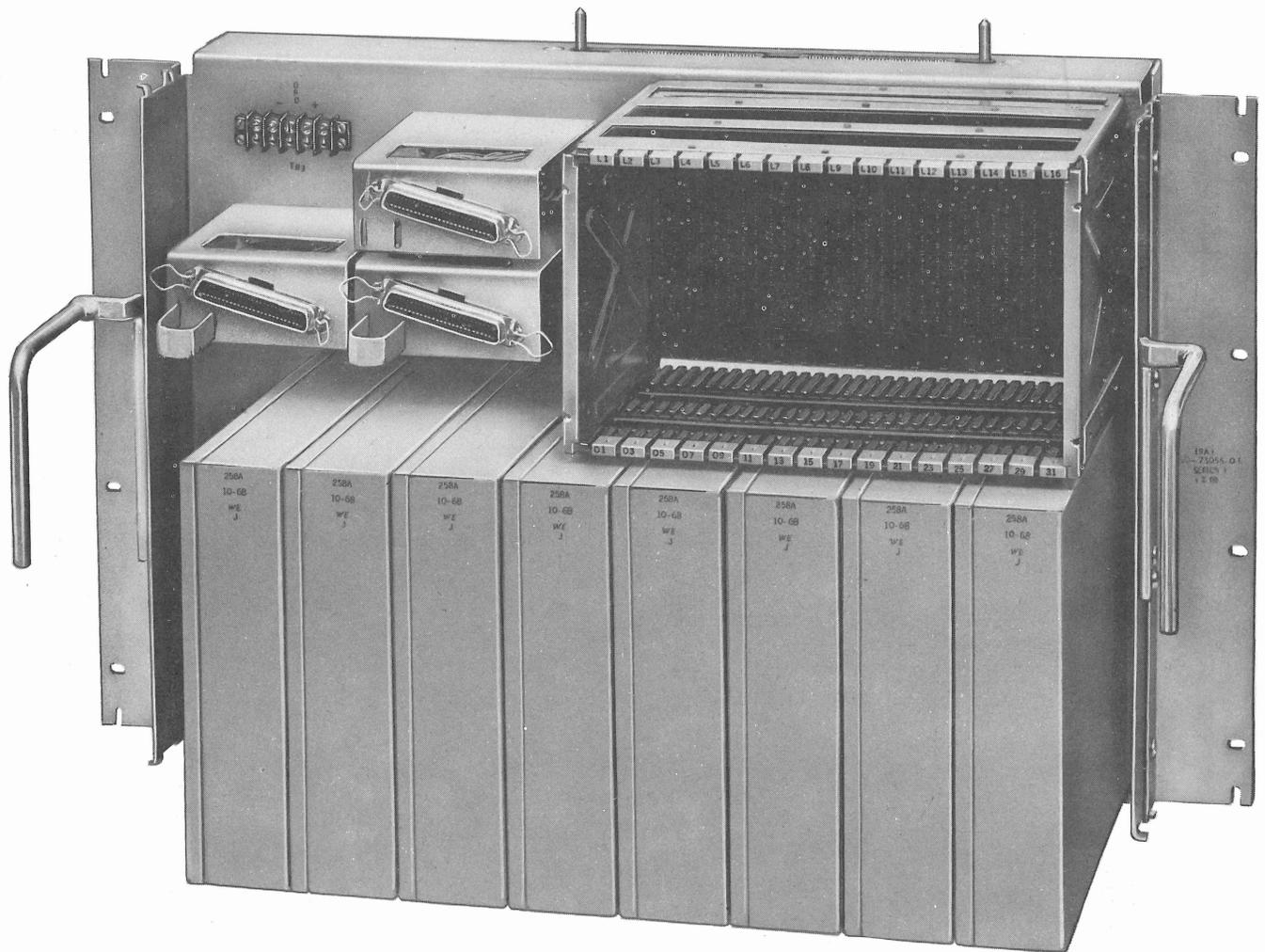
#### POWER SUPPLY MODULE

**2.14** When 110V ac 60-Hz power is to be used, a 71A apparatus mounting equipped with

KS-20575 rectifier(s) (Fig. 8) will be required to furnish the  $\pm 24V$  dc to the concentrator modules. When more than 64 lines are required,  $-48V$  dc must also be applied to the control module. A KS-20575 rectifier can be arranged to provide this voltage. The number of rectifiers required is determined by the size of the concentrator. One KS-20575 rectifier supplies power to the control, trunk, and two line and switch modules. Two additional rectifiers are needed for installations exceeding 64 lines, one to supply power to the third and fourth line and switch modules, and one to provide  $-48$  volts to the pulser circuit of the control module. Each KS-20575 rectifier will draw 115 watts maximum.

**2.15** The dc power is distributed to each mounting with 16 GA wire.

**2.16** The 71A apparatus mounting measures 6 inches high, 25 inches wide, and 6 inches



**Fig. 3—19A1 Data Mounting**

deep and weighs 9 pounds. Each KS-20575 rectifier weighs 13 pounds.

**2.17** If the concentrator is to utilize power from a -48 volt dc source, such as in a central office, a 71B apparatus mounting equipped with either one or two J87308B converters will be used as the power module in place of a 71A apparatus mounting equipped with KS-20575 rectifier(s).

**2.18** For concentrators with 64 lines or less, only one converter is required. For concentrators with more than 64 lines, two converters are required. The -48 volts required by the control module pulser when the concentrator contains more than 64 lines

may be obtained directly from the primary power source.

#### **MANUAL TEST EQUIPMENT**

**2.19** The manual test equipment allows installation and maintenance personnel to establish, at the concentrator, any desired line-to-trunk connection through the concentrator switching network.

**2.20** The manual test equipment consists of Data Auxiliary Set (DAS) 803E1 (Fig. 9) and an AR464 circuit pack. The DAS 803E1 is equipped with a clip which allows it to be hooked on the left side of the line and switch or trunk module for storage. A cord from the AR464 circuit pack,

