TRAFFIC USAGE RECORDER
NO. 1 PORTABLE
GENERAL DESCRIPTIVE INFORMATION

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1. GENERAL

1.01 This practice describes the No. 1 portable usage recorder and its function as a measuring facility in obtaining traffic load information for dial switching systems. This equipment is designed to be readily transported and to be installed without the necessity of providing permanent connections to other central office equipment. The switch count principle of scanning circuits and recording the number in use is employed in its operation, and the traffic load is measured in usage units of hundred call seconds per hour. The principal elements of the recorder are as follows:

(a) The scanner unit containing the control, scanning, and testing equipment.

(b) The register unit housing the traffic registers on which the information is recorded and cross-connection facilities for assigning the registers as desired.

(c) Appropriate connecting cordage for providing power, interconnecting the two preceding units, and making temporary attachment to the central office circuits it is desired to measure.

(d) A traffic register camera.

1.02 The No. 1 portable usage recorder is intended for temporary association with equipment of the step-by-step, panel, and crossbar types of switching systems, and associated switchboards, in cases where the permanently installed usage recorder is not provided. Usage can be measured on such circuits as trunks, links, selectors, subscriber lines, senders, and other components of these systems. The recorder is used principally to secure traffic data for engineering and administrative purposes and for division of revenue studies. It was designed to secure automatically, directly, and for any desired period, accurate load data in standard usage units of ccs (hundred call seconds) per hour. Provision has been made for photographic recording of the register readings through the use of the standard traffic register camera. Because of these features, this recorder constitutes an improved traffic measuring facility particularly applicable for use in small, unattended offices and for use on a sampling basis in larger offices where a permanently installed traffic usage recorder frame is not available.

1.03 *Capacity:* There are 800 terminations for test leads available in the scanner unit. However, this maximum capacity can be used only as eight inflexible groups of 100 terminals each; that is, the usage of each bank of 100 terminals will be recorded on a single usage register per bank. This will be satisfactory where a few very large groups are to be measured or where only the bulk total usage of many circuits is desired. Under other circumstances, blocks of 100 terminations can be flexibly arranged in a number of smaller groups of any size at a sacrifice of 100 terminations in total capacity for each 100-block so arranged. For example, the first bank might contain two groups of 15 line finders each, seven groups of eight connectors each, one group of 12 outgoing trunks, and two terminals unassigned. The flexibility feature permits the assignment of individual registers to record the usage of each of these ten groups. This arrangement for flexibility can be applied in four steps by manually operating keys with resultant capacities as shown in Table A. The register cabinet has a capacity of 100 traffic registers in addition to a cycle count register.

TABLE A

NO. OF F- KEYS OPERATED	TEST LEAD TERMINATIONS AVAILABLE		
	TOTAL	INFLEXIBLE	FLEXIBLE
None	800	800	0
1	700	600	100
2	600	400	200
3	500	200	300
4	400	0	400

1.04 ***Lead Connections:*** Test leads for the circuits to be measured are connected to the usage recorder by means of 20-conductor patch cords equipped with specially designed individual clips or multicontact plugs designed to clamp on distributing frame terminal strips.

1.05 ***Group Size:*** When the flexibility feature mentioned in 1.03 is employed, the register leads may be cross-connected to permit treating one to 100 circuits as a group.

1.06 ***Scanning Cycle:*** All test leads are scanned once each 100 seconds. This constitutes a scanning cycle and 36 scanning cycles are completed during each hour of operation. The total number of cycles completed is scored on a traffic register. In addition to the basic 100-second scan rate, 20 per cent of the terminals may be scanned at 10-second intervals by an arrangement which causes the scanner to return to these terminals repeatedly during the progress of the regular cycle through the remaining terminals.

1.07 ***Operation Control:*** The No. 1 portable usage recorder can function automatically under control of a program timer and can be started and stopped at predetermined intervals within one day. These operating periods will be repeated automatically for predetermined days within a week. Operation of the recorder can be stopped at any time by manually restoring a key.

1.08 ***Detector Circuits:*** Busy detector circuits are available to cover both ground- and battery-busy conditions.

1.09 ***Recording:*** The 14-type traffic registers are used to record the data. The register readings for 1 hour of testing will indicate hourly usage in ccs directly except for groups scanned at the 10-second rate, in which case the readings must be divided by ten. One usage register is required per circuit group. However, when the bank of 100 terminals served by a particular detector is subdivided into many small circuit groups, it may be desirable to provide a detector group usage register in addition to the regular usage registers in order to obtain a quick total of the several groups. A detector group usage register accumulates the total usage of all circuit groups scanned by a single detector. Such arrangements may save effort in summarizing readings when traffic engineering considerations require total usage data on a busy-hour basis, while administrative procedures require the data by circuit groups, but only at rather infrequent intervals. Any register may be assigned either as a regular usage register or a detector group register by cross-connection facilities.

1.10 ***Camera:*** The standard traffic register camera may be furnished for reading these usage registers and provides a convenient means of obtaining accurate readings at frequent intervals. Control for photographing automatically at 1/2-hour or 1-hour intervals is provided.

1.11 ***Testing:*** Test features are provided which permit checking the integrity of cordage, connectors, and scan switch terminals and the operation of detectors and registers.

2. OPERATING PRINCIPLES

2.01 The No. 1 portable usage recorder indicates usage in ccs per hour by employing the switchcount method of measuring. This method, simply expressed, involves the repeated scanning of busy-test terminals for the circuits under study and the cumulative recording of the number found busy per group on each scan. At the end of any period of time, the average traffic load carried by a study group can be determined by taking account of the number of scans made and the total number of busy conditions encountered. Since the test leads from the circuits are scanned 36 times per hour at the basic 100-second cycle rate, the accumulated number of busy conditions recorded on the register in 1 hour will indicate the group traffic load directly in the desired units of ccs per hour under these circumstances.

3. EQUIPMENT ELEMENTS

3.01 As indicated above, the principal elements of the No. 1 portable usage recorder are:

(a) Scanner unit.
(b) Register unit.
(c) Connecting cords.
(d) Traffic register camera.

