TRAFFIC USAGE RECORDER
GENERAL DESCRIPTIVE INFORMATION

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1. GENERAL

1.01 This practice describes the traffic usage recorder and its function as a measuring facility in obtaining traffic load information for dial switching systems. The switch-count method of testing circuits is employed in its operation and the traffic load is measured in usage units of hundred call-seconds (ccs) per hour. The principal elements of the recorder are as follows:

(a) Traffic usage recorder frame containing the scanning and testing equipment.

(b) Control panel containing the control features.

(c) Traffic registers on which the information is recorded.

1.02 This section is reissued to cover the provision of an optional feature for limited scoring of usage registers which makes it possible to accumulate only busy hour data on a weekly basis for certain of the connecting circuits, even though the recorder is operated during several other hours. This issue also includes a description of an automatic test for crosses in the crossbar switch verticals and for checking the ability of detectors to operate properly.

1.03 Since this is a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.04 The traffic usage recorder is designed for permanent installation as a part of the switching system and is applicable to the step-by-step, panel, and crossbar types of local, tandem, and toll switching systems, and associated switchboards. Usage can be readily measured on such circuits as trunks, links, district junctors, selectors, subscriber lines, subscriber senders, and other components of these systems. The recorder is applicable to securing traffic data for engineering and administrative purposes and as a tool in securing division of revenue information. It provides an improved traffic measuring facility for all types of switching systems and was designed to secure automatically, directly, and at unrestricted frequency, accurate load data in standard usage units of ccs per hour.

1.05 *Capacity:* There is a maximum of 3600 terminations for test leads in the traffic usage recorder frame. These are available in increments of 600 each. It is possible to associate as many as 12 traffic usage recorders, each with 3600 terminations, with one master control panel.

1.06 *Lead Connections:* Test leads for circuits to be measured are cabled to the traffic usage recorder generally on a permanent basis from test points in the central office equipment. Leads may be cabled from test points for any spare available facilities. However, provision will be made in certain cases for association with outgoing and incoming trunks by cross connection at distributing frame terminations. Also, for obtaining customer line usage, temporary connections will be established by cord and jack facilities at distributing frames, except in No. 5 crossbar offices where the attachment will be made at line link frames. Means are available at the recorder for arranging these test leads into the desired test grouping. For day-to-day administration of these test groups, only cross-connection changes are required to alter the test group size. Additional cabling of test leads to the recorder is necessary only when an addition is made to the office.

1.07 *Group Size:* Flexibility in grouping of the output leads permits the testing of one to 600 circuits as a group. However, it is generally desirable to assign no more than 300 circuits to a group, in order to avoid scoring more than 9999 counts in 1 hour on the associated usage register.

1.08 *Scanning Cycle:* All test lead terminations are scanned once each 100 seconds. This constitutes one scanning cycle. There are 36 cycles completed each hour of operation. The total number of cycles completed is scored on a traffic register. For greater accuracy in measuring facilities having very short holding times, arrangements are available to multiple the test leads of these circuits to ten regularly spaced terminations so that these circuits are effectively scanned at ten times the normal scan rate.

1.09 *Operation Control:* The traffic usage recorder is under control of the control panel at all times. The machine can function automatically under control of a program timer and be started and stopped at predetermined intervals within 1 day. These operating periods may be automatically repeated for predetermined days within a week. The machine can be started manually and stopped manually at the end of any cycle by means of keys. Also by keys, one recorder, a portion of a recorder, or several recorders may secure usage data at the same time.

1.10 *Detector Circuits:* Busy-detector circuits are available to cover the various busy indications encountered in the different types of circuits under observation.

1.11 *Recording:* The 14-type traffic registers are used to record the data. The register readings for 1 hour of testing will normally indicate hourly usage in ccs directly. However, in cases where circuits are scanned ten times in a cycle (see 1.08) the readings must be divided by ten.

1.12 *Camera:* The traffic register camera may be furnished for reading these usage registers and provides a convenient means of obtaining accurate readings at frequent intervals. One camera photographs a field of 150 registers (15 rows of 10 per row). Control for photographing at 1/2 hour or 1 hour intervals is provided. Means are provided to operate traffic register cameras associated with registers other than usage registers. By a key, these cameras can be associated with the camera control features of the traffic usage recorder.

1.13 *Ultimate Recording:* The recorder has been designed to be easily adapted to fully automatic recording on some medium other than registers, thus permitting the automatic processing of all traffic data to be realized at some time in the future.