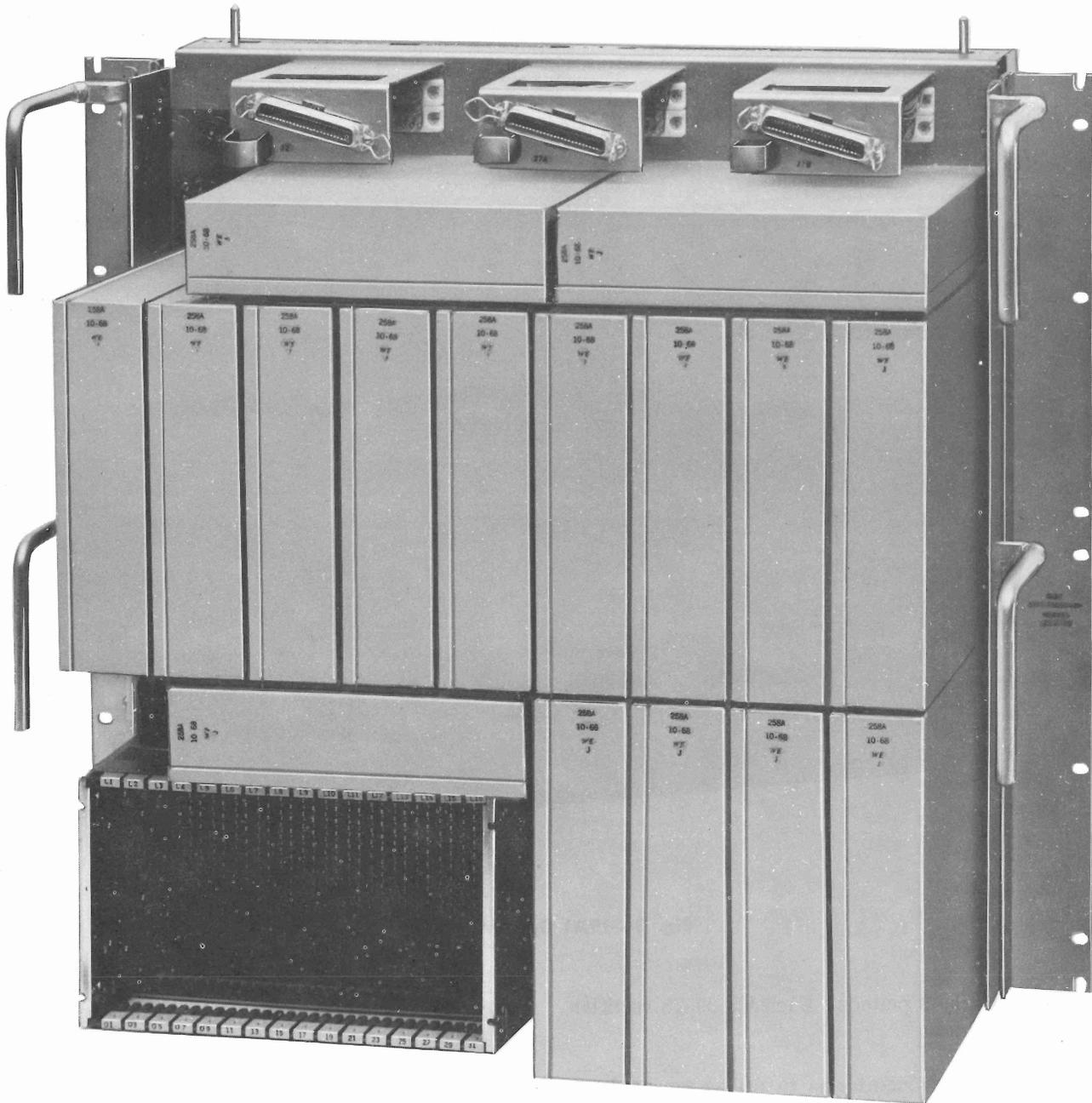


Fig. 4—20A1 Data Mounting

which is located in the control module, plugs into the DAS 803E1.

**2.21** The DAS 803E1 measures 6 inches high, 1-1/2 inches wide, and 3-1/4 inches deep and weighs 2 pounds.

**MISCELLANEOUS CONCENTRATOR EQUIPMENT**

**2.22** The ac power distribution in the concentrator cabinet shall be accomplished with a KS-20129-L1 power strip mounted as shown in Fig. 2 of B-746670 which is supplied with the power strip.

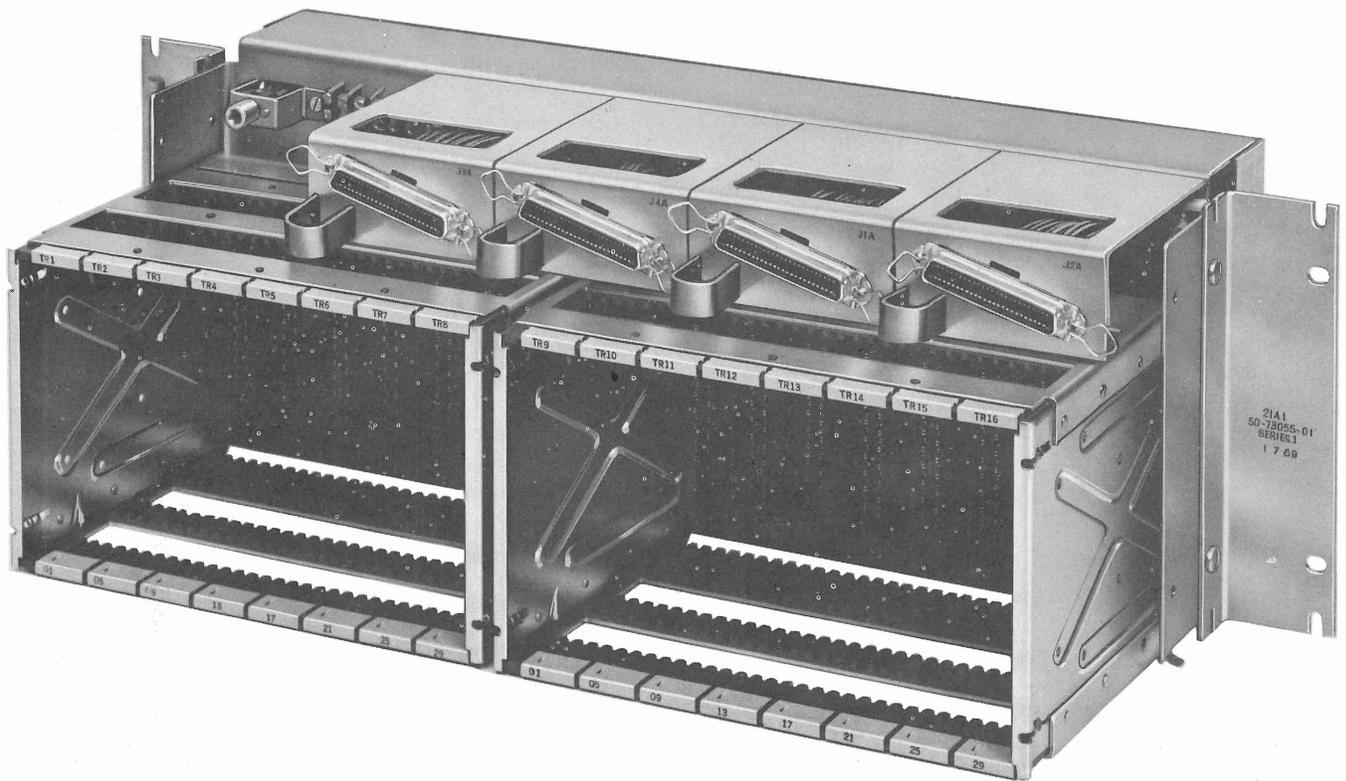


Fig. 5—21A1 Data Mounting

**2.23** M50H cords, or double-ended A25D connector cables, are used to interconnect the control module with the trunk module and each line and switch module.

**2.24** Interconnections between vertically adjacent line and switch modules, or between the trunk module and an adjacent line and switch module, are made with 198B adapters (Fig. 10). These adapters plug into the bottom connector(s) on the trunk and into the top and bottom connector(s) on the line and switch modules. The modules are then installed, one above the other.

**2.25** The 198A adapters (Fig. 11) must be plugged into the bottom connector(s) of the last line and switch module for proper termination.

**2.26** When a trunk module cannot be installed directly above a line and switch module or when two line and switch modules are not vertically adjacent, M40A cords are used to interconnect the 198B adapters in the connector(s) of the modules.

**2.27** To make installation easier, the 19A1 and 20A1 Data Mountings are equipped with handles, and mounting lugs are provided to support and align the mountings while the hardware is applied.

### 3. FUNCTIONAL CHARACTERISTICS

**3.01** The 10A Data Line Concentrator is functionally divided into the following five major parts (Fig. 12).

- The power supply circuits (not shown in Fig. 12)
- The switching matrix—part of the line and switch module
- The control module
- The line circuits
- The trunk circuits