SCANNER UNIT (Fig. 1A and 1B)

3.02 This is a sheet-metal cabinet 25-3/4 inches long, 12-3/4 inches deep, and 22-9/16 inches high, containing the scan switch, program timer, electronic detectors, control keys and other control apparatus and multicontact jacks through which connections are made to the circuits under study and to the register unit. Removable coverplates are provided on front and rear, and carrying handles on either end of the cabinet.

3.03 ***The scan switch*** is a modified step-by-step line finder equipped with eight wiper brushes, each scanning a bank of 100 terminals arranged in ten levels of ten terminals each. Each of the wipers is associated with a detector circuit and the 800 bank termials are wired to patch jacks in the rear of the cabinet.

3.04 ***The program timer*** is identical to the one used with the permanently installed traffic usage recorder described in Section 951-510-100 and is an electrically-driven 24-hour clock equipped with two dials, one indicating the hour, the other the minute within the hour. The hour dial is divided into two parts, the segment from 6 p.m. to 6 a.m. being painted black to distinguish the night hours. At every quarter-hour point around the circumference of the dial, metal tabs are located which, when depressed, cause the recorder operation to start at the selected moment. A day wheel is also provided into which threaded pins may be inserted to suspend operation on any desired days of the week.

3.05 ***Eight detector circuits*** are furnished to determine the busy or idle condition of the circuits under study. Each detector serves a particular bank of 100 terminals and provides a high-impedance electronic circuit for ground detection. An important feature of these detectors is a circuit arrangement which permits them to respond to busy conditions during only a tiny fraction of their stay on a terminal. This short "look" time contributes greater accuracy when circuits having very short holding times are measured. Detectors No. 1 through 4 may also be rearranged as relay detectors for battery conditions by operating the associated B1 to B4 keys. Although a ground condition is generally a busy indication, for certain circuits it indicates "idle." If ground-idle conditions are being observed, the idle conditions will be registered and this fact must be taken into account when evaluating the registered data.

3.06 ***Control keys*** are provided for putting the recorder into operation, for selecting half-hour or hour intervals or manual operation for photographing the registers, for causing certain terminals to be scanned every 10 seconds, and for setting the recorder to permit manual testing of all its functions. Other keys are used to provide flexibility of group size within banks of 100 terminals and to switch particular detectors from ground operation to battery operation.

3.07 ***Other control devices,*** comprising relays, an electrically-driven, 10-second interval timer, and two rotary switches, are also mounted in the scanner cabinet. The 10-second timer provides an accurate basic interval for regulating the time of scanning successive levels of bank terminals, while the rotary switches serve as level counter and cycle counter to mark, respectively, the progress of scanning through the ten levels constituting a full 100-second cycle and through the 36 cycles covered in an hour.

3.08 ***A patch jack field*** is located in the rear of the cabinet. This field consists of forty 20-circuit jacks arranged in eight horizontal rows of five jacks each. These jacks are designated with a 3-digit number, the first digit corresponding to the number of the associated detector and switch bank; the other two indicating the two level numbers of the 20 terminals connected to the bank. The banks and levels are numbered from 1 upward, bottom to top. Other jacks or sockets are provided for connecting to a source of 110-volt ac power, to 48-volt central office battery and ground, for a traffic register camera, and to extend battery and other control leads to the register cabinet.

REGISTER UNIT (Fig. 2A and 2B)

3.09 The register unit is a cabinet identical to the scanner cabinet in dimensions and external construction. It contains the traffic registers, a cross-connection field, and patch jacks for connecting to the scanner unit.

3.10 ***The traffic registers*** are 14-type registers arranged in horizontal rows of ten each, with provision for 100 maximum, and wired to a terminal strip in the rear of the cabinet. An extra mounting plate containing a cycle count register and a lamp to identify the initial picture in a sequence of half-hourly or hourly photographs is located above the tenth row of usage registers. Brackets for attaching a camera are provided at the top of the register field.

3.11 ***Cross-connecting facilities*** are provided in the rear of the register cabinet for associating the traffic registers with the leads representing the groups of circuits under study. The arrangement consists of two parallel rows of terminal strips, the upper row providing terminations for 100 traffic registers, the lower row for 400 leads which may be extended to the scanner unit through 20-circuit patch jacks located below the terminal strips. These terminals are of the wire-wrap type which eliminates the necessity of soldering on the cross connections. Sockets are also provided for supplying battery to the registers and for connecting the output leads of the eight detector circuits to the cross-connecting field.

CONNECTING CORDS

3.12 Several types of connecting cords are available for connecting to the equipment under study and for interconnecting the scanner and register units. These cords are basically 20-conductor cords with one end terminated in a plug used to patch into the recorder. The other end is arranged in one of the following ways.

(a) Fanned out into individual leads, each equipped with a clip designed to attach to terminal punchings.

(b) Terminated in a multicontact connector which may be clamped to a terminal strip where the circuits to be studied appear consecutively in a row.

(c) Terminated in a 20-point female socket used to patch to the register unit or to provide an extension cord for longer runs of the other types of cords.

Two other cords equipped with suitable plugs are furnished for supplying 110 volts ac and 48-volt battery and ground and a single 12-conductor cord is used for extending the detector output leads and miscellaneous circuits to the register cabinet.

TRAFFIC REGISTER CAMERA

3.13 The traffic register camera consists of a metal hood and associated apparatus which attaches to the register cabinet. The actual camera is mounted on the outer surface of the hood and photographs the registers on 35-millimeter film. Also mounted on the hood are a push-button switch for manually operating the camera, a counter which indicates the number of exposures made on the film, a pilot lamp which indicates whether the camera is in service, and a toggle switch to make the camera operative or nonoperative. Located within the hood are the following parts.

(a) Clock, the dial of which is photographed with the registers to indicate the time at which the picture is taken.

(b) Holder for designation card which is photographed with the registers.

(c) Lamps to illuminate the registers, clock, and designation card.

(d) Mirror in which the registers, clock, and designation card are reflected toward the camera.

(e) Control apparatus which causes the proper sequence of operations to take place upon signal from the usage recorder.