2. OPERATING PRINCIPLES

2.01 The traffic usage recorder records usage in ccs per hour by employing the switch-count method of testing. This method, simply expressed, involves the repeated scanning of busy-test terminals for the circuits under study and the cumulative recording of the number 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, 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.

2.02 Because the load carried by individual links in any of the ten link groups within each of the major switching frames in crossbar-type systems bears a predictable relationship to the total load carried by the group, it is practicable and economical to determine the total office load by measuring only certain selected links within each group on all link frames involved. The total office load is derived from the usage of the sampled links by applying the ratio which exists between total calls on which any link was selected and the calls on which the sampled links were selected. These call volumes may be obtained by providing sample link and total peg count registers which will be scored by the markers used to establish the connections.

2.03 In securing usage data for balancing the loading of subscriber line groups, it is desirable to accumulate weekly totals of the busiest 2 or 3 hours each day. The limited scoring feature provides a means of restricting the operation of usage registers associated with such equipment as the line finders or line links to the

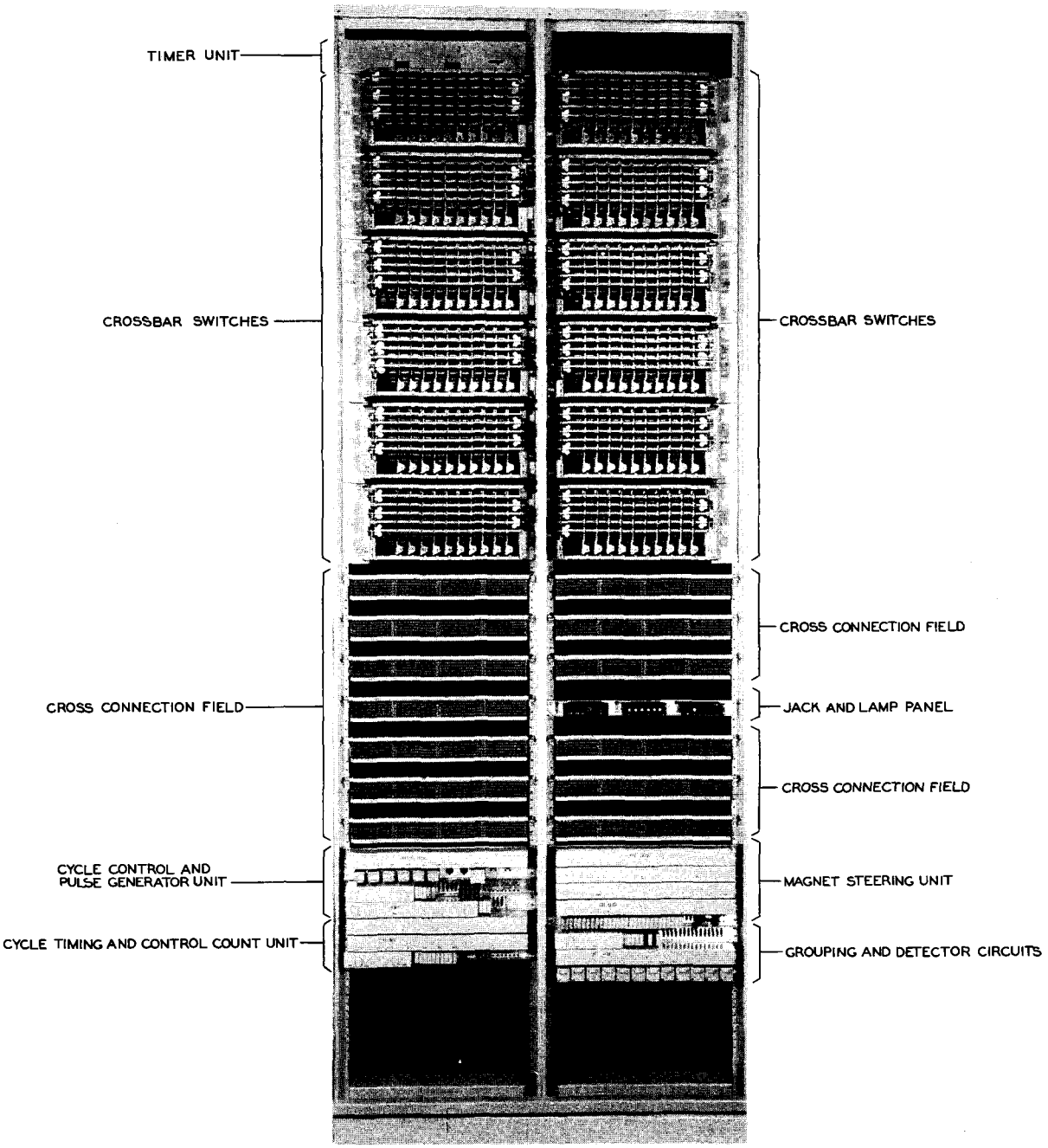

Fig. 1 – Traffic Usage Recorder Frame

required hours as set on an auxiliary program timer, even though the recorder frame is operated for several additional hours. This arrangement avoids the necessity of making subtractions of the daily register readings to eliminate data for the undesired hours of operation. Relays operated by the auxiliary timer close the path from ground-busy detectors to LSC terminals in the cross-connection field, which may be associated with register switch terminals as required.

3. EQUIPMENT ELEMENTS

3.01 As stated previously, the principal elements of the traffic usage recorder are:

Traffic usage recorder frame.
Control panel.
Traffic registers.

A. Traffic Usage Recorder Frame (Fig. 1)

3.02 This is a standard double-bay frame, 4 feet 1-1/4 inches wide and 11 feet 6 inches high, on which is mounted the equipment required for scanning a maximum of 3600 test leads. It is located in the switch room.

3.03 ***The SCAN switches*** are 100-point, 6-wire crossbar switches. The stationary springs of all like-numbered crosspoint contacts on each switch are multipled together and are wired to a cross-connection field for association with busy detectors. The test leads from the circuits to be tested are cabled to the armature springs of the contacts. There is a maximum of 600 terminations per switch. From one to six SCAN switches can be mounted on the frame. Fig. 2 shows the lead assignment and contact multiple for a SCAN (or REGISTER) switch.