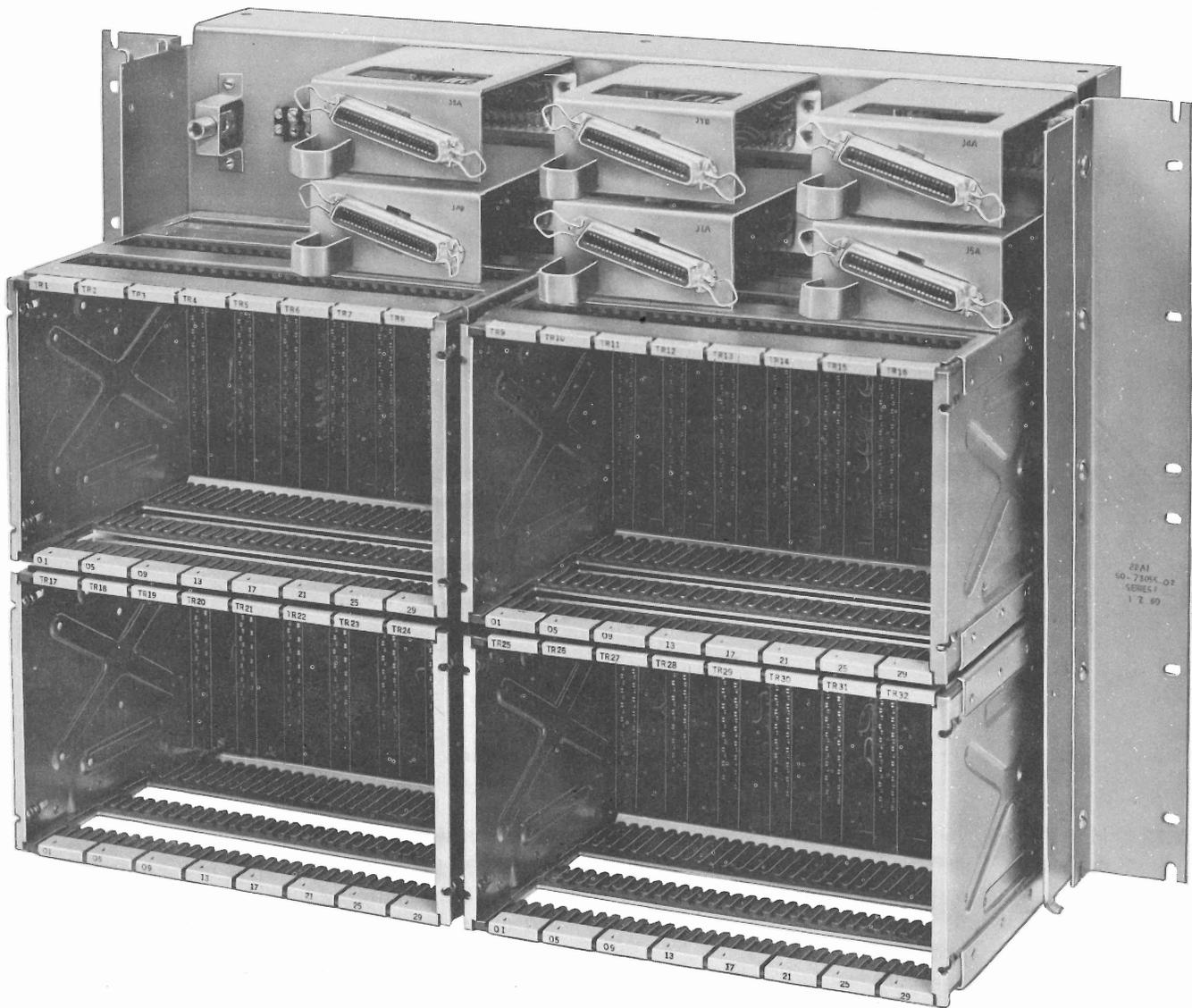


Fig. 6—22A1 Data Mounting

**3.02** The switching matrix interconnects lines and trunks to provide a metallic transmission path between station lines and computer port trunks. The control unit provides the circuits necessary for controlling the transmission path through the switching matrix. The control unit employs a clock circuit (Fig. 13) to provide the timing control for a trunk scanner and a line scanner. The pulser circuit activates the appropriate ferreed crosspoint connecting the line pair to the trunk pair. The line circuit terminates its associated station loop, when idle, and detects a station service request. A station-initiated call causes the line loop to connect

to an idle trunk under control of the scanners. The trunk circuit monitors the trunk status and detects a disconnect (either station or port originated).

**3.03** A typical sequence of events in establishing, using, and dropping a line-to-trunk connection is as follows.

- (1) The station terminal goes off-hook, applying +4 volts from tip to ring which is recognized by the line circuit.

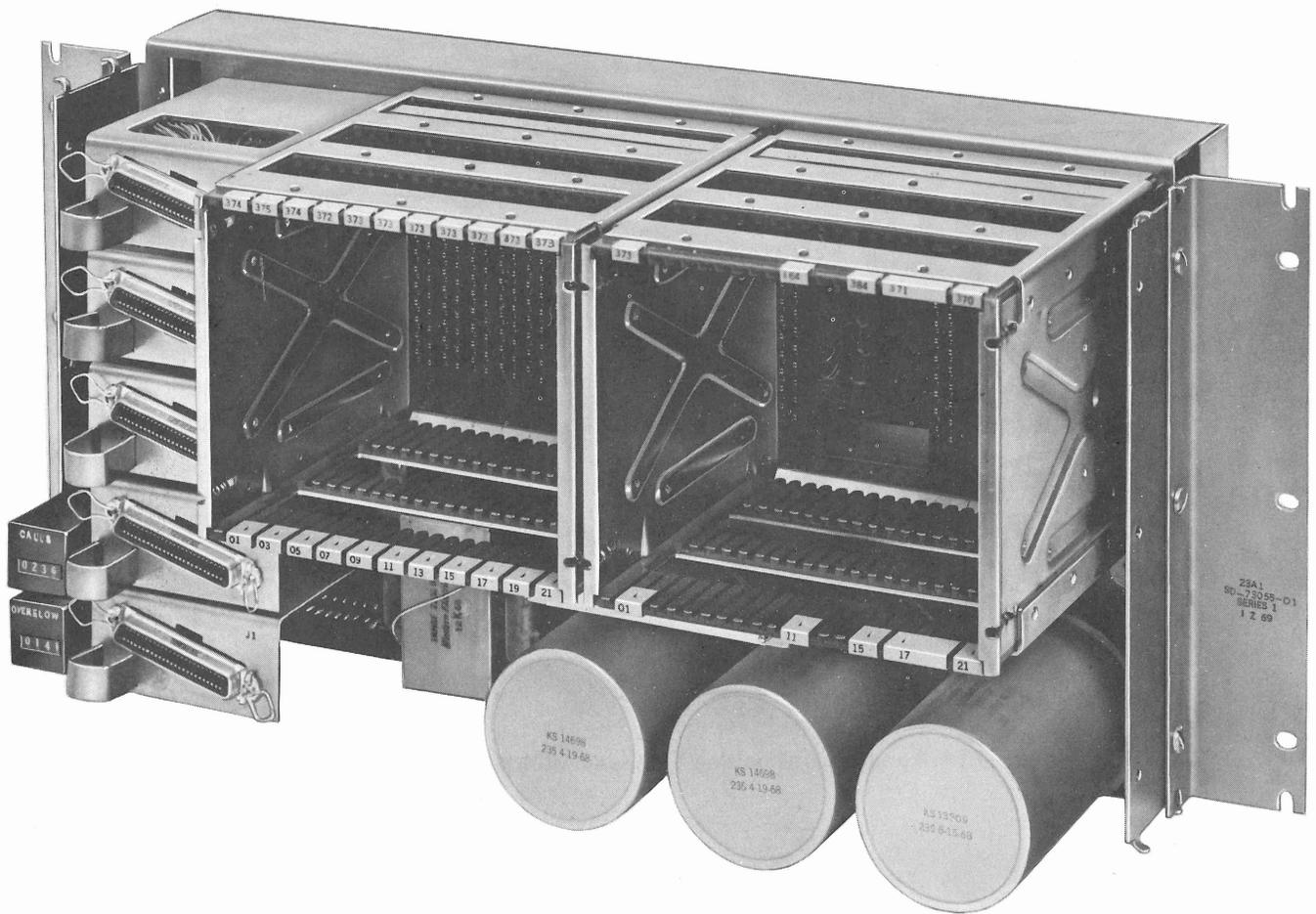


Fig. 7—23A1 Data Mounting

- (2) The trunk scanner remains locked on a free trunk during idle periods. The line scanner hunts for a line requesting service. When the line scanner reaches the line requesting service, it stops and causes one end of that line's matrix winding lead to be grounded.
- (3) This grounding is detected by the pulser circuit and, providing a trunk is available for pickup, a pulse is sent through the switching matrix to close the crosspoint corresponding to the line requesting service and the idle trunk.
- (4) When a trunk is not available, a camp-on signal is sent back to the station indicating that the station request for service has been recognized. A camp-on signal consists of a delete character being sent to the station once every two to three seconds. The station is placed in queue until a trunk becomes idle.
- (5) After the connection is made through the switching matrix, a relay closes in the trunk circuit to complete the connection from line to trunk. This relay keeps the ferreed switches from switching currents in order to prolong their life and improve their reliability.
- (6) A loop current sensor in the trunk circuit monitors the circuit. When either the station or computer opens the loop, the trunk circuit opens the connection, signals the line circuit, and restores the concentrator to normal. On a port originated disconnect, however, the station must go on-hook again in order to place another request for service.