3.14 During a 5-second period following receipt of a short impulse from the recorder, the camera lamps are lighted, the shutter is tripped, and the exposed film is advanced to bring fresh film into position for the next picture.

4. METHOD OF OPERATION

4.01 The normal functions of the No. 1 portable usage recorder are controlled by the operation of the keys and program timer on the

scanning unit. As a preliminary to describing the method of operation of these controls, a general description of the following operational features is given.

(a) The fundamental scanning and registering process.

(b) Ten-second scanning of certain terminals.

(c) Providing flexibility in group size.

SCANNING AND REGISTERING

4.02 The scan switch described in 3.03 is used to connect test leads from the various circuits being measured to the detectors for the recognition of busy conditions present on these leads. Each cycle of operation starts with the scan switch stepping vertically to the first level of terminals, then sweeping around horizontally, and pausing briefly on each of the ten terminal locations. While resting on a terminal, each of the eight wiper brushes connects the associated circuit to a detector to test for idle or busy conditions. Each detector circuit will function on a busy indication and operate the associated usage register through the patch cords and cross-connection field. On the eleventh rotary step, contacts close which cause the scan switch to restore to normal and advance the level counter to indicate the next level to be scanned. The scan cycle of 100 seconds is measured by counting ten level scans, each started at successive 10-second intervals.

TEN-SECOND SCANNING

4.03 When the 10-SEC SCAN key is operated, the scan cycle is modified so that every 10 seconds the first and second levels of all banks are scanned in quick succession, and in addition, except during the first and last 10-second interval of each 100-second cycle, one of the other eight levels is scanned, beginning with level 3 during the second 10-second interval. Thus, the first 20 terminals of each bank are scanned at the 10-second rate and the remaining 80 terminals at the regular 100-second rate. The 10-second scan rate will generally be used to secure increased accuracy in measuring short-holding time circuits such as markers and some types of senders. This feature should be used only in conjunction with the operation of all flexibility keys (see 4.04), unless care is taken to assign only the first 20 or the last 80 terminals in nonflexible banks. If a circuit group were assigned partly to the first 20 terminals and partly to the last 80, with 10-second scanning in effect, busy circuits in the first portion would be recorded disproportionately to those in the second portion and the results could not be interpreted correctly.

PROVIDING FLEXIBILITY IN GROUP SIZE

4.04 Flexibility in group size is obtained from key and cross-connection arrangements incorporated in the circuit. The detectors and associated scan switch wipers and banks of terminals are arranged in pairs, each pair controlled by an F- key which can switch the wiper serving as the input of one detector over to serve as the output of the mate detector (see Fig. 3). As an example, operation of the F1 key removes No. 5 detector from service and connects No. 5 wiper to the output of No. 1 detector so that the terminals of No. 5 bank serve to distribute the busy registrations on an individual lead basis. Since all the wipers move over their banks in synchronism, each output terminal in No. 5 bank represents the corresponding input terminal in No. 1 bank. The output terminals are extended by patching cords to the cross-connection field in the register cabinet where the corresponding terminals comprising a study group may be strapped together and connected to the assigned usage register. F2, F3, and F4 keys are similarly arranged to control detector pairs numbered 2 and 6, 3 and 7, and 4 and 8.

Setting up the Recorder

4.05 The scanner and register cabinets will normally be placed side by side as close as practicable to the point at which connections to the circuits under study will be made. Assignments of these circuits to the scan switch bank terminals will be made, taking into account the size of groups, type of busy indication, and need for 10-second scanning. Connections will be made between the scanner patch jacks and the terminals of circuits studied by means of cords, and extension cords if necessary, supported in temporary fashion on distributing frame shelves, cable racks, or other superstructure. Attachment and extension cords have a length of 25 feet each. Fig. 4 indicates the manner of associating the

various equipment units. The scanner unit is supplied with 110 volts ac and 48-volt battery and ground by cords plugged into switch frame outlets normally available. The two cabinets are patched together by a 2- and a 12-conductor cord, plus as many 20-conductor cords as required to handle the number of flexibly-arranged terminals assigned.

4.06 The patch cords for flexible terminals will normally be connected so that jacks numbered 512, 534, 556, 578, and 590 of the scanner unit will be patched in sequence to jacks designated 000-019, 020-039, 040-059, 060-079, and 080-099 in the register cabinet, with similar treatment for succeeding sets of five jacks. With this arrangement, the association between the circuits assigned to bank 1, the connecting cord leads, scanner bank terminals, and "XD" terminals of the cross-connection field will be as shown in Table B. Similar relationships may be arranged between circuits assigned to banks 2, 3, and 4 and "XD" terminals 100-199, 200-299, and 300-399.

4.07 The F- keys will be operated as required to provide the necessary number of flexibly arranged terminals and the B- keys will be operated for any of detectors No. 1 to 4 which will be required to scan circuits presenting a battery-busy indication.

4.08 Strapping will be applied to the terminals in the cross-connection field in accordance with the pattern of assignments for flexible terminals. For a bank of 100 terminals treated as a single group, only a single cross-connection between the corresponding detector output terminal (D1 to 8) and the assigned usage register is needed. This cross connection will also be provided for banks arranged for many small groups if a quick total of the several group registers is desired as discussed in 1.09.

Setting Program Timer

4.09 The program timer furnishes a pulse to start each hourly measurement period when the recorder is in operation. When thus started, scanning continues for a minimum of 36 cycles (1 hour). Scanning may be started on the hour or on any quarter- or half-hour, for as many hours as many times during the day as required.

4.10 When connected initially, the timer is set to the correct time of day by turning the minute hand in a clockwise direction until the proper hour lies opposite the 60-minute index, then advancing the hand the proper number of minutes past the hour. In order that usage measurements will be taken as closely as practicable between the hours indicated by the program timer, the latter closes the starting circuit a little in advance of the indicated time. This compensates for a delay interval which is provided in the scanning control circuits to insure that the electronic detectors are properly warmed up before the first scanning cycle starts.