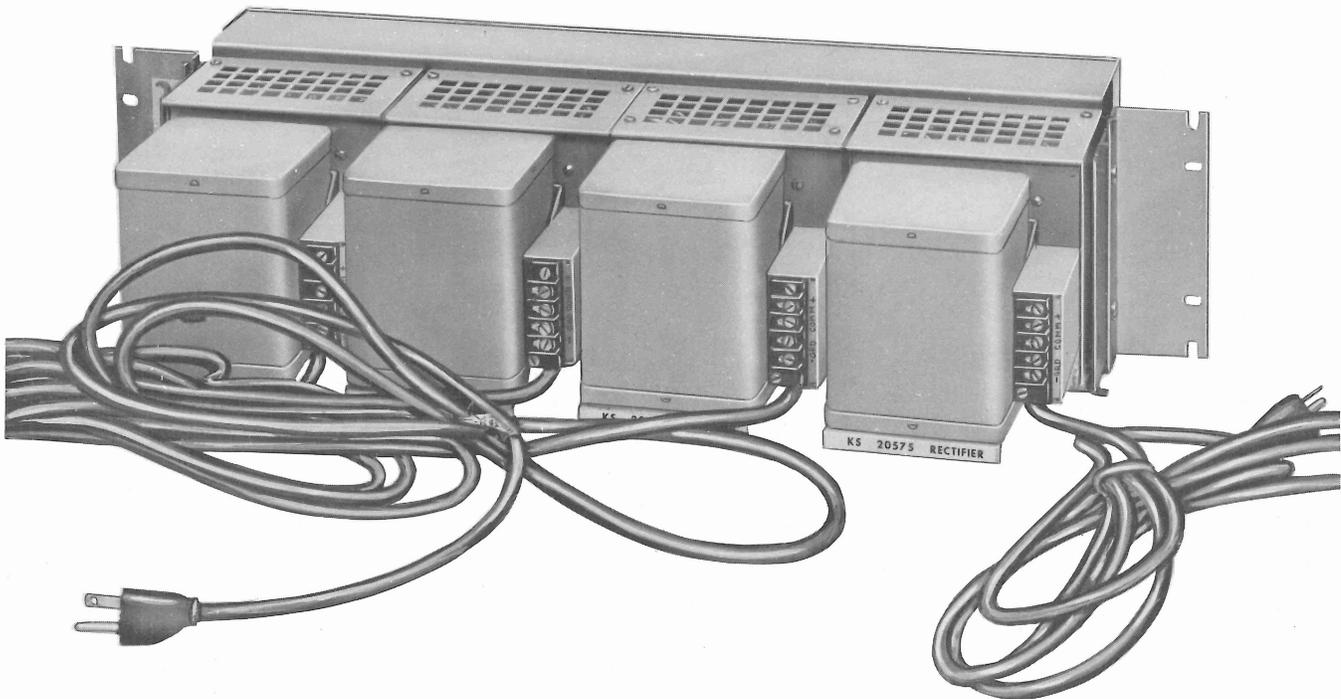


Fig. 8—71A Apparatus Mounting Equipped With Four KS-20575 Rectifiers

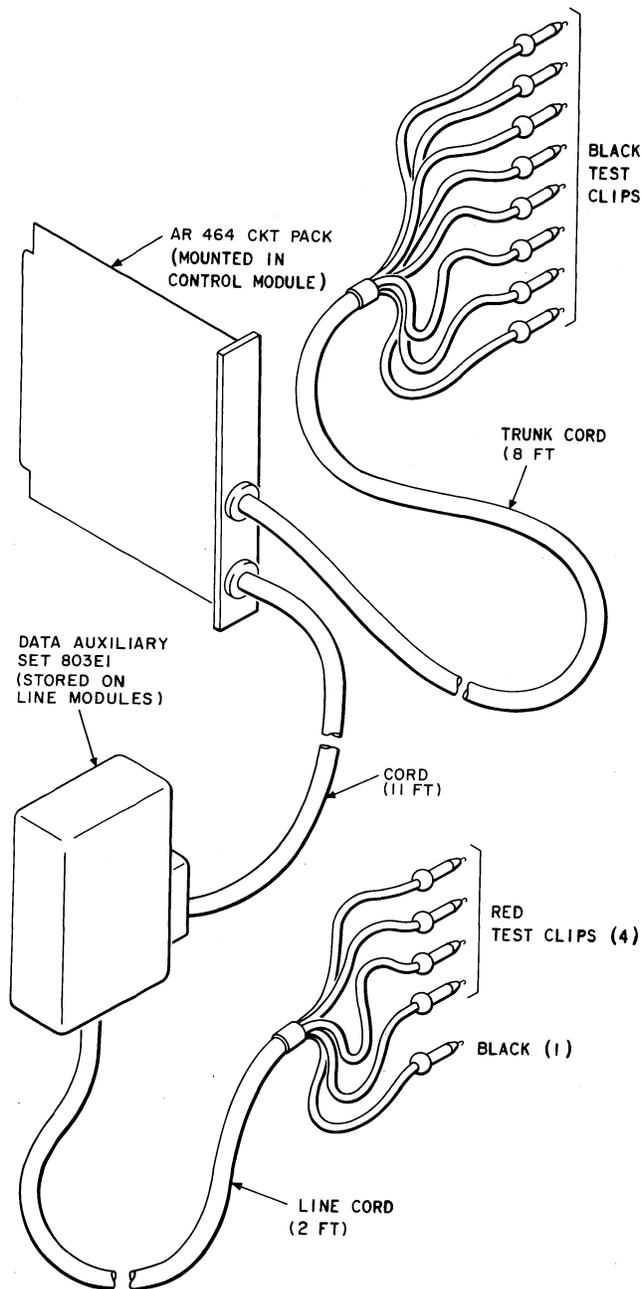
## SWITCHING MATRIX

**3.04** The switching matrix consists of an array of 258A switches. The 258A switch (Fig. 14) is an 8 by 8 array of ferreed switches. All switches in a vertical column within a matrix are connected in multiple, and all switches in a horizontal row are connected in multiple. In this way, tip, ring, and sleeve are multiplied together in their respective rows and columns. Eight columns and eight rows are provided with a crosspoint at each of the 64 intersections. Each crosspoint contains three sealed contacts within the windings of the ferreed sleeve. There are two control windings in each ferreed switch. Pulsing both control windings closes the three contacts, and pulsing either control winding opens the contacts. This control current pulse is approximately 10 amperes peak and its duration is approximately 500  $\mu$ sec .

**3.05** To close a particular crosspoint, a pulse is applied to the row and column corresponding to that crosspoint. The current pulse flows across the row and down the column corresponding to the crosspoint. The pulse flows through *both*

control windings of the ferreed switch at the crosspoint and through *only one* control winding of each of the other ferreed switches in the row and column corresponding to the desired crosspoint. Therefore, when the pulse is applied, the ferreed switch at the crosspoint will close, and any other previously closed ferreed switches in the row and column corresponding to the crosspoint will open. Once a ferreed switch is made to close by a pulse through both of its control windings, it will remain closed because of the remanent magnetic field created inside the switch.

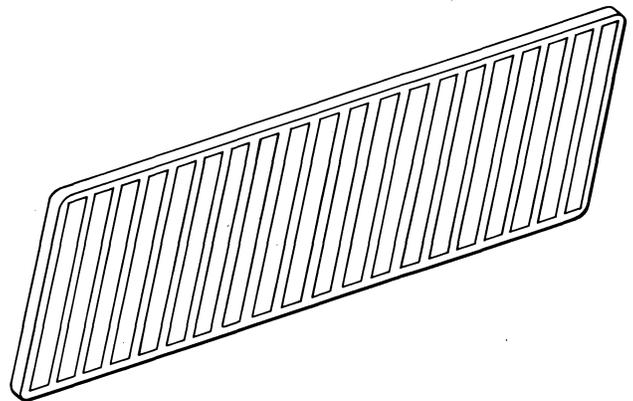
**3.06** A variety of 258A switch arrangements can be made available. The number of station lines and the traffic handling capacity desired will determine the choice of matrices to be combined into a switching network. The line capability may be provided in modules of up to 32 lines each. The 18A1 Data Mounting provides 256 crosspoints for switching 32 lines and 8 trunks. The 19A1 Data Mounting provides 512 crosspoints for switching 32 lines and 16 trunks. The 20A1 Data Mounting provides 1024 crosspoints for switching 32 lines and 32 trunks.



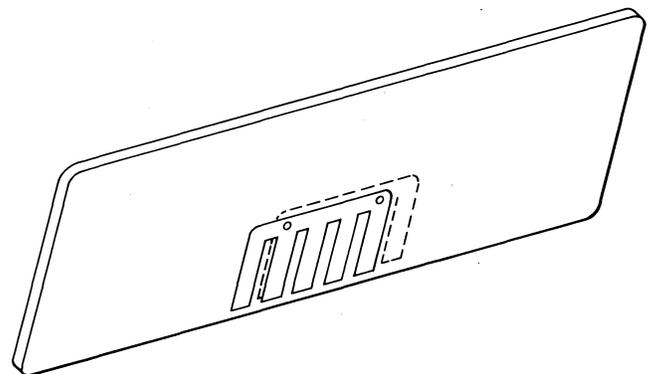
**Fig. 9—AR464 Circuit Pack and Data Auxiliary Set 803E1 (Manual Test Equipment)**

**CONTROL UNIT**

**3.07** The control unit contains the matrix pulser, the master clock, and the line and trunk scanners. Other circuits included in the control unit are the camp-on generator, the manual test circuit pack, and the alarms and registers.



**Fig. 10—198B Adapter**



**Fig. 11—198A Adapter**

**3.08** The matrix pulser produces the control winding pulses used to establish connections in the transmission path between line loops and trunk loops. The master clock generates the timing signals which control the operational sequence of establishing a connection.

**3.09** Fig. 15 shows the control path of the switching network used in the data line concentrator. As an example, assume that the second trunk is available and has been selected for connection to a line. The K1 relay of this selected trunk is