Table B – Association of Circuits Assigned to Bank 1 With Connecting Cords, Bank Location, and "XD" Terminals

CIRCUIT	CONN. CORD PATCHED TO JACK NO.	CONNECTING CORD LEAD NO.	BANK LOCATION LEVEL NO.	BANK LOCATION TERMINAL NO.	"XD" TERMINAL NO.
1-10	112	0-9	1	1-9, 0	000-009
11-20	112	10-19	2	1-9, 0	010-019
21-30	134	0-9	3	1-0, 0	020-029
31-40	134	10-19	4	1-9, 0	030-039
41-50	156	0-9	5	1-9, 0	040-049
51-60	156	10-19	6	1-9, 0	050-059
61-70	178	0-9	7	1-9, 0	060-069
71-80	178	10-19	8	1-9, 0	070-079
81-90	190	0-9	9	1-9, 0	080-089
91-100	190	10-19	0	1-9, 0	090-099

4.11 When the timer is set, the notched day wheel is also set by turning it in a counterclockwise direction until the letter representing the current day of the week is opposite the index mark on the faceplate. If the same hourly measurements are to be made for the business days of consecutive weeks, the Saturday and Sunday records can be omitted by inserting cutout pins in the day wheel holes which represent those days of the week. It will be noted that the letter X is used to indicate Sunday. A holiday occurring during the week can be omitted in similar fashion.

4.12 The program for recorder operation is set up by adjusting time selector tabs on the perimeter of the hour dial. In their normal position, these tabs project forward from the face of the dial. One tab will be fully depressed to mark the desired starting time of each hour of usage measurement. If one of the tabs to be depressed happens to be near the top of the dial, the time selector pawl should first be raised to avoid possible damage and to insure proper operation. All other tabs, except those indicating each hourly starting point, should be in their normal outward position. A paper clip inserted in the notch of the tab is a convenient tool for setting the tabs. As an example, if these hours are to be recorded in the morning, 9:00 through 12:00 o'clock, tabs opposite 9, 10, and 11 in the daytime field are pushed in. If the hours were 9:30 through 12:30, tabs opposite 9:30, 10:30, and 11:30 would be depressed.

Preparation of Camera

4.13 The standard traffic register camera can be attached to the register cabinet by inserting the camera handle extensions into V-shaped brackets at the top of the register field and plugging the camera cord into the camera outlet in the scanner cabinet. The small, electrically-driven clock located within the camera hood is set to the correct time when the camera is first connected. The standard 20- or 36-exposure rolls of film available for loading the camera will actually provide for 33 or 60 photographs, respectively. The camera contains an exposure counter for checking that sufficient film remains for the pictures to be taken. It also provides for the insertion of a designation card to identify the record.

Recorder Operation

4.14 The controls for recorder operation are set sometime before the first hour of measurement is to begin. The program timer will be set up, as previously described in 4.11, by depressing one tab for each hour desired. The camera key will be operated to the 1/2 HR position to take pictures at half-hourly intervals; otherwise they will be taken hourly. The 10-SEC SCAN key will be operated if any circuits are to be scanned at the 10-second rate. Last, the start (ST) key is operated.

4.15 The recorder now awaits the arrival of the scheduled starting moment on the program timer, whereupon the 10-second interval timer is started. Six 10-second intervals are counted to allow time for the electronic detectors to reach operating temperatures and during the first interval the P lamp in the scanner cabinet is lighted as an indication that the camera control circuit is prepared to take a picture. A pulse for operating the camera is sent 2 seconds before the end of this interval. The IP lamp in the register cabinet is also lighted during the initial picture to mark the exposure on the film as the first of a new sequence of records. At the beginning of the seventh 10-second interval, scanning starts and progresses automatically, as described in 4.02 and 4.03, completing a cycle through the ten switch levels every 100 seconds. At the end of every cycle, the cycle count switch is advanced, and the cycle count register is scored. During the thirty-sixth cycle (and also the eighteenth if the 1/2 HR key is operated) the P lamp is lighted and at the end of the cycle the camera will be operated. After 36 cycles (1 hour) have been completed, the cycle count switch is reset in preparation for counting the succeeding hour. When operation continues for several consecutive hours, after the first hour there will be no warm-up delay before the first cycle. At the conclusion of each programmed record period, scanning stops until the program timer reaches the start of another period. Operation may be stopped at any point by manually releasing the ST key. When the record is completed, all keys are restored to normal.

Manual Camera Operation

4.16 If it is desired to photograph the registers at times other than the hourly or half-hourly intervals, the camera may be oper-

ated manually by means of the PH key. When this key is momentarily operated at the conclusion of scanning on any level in any cycle, a properly timed pulse will be generated to operate the camera. If a picture is desired when scanning is not in progress, it will be necessary to hold the PH key operated for approximately 2 seconds.

5. TEST OPERATION

5.01 Operation of the TST key places the scan switch and detectors under manual control and disables the camera control circuit.

MANUAL STEPPING

5.02 When the ST key is operated in conjunction with the TST key, the 10-second timer is started independently of the program timer setting and a 60-second warm-up period is measured to insure proper operation of the detectors. At the start of the next 10-second interval, the scan switch automatically steps vertically to the first level. Horizontal stepping is then accomplished manually by operating the ADV key once for each step. On the eleventh rotary step the switch is automatically released and then stepped vertically to the next level. In similar manner, the scan switch may be advanced through the remaining levels a step at a time. At the end of the cycle or at any point in the cycle if it is desired to start a new test cycle, the RLS key may be momentarily operated to release the scan switch and reset it to start at the first level without allowing a warm-up delay.

DETECTOR OPERATION

5.03 During a test cycle, the detectors will function only when the READ key is momentarily operated while the scan switch wipers are resting on the terminals between steps. The READ key enables the detectors to respond to appropriate busy conditions which may be placed on the bank terminals. Detector operation may be checked by observing the operation of usage registers connected to the detector outputs. Repeated checks may be made on any particular scan switch terminal by repeatedly operating and releasing the READ key.