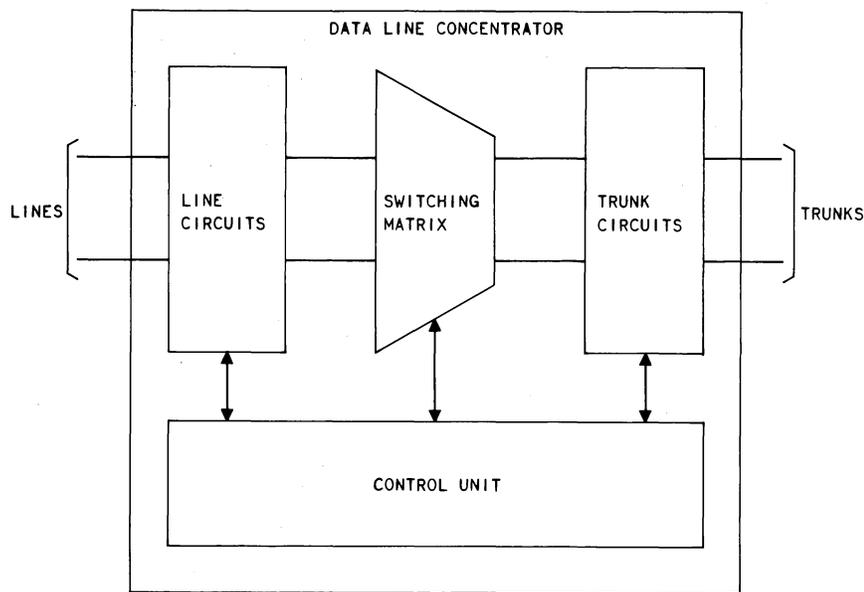


Fig. 12—Concentrator Block Diagram

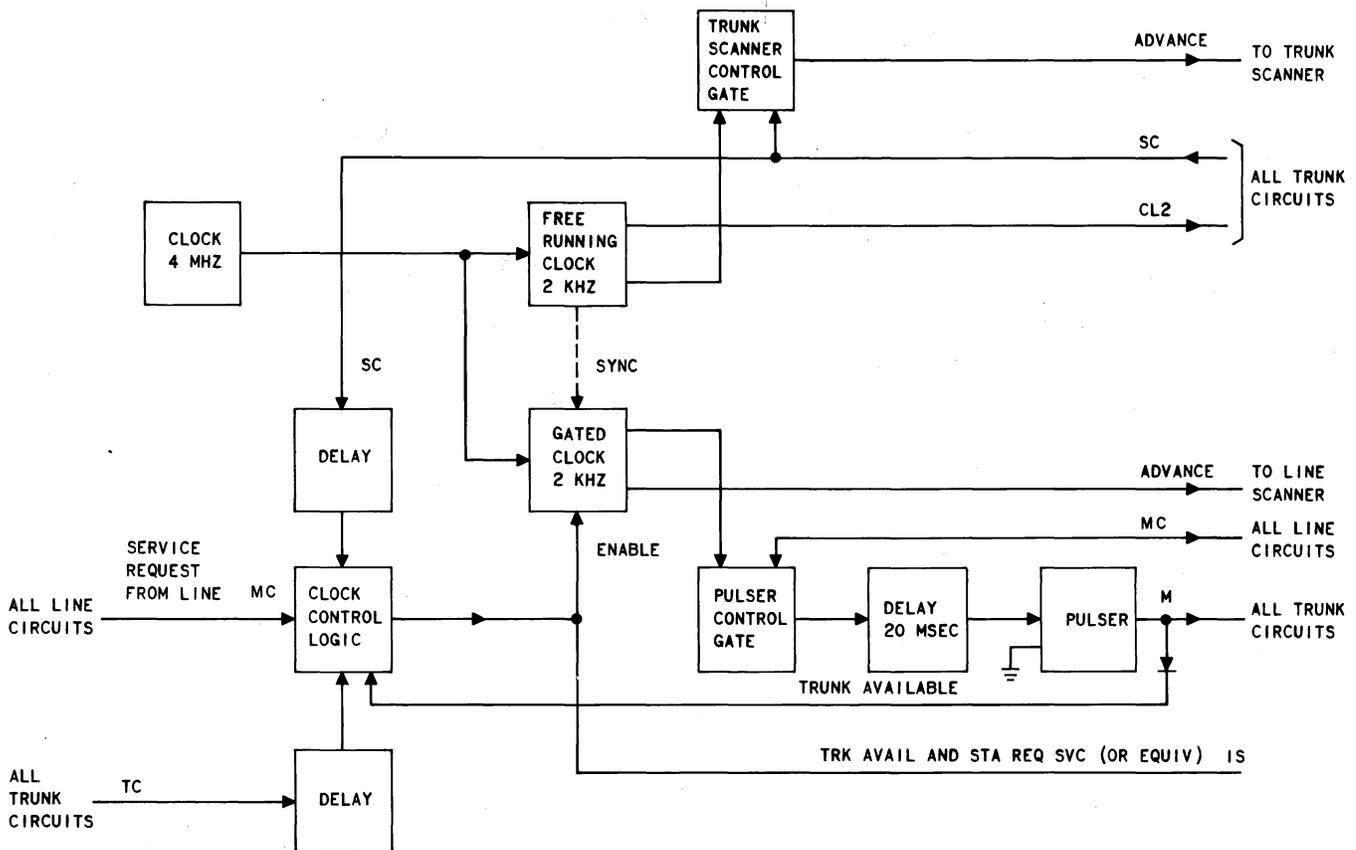


Fig. 13—Clock and Pulser

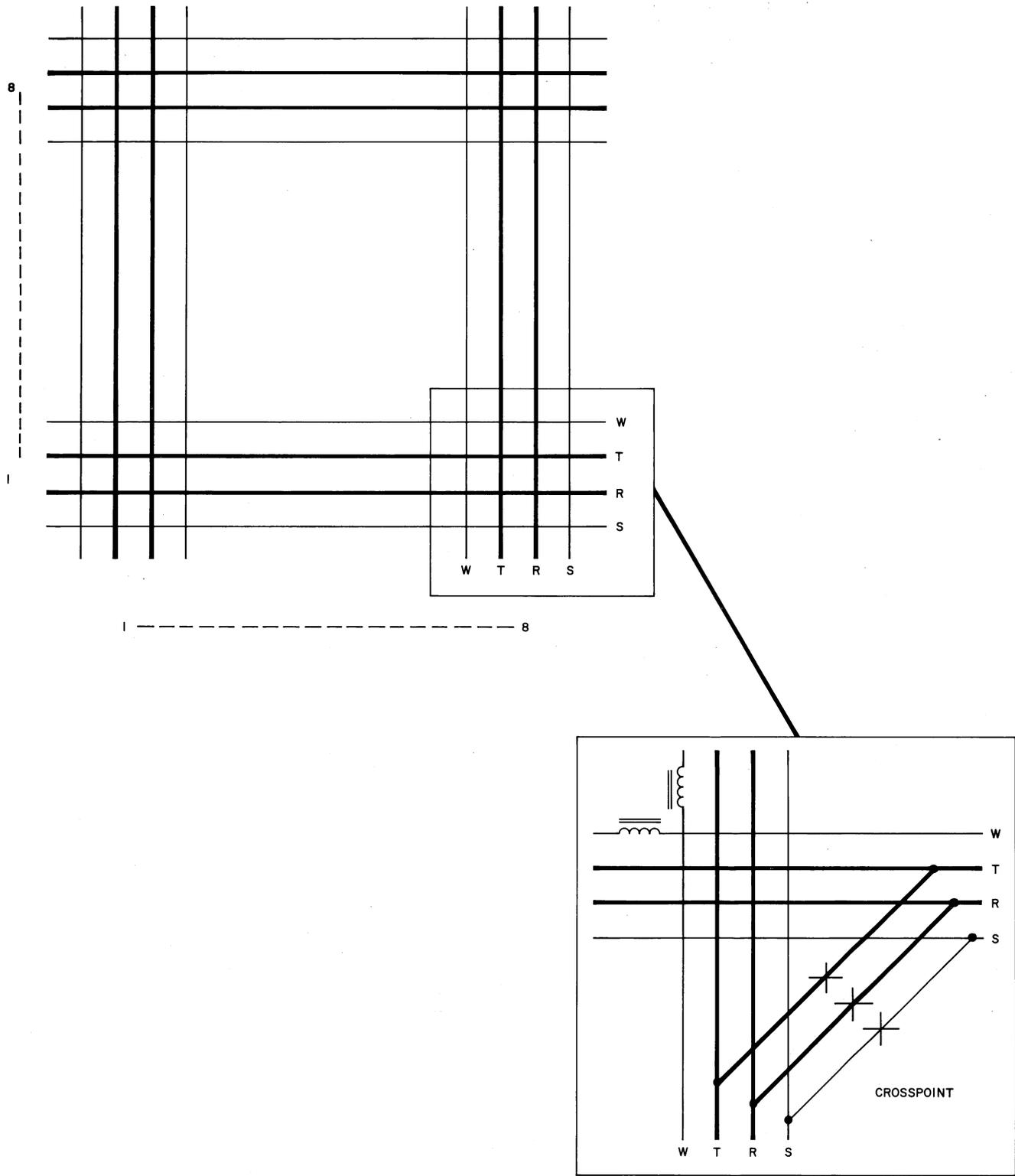


Fig. 14—Switching Matrix

operated. Assume that the line scanner has selected line circuit No. 2 by recognizing its service request. The pulser switch transistor in line circuit No. 2 is turned on (shown symbolically by the closed contact) to complete the ground return path for the pulser. The pulser is then triggered to produce a closure of the ferreed switch contacts at the crosspoint associated with the second trunk and line No. 2. The pulse path is shown in heavy lines. The operated crosspoint is denoted by an asterisk (\*). Thus, a pulser path is established to connect the clock and pulser circuit of the control unit through the applicable column and row leads (W) and the associated ferreed switch control windings to ground. If another line requests service, the control unit prevents pulser operation for at least 60 msec to allow time for the connected trunk circuit to drop its K1 relay and the pulser network to build up sufficient energy to close another crosspoint.

**3.10** When all trunks are busy, a connection cannot be established. An all trunks busy condition is indicated when no trunk select relay (K1) is operated. The trunk scanner continues to step sequentially through the trunk circuits searching for an idle trunk. The line scanner enables the supervisory detectors in each line circuit to respond to a service request. The line scanner stops on the first line with a service request and waits until a trunk becomes idle. A camp-on signal is sent back to the station terminal, as well as other camped-on stations, during this waiting period.

**3.11** The camp-on signal generator is used to send a wink signal to all stations with a service request when all trunks are busy. The camp-on signal generator (Fig. 16) consists of a 3-second timer, a register, and an output signal timer. The 3-second timer is free running and sets the register once every 2 or 3 seconds. The 10.5-msec timer is activated when the register is cleared by the next clock pulse.

**3.12** The 10.5-msec timer may optionally be arranged to produce any one of three pulse durations (3-, 6-, or 10.5-msec) depending on strapping. The duration of this pulse corresponds to the type of stations (300, 150, or 75 baud, respectively) used with the concentrator. When there are no idle trunks, this signal is distributed to all line circuits to produce a momentary open (wink) on the lines with a service request.

**3.13** The alarms and registers circuitry provides a facility for monitoring the most important functions of the concentrator and also indicates a failure of these functions. The alarms and registers circuit (Fig. 17) consists of an alarm relay (K1), a group of detectors, monitoring leads, and registers. Any failure of one or more monitored functions causes the K1 relay to release. The following functions are monitored for alarm: the clock, line scanner output, trunk scanner output, pulser, +24 and -24 volt supplies to each module, and the +24 and -24 volt fuses of the line and switch modules. An external master alarm may be connected to the contacts of K1. The following individual lamp indications are provided:

- CLK—Clock failure
- PL3R—Pulser failure
- LS—Line scanner failure
- TS—Trunk scanner failure.

**3.14** The clock alarm monitors the free-running clock with a resistance-capacitance type storage circuit which remains charged as long as the clock operates. The pulser alarm monitors the current drain of the pulser filter capacitor. The line scanner alarm monitors the scanner counter. When the line scanner is being stepped under normal operation, a resistance-capacitance network is maintained in the discharged state. If the line scanner malfunctions, the circuit charges and triggers an alarm. The trunk scanner alarm operation is identical to the line scanner alarm operation. Monitors for  $\pm 24$  volts from the line and switch modules are also provided.

**3.15** The register circuitry provides a count of the number of calls processed by the computer and the number of times the line scanner is stopped because a line requests service and no free trunk is available.

## LINE CIRCUITS

**3.16** Fig. 18 includes a block diagram of a single line circuit. The line circuit provides the following functional circuits.