TESTING CORDAGE

5.04 The 20-circuit connecting cords may be tested for continuity and crosses by operating the recorder on the test cycle basis with the F- key for one detector pair operated and the corresponding output bank terminals patched to the register cabinet. Traffic registers will be cross-connected individually to the terminals representing one or more of the 20-circuit patch jacks. Cords to be tested are plugged into the input jacks, and as the scan switch is stepped to each terminal in turn, the busy condition is manually applied to the corresponding lead in the cord and the READ key is then operated. The register assigned to that particular terminal should operate if the conductor is continuous and not transposed. A check for crosses may also be made by applying the busy condition to the terminals adjacent to the one under test and noting that the register does not score when the READ key is operated. Extension cords may be simultaneously checked by connecting one or more in tandem with the connector cords.

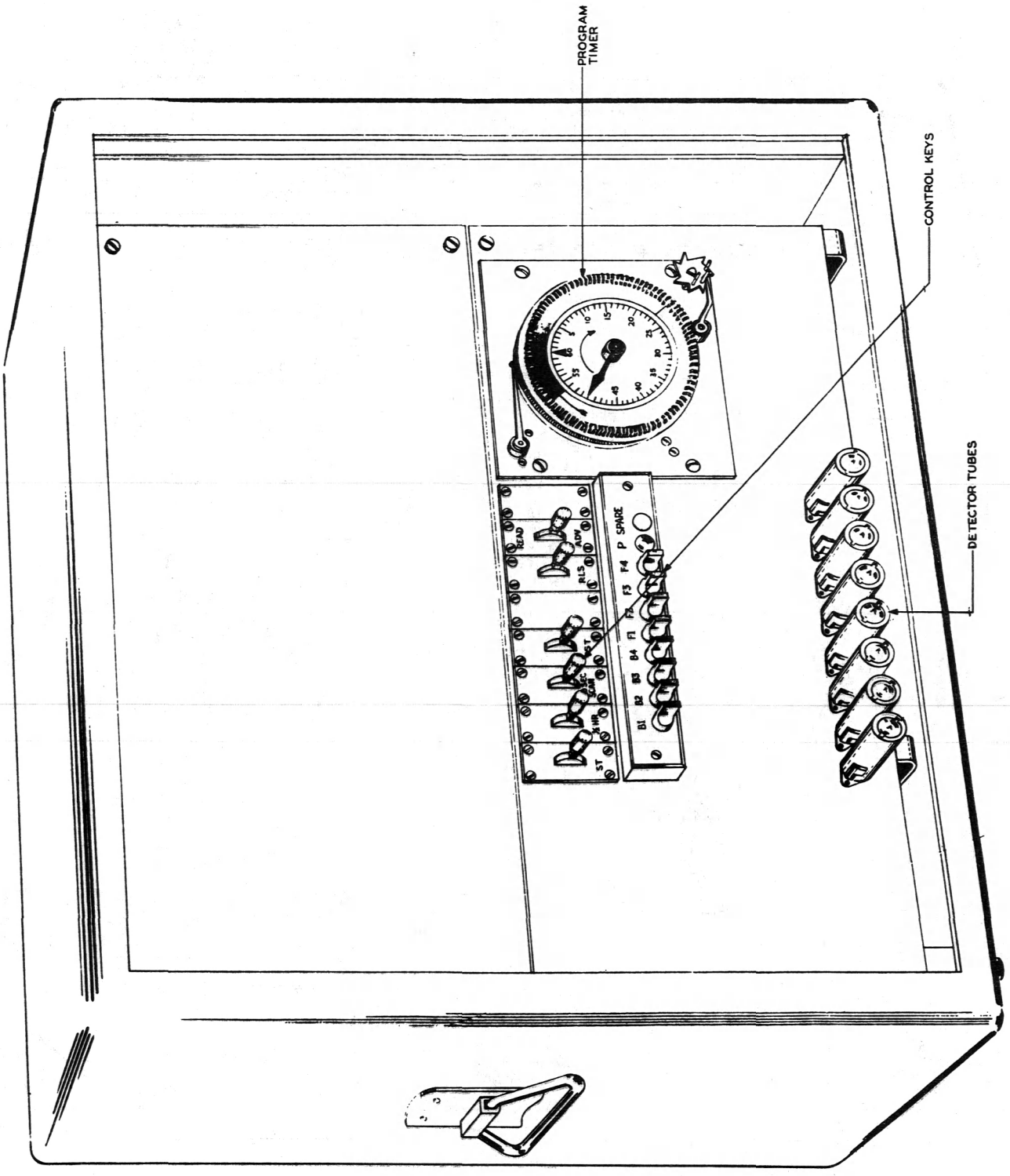

Fig. 1A – Scanner Unit — Front View

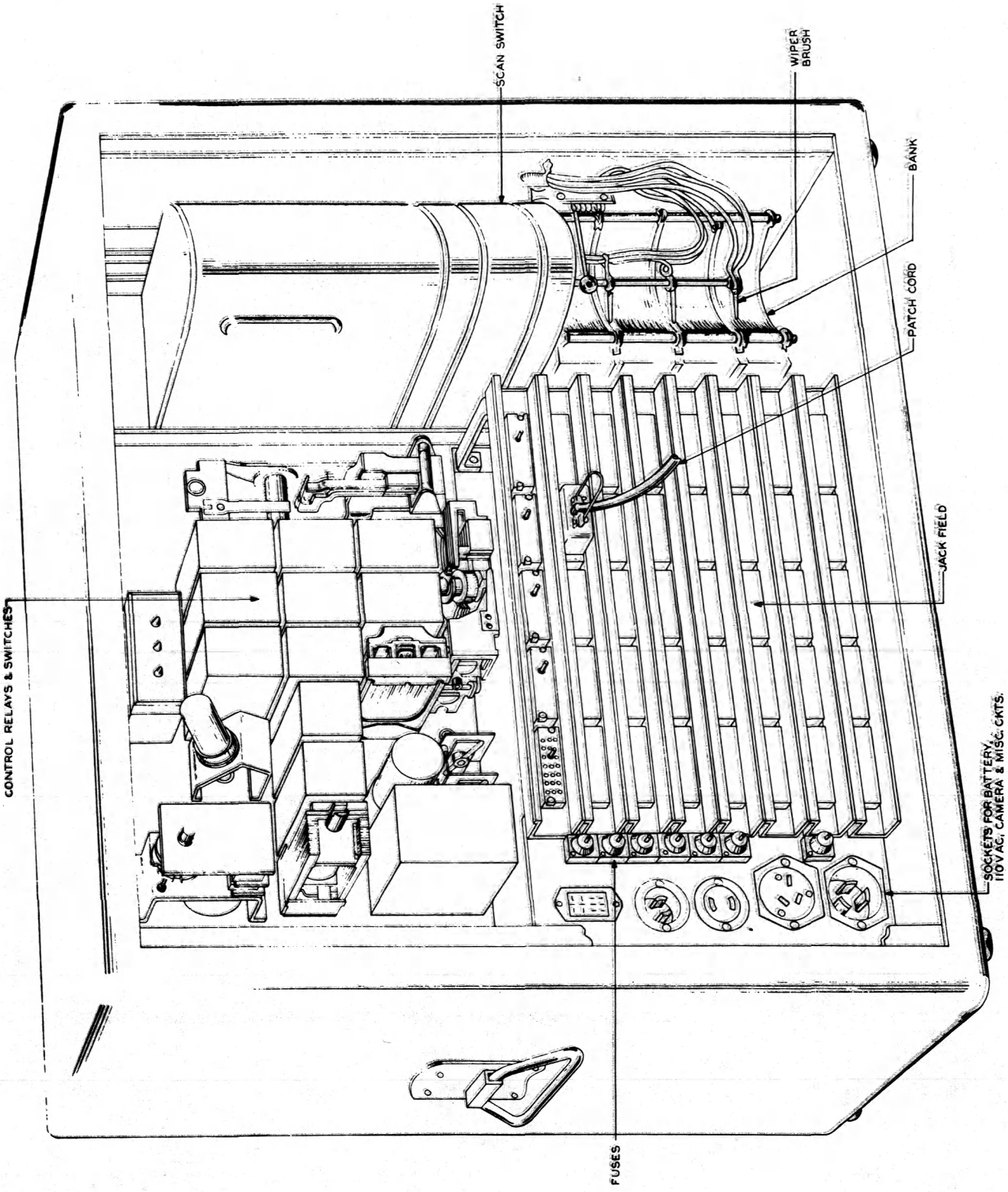