- Line supervision monitors

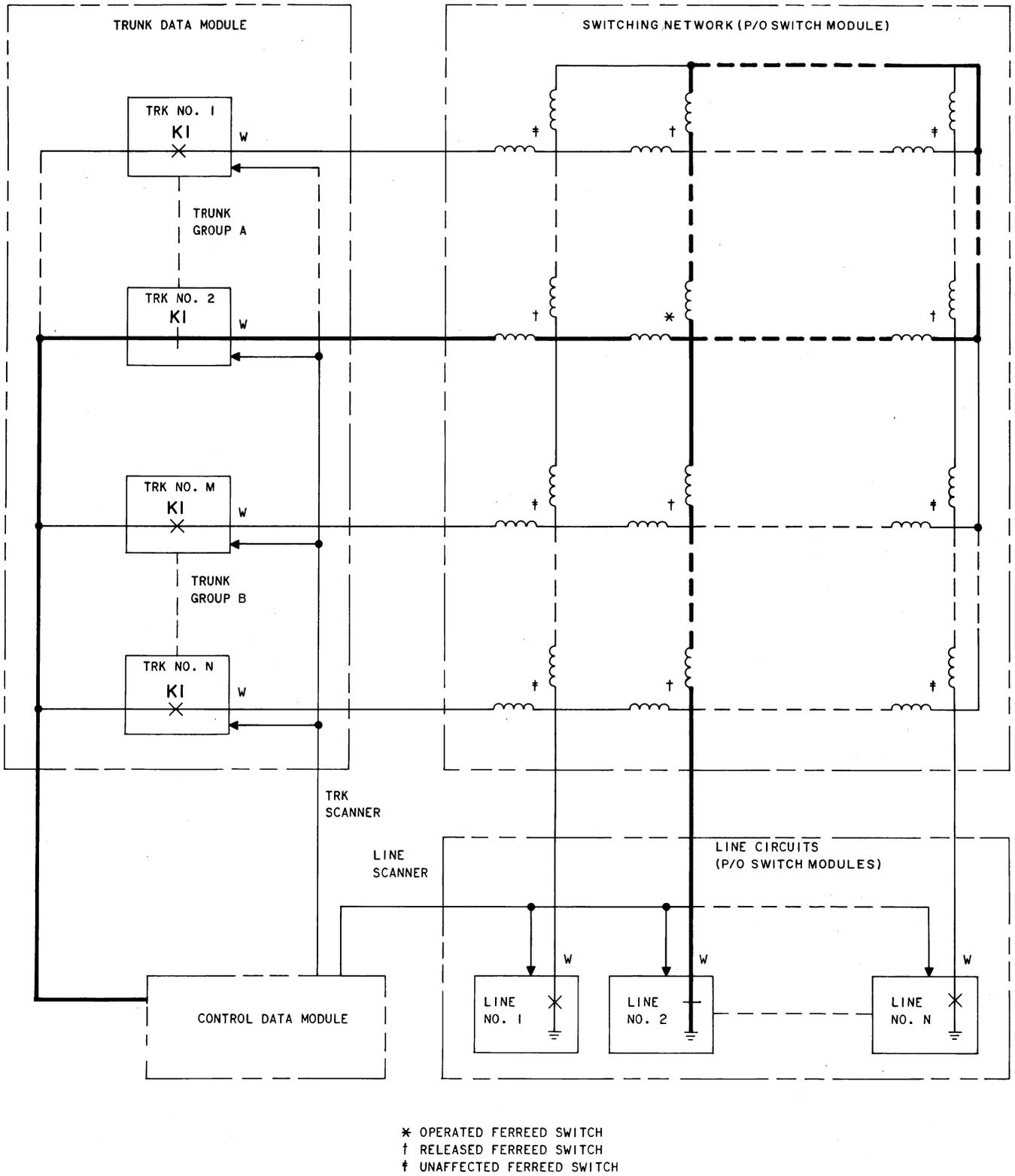


Fig. 15—Switching Network Control Path

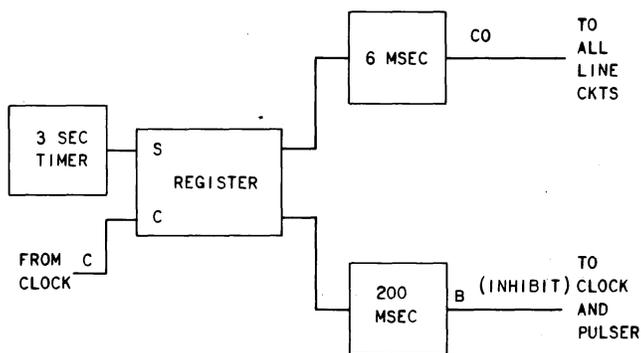


Fig. 16—Camp-on Signal Generator

- Registers for marking the line and trunk supervisory conditions
- A pulser switching transistor to complete the ground path for the pulser through the switching matrix
- A logic control circuit to provide overall coordination.

**3.17** The line scanner sequentially scans the line circuits. When the associated station terminal goes off-hook, the line circuit supervision monitor responds by placing a low impedance termination across the line loop.

**3.18** A combination of this service request and an interrogation signal from the line scanner causes the line circuit to be selected for connection to an idle trunk circuit. The selection of the line circuit sets the station on-hook register. This enables the line pulser switch to complete the ground return pulse path via the associated vertical control lead of the switching matrix and the trunk relay (K1).

**3.19** Once the connection has been established, the sleeve(s) lead provides a circuit for a continuity check through the connected trunk circuit. The presence of continuity causes a line supervision monitor lockout or disabling and restores the low impedance line loop termination in the monitor to the high impedance state. The line circuit will then not respond to subsequent interrogations by the line scanner.

**3.20** At the end of the call, either the station or trunk terminal goes on-hook and opens the loop. This condition is recognized by a loop current monitor in the trunk circuit which then signals the line circuit on the sleeve lead through the switching matrix. This signal sets the trunk disconnect registers and the on-hook register. The continuity check then removes the line monitor lockout.

**3.21** If the disconnect is station generated, the line monitor circuits detect an open line loop and recycle the line circuit to the idle condition, the station on-hook register clears, and the trunk disconnect register clears.

**3.22** If the disconnect is trunk generated, one of the line monitor circuits detects the sustaining mark voltage from the off-hook station after disconnect. This state is identical to another request for service; however, both the trunk disconnect register and the on-hook register remain set, producing a lockout in the logic control. With both registers set, the line is prevented from being selected by the scanners and reconnected to another trunk. When the station goes on-hook for more than 200 msec, the lockout is removed, causing the line circuit to recycle to the idle condition. The line circuit can then recognize the return to the off-hook as a new request for service by the station.

**3.23** When an idle trunk is not available, the camp-on generator (in the control module) provides a wink signal to be applied to the line. The wink signal from the camp-on generator causes the logic control of the line circuits with a service request to remove the low impedance line shunt momentarily every three seconds until either a connection is made or the station terminal goes on-hook.

## TRUNK CIRCUIT

**3.24** A block diagram of the trunk circuit is shown in Fig. 18. The trunk circuit provides the following functional circuitry:

- Supervisory monitors for supervision of the trunk
- Trunk connect control logic for controlling the connection of the selected trunk