Fig. 1B – Scanner Unit — Rear View

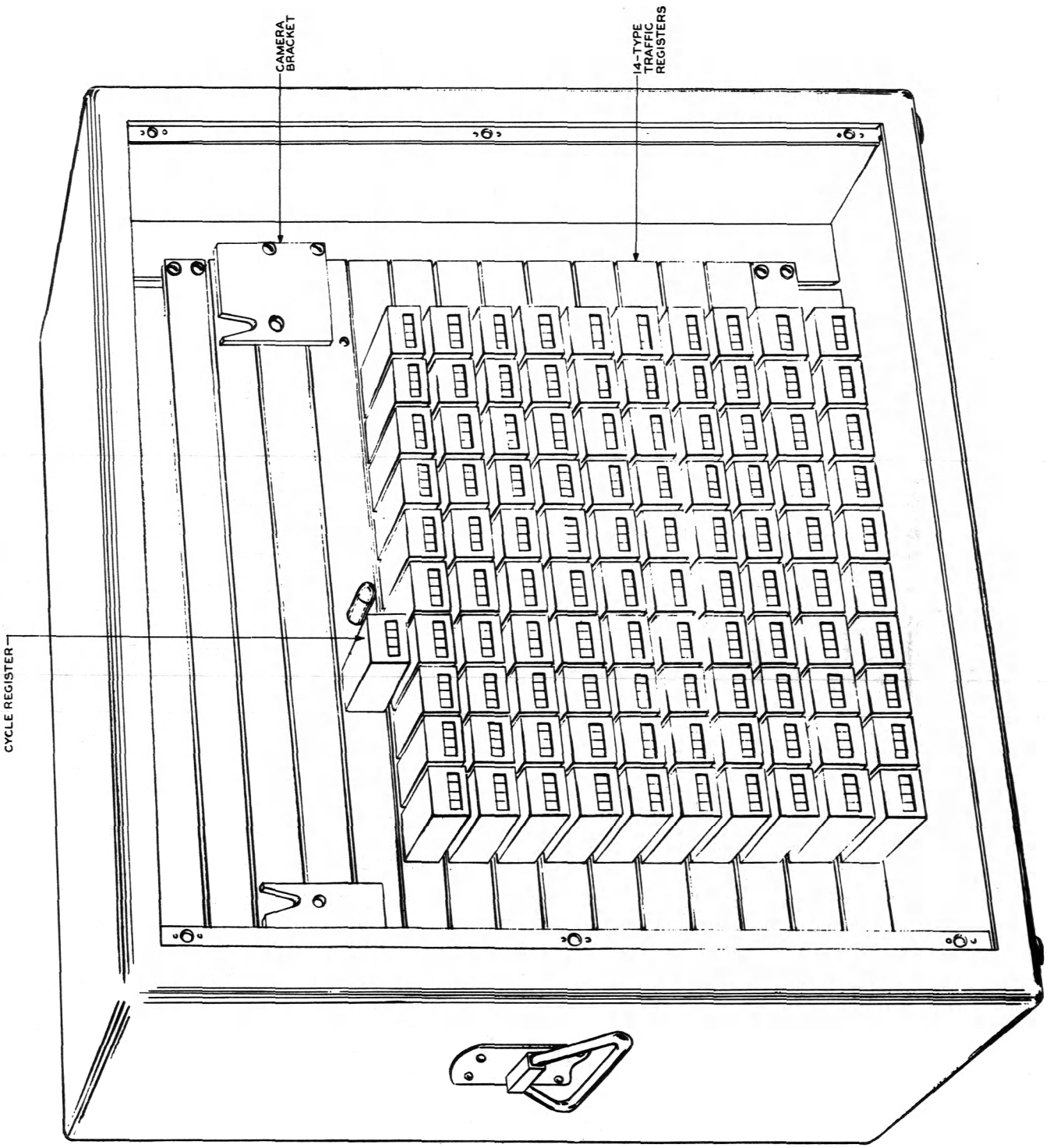

Fig. 2A – Register Unit — Front View

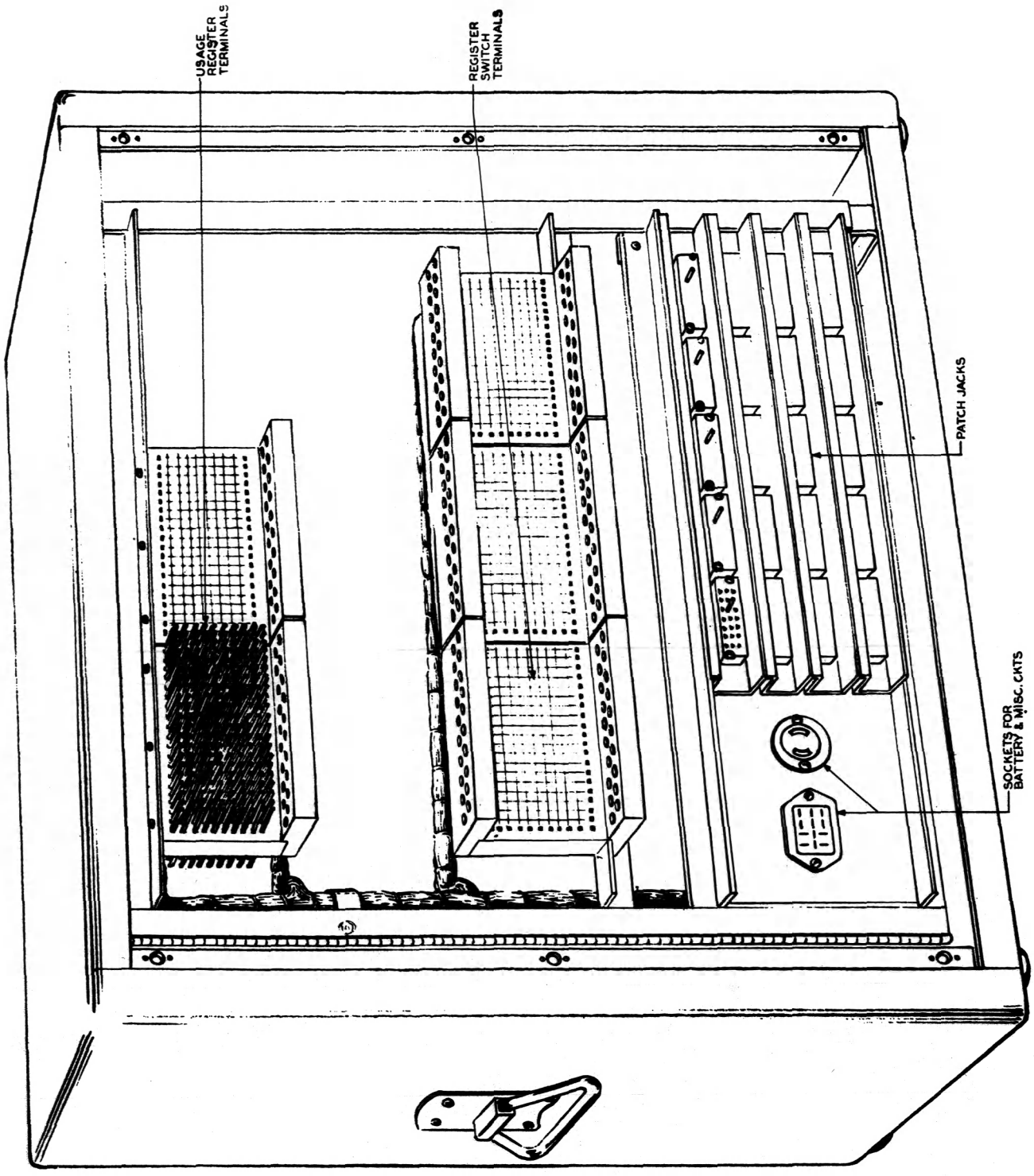

Fig. 2B – Register Unit — Rear View

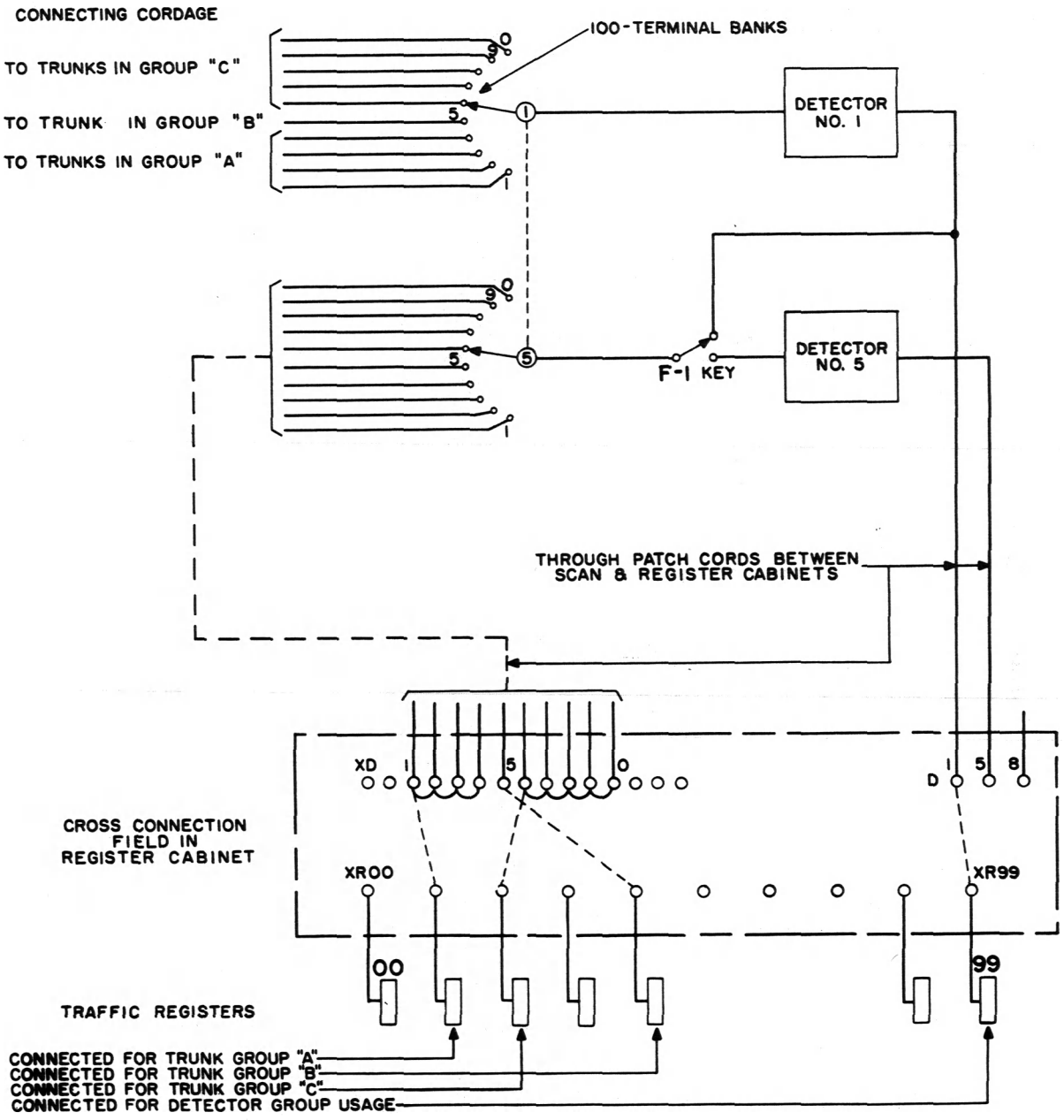

Fig. 3 – Simplified Schematic for Flexible Grouping of Terminals

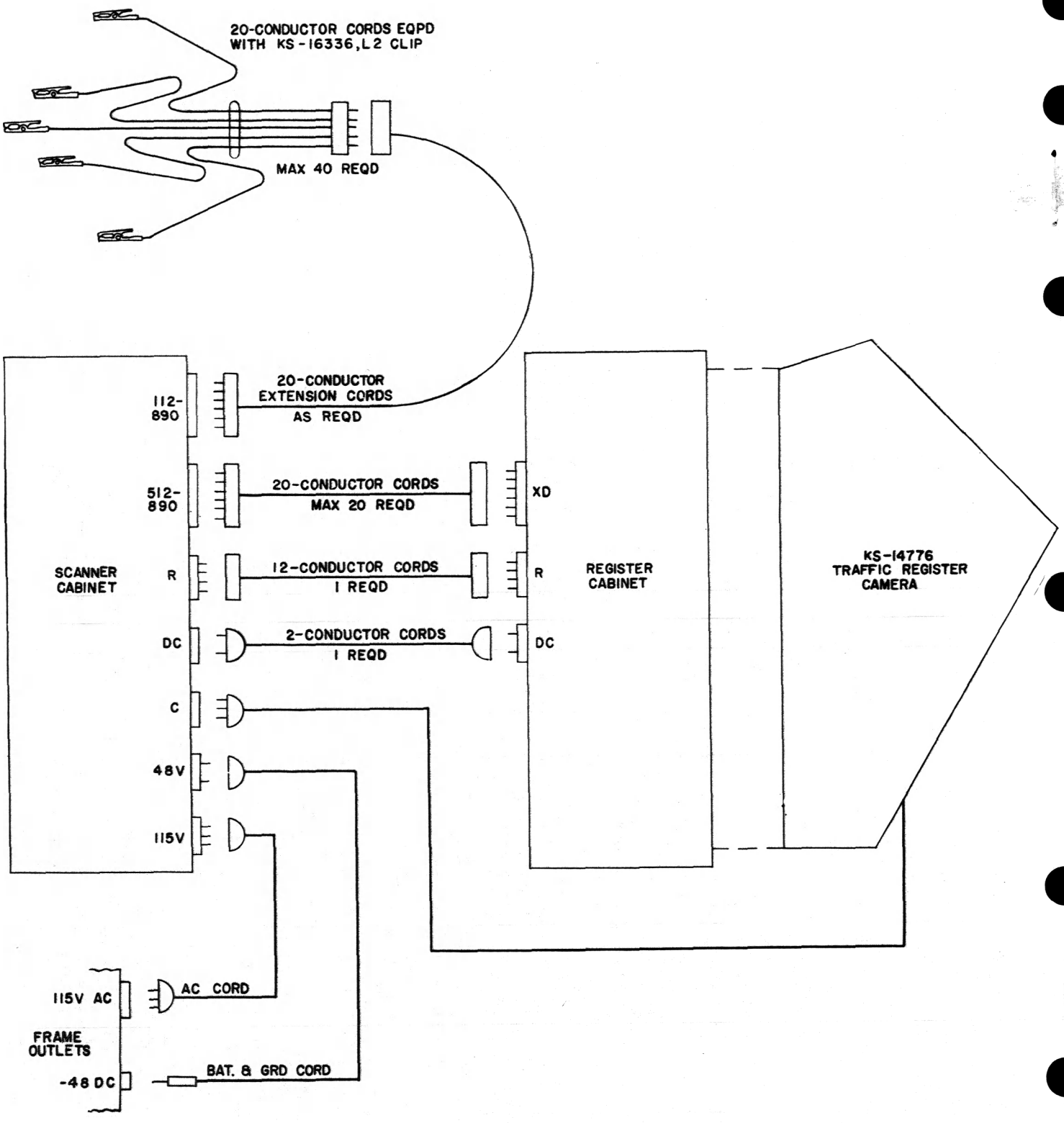

Fig. 4 – Association of Equipment Units