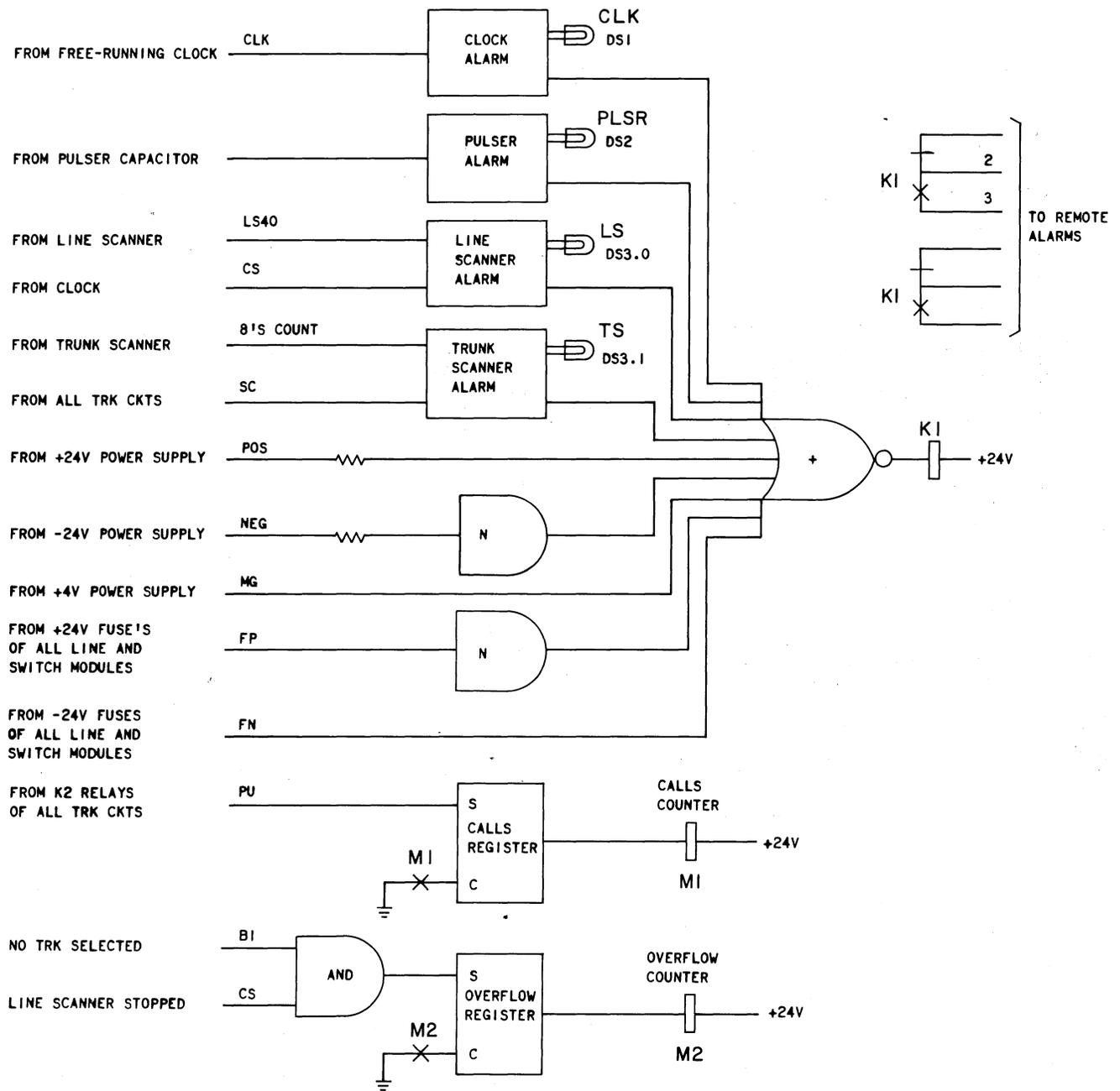


Fig. 17—Alarms and Registers

- Trunk select relay to establish a path from the pulser into the switching matrix
- Trunk connect relay to complete the loop from station terminal to computer port. This closure is made after the switching matrix crosspoint connection is made and

protects the ferreed switches from switching voltages, thereby prolonging contact life and reliability.

**3.25** The trunk circuit provides a supervisory monitor using voltage and current sensors. When the trunk loop is open (before connection to

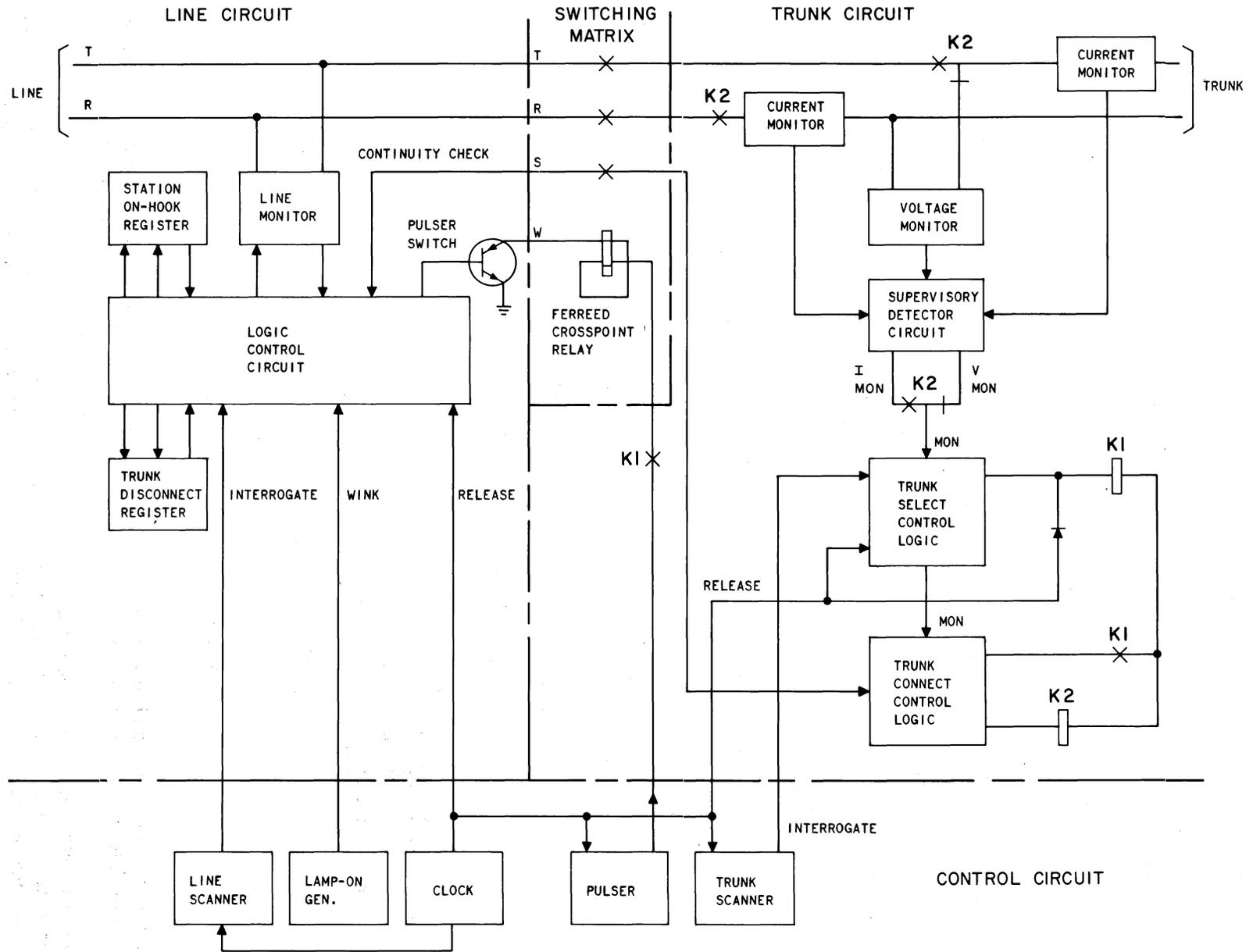


Fig. 18—Line and Trunk Circuit Interconnections

a line loop) a voltage sensor is employed to detect the presence or absence of voltage across the trunk tip and ring leads. The presence of voltage indicates that the trunk is idle and available for traffic. The absence of voltage indicates a trunk made busy. After the trunk circuit has been selected and connected to a line with the appropriate service request, the monitor is switched from the voltage sensor to loop current sensors by the operation of the trunk select relay (K2). Current sensors are employed in both tip and ring leads to monitor loop current and indicate when a disconnect is generated by either the line or trunk terminal.

**3.26** The trunk circuits are sequentially interrogated by the trunk scanner. When the monitor circuitry of the interrogated trunk circuit indicates an idle trunk condition, the trunk select control logic causes the trunk connect relay (K1) to operate. When K1 operates, the trunk is selected and a pulser path is established through the matrix and line circuit to ground. Once the trunk is selected, the trunk scanner stops until the trunk is connected to a line requesting service. After a selected line is connected to an idle trunk, the trunk scanner resumes the search for the next available idle trunk.

**3.27** When the pulser operates the matrix control windings, a closure of the tip, ring, and sleeve ferreed switch contacts connects the line and trunk circuits through the normally open contacts of K2. The trunk connect relay (K2) must operate after the ferreed switch operation in order to prolong ferreed contact life. K2 operates if the trunk connect control logic detects that the K1 relay is operated, and the continuity check over the sleeve(s) lead shows that the ferreed switch has closed. The closure of K2 also advances the calls register (on the control module) one count, releases K1, and switches the supervisory loop monitors from voltage detection to loop current detection.

**3.28** Two loop current detectors (one each in tip and ring) are used to protect against longitudinal currents in the loop due to ground

potential differences between the trunk end and the station end.

**3.29** When loop current is interrupted, the trunk circuit recognizes this as a disconnect and the following events occur.

- (1) K2 releases, disconnecting the trunk loop from the switching matrix.
- (2) The supervisory circuit monitor switches from current to voltage sensing.
- (3) The sleeve lead is conditioned to initiate a disconnect operation in the line circuit (see 3.20, 3.21, and 3.22).

#### 4. REFERENCES

**4.01** The following circuit description, schematic drawing, and Bell System Practices (BSP) pertain to the 10A Data Line Concentrator.

SD- & CD-73055-01	Data Systems — No. 10A Data Line Concentrator and 803E1 Data Auxiliary Set
BSP 591-810-Series	10A Data Line Concentrator System (DATREX*)
BSP 590-102-110	18A1 Data Mounting — Identification
BSP 590-102-111	19A1 Data Mounting — Identification
BSP 590-102-112	20A1 Data Mounting — Identification
BSP 590-102-113	21A1 Data Mounting — Identification
BSP 590-102-114	22A1 Data Mounting — Identification
BSP 590-102-119	23A1 Data Mounting — Identification