3.04 ***The REGISTER switches*** are 100-point, 6-wire crossbar switches. The stationary springs of all like-numbered crosspoint contacts on each switch are multipled together and are wired through a cross-connection field to the output of the busy detectors. The register leads of the switches are wired from the armature springs of the contacts to a cross-connection field for circuit-grouping flexibility. There is a maximum of 600 output leads per switch. REGISTER switches are always paired with like-numbered SCAN switches. A maximum of six REGISTER switches can be mounted on the frame.

3.05 ***The timer unit and the cycle timing and control count unit*** contain the circuits which control the over-all functions of the traffic usage recorder, including the scanning interval timing. These units are mounted only on the initial frame of any installation associated with one master control panel.

3.06 ***The cycle control, pulse generating, and magnet steering units*** are provided on each frame. They contain the steering control circuits for the switch, hold, and select magnets.

3.07 ***The grouping circuit*** contains the relays required for the register grouping feature as described in Part 4.

3.08 ***The busy-detecting circuits*** are provided to cover the various busy-test conditions encountered in the different types of circuits to be observed. The 100 leads of a like-numbered contact group per switch are the minimum associated with a detector. Like-numbered contacts on more than one switch on the same frame may be associated with the same detector, if the busy-test conditions are the same.

3.09 ***The cross-connection fields*** permit the grouping of output leads from REGISTER switches for association with traffic registers, as required. In order that a group may extend over more than one switch, 80 common leads for interswitch connections and rings for supporting additional cross connections are provided. There are also provisions for associating groups of 100 test leads with a detector, for terminating traffic register leads on each switch cross-connecting field, and means of connecting the register grouping feature described in Part 4.

3.10 ***The jack and lamp panel*** contains the test jacks, keys, and lamps required for plant maintenance.

B. Control Panel

3.11 The control panel contains the control keys, lamps, cycle-count register, and program timer for one to 12 recorders. The panel, in most instances, is located in traffic quarters rather than in the switch room and is available in two types of mountings.

(a) ***A wall- or column-mounted arrangement*** is contained in one or two metal cabinets, each 13-5/16 inches high, 11-1/2 inches wide, and 7-3/8 inches deep, with a hinged plexiglass window for easy viewing of keys and lamps. The cabinets are suitable for mounting either on a column or wall space. One contains the program timer, four lamps, cycle-count register and five lever-type control keys. Where a maximum of three TUR frames is required, up to three hand-operated rotary switches, one per traffic usage recorder frame installed, are also provided in this cabinet. Where more than three frames are required, all the rotary switches up to the maximum of 12 are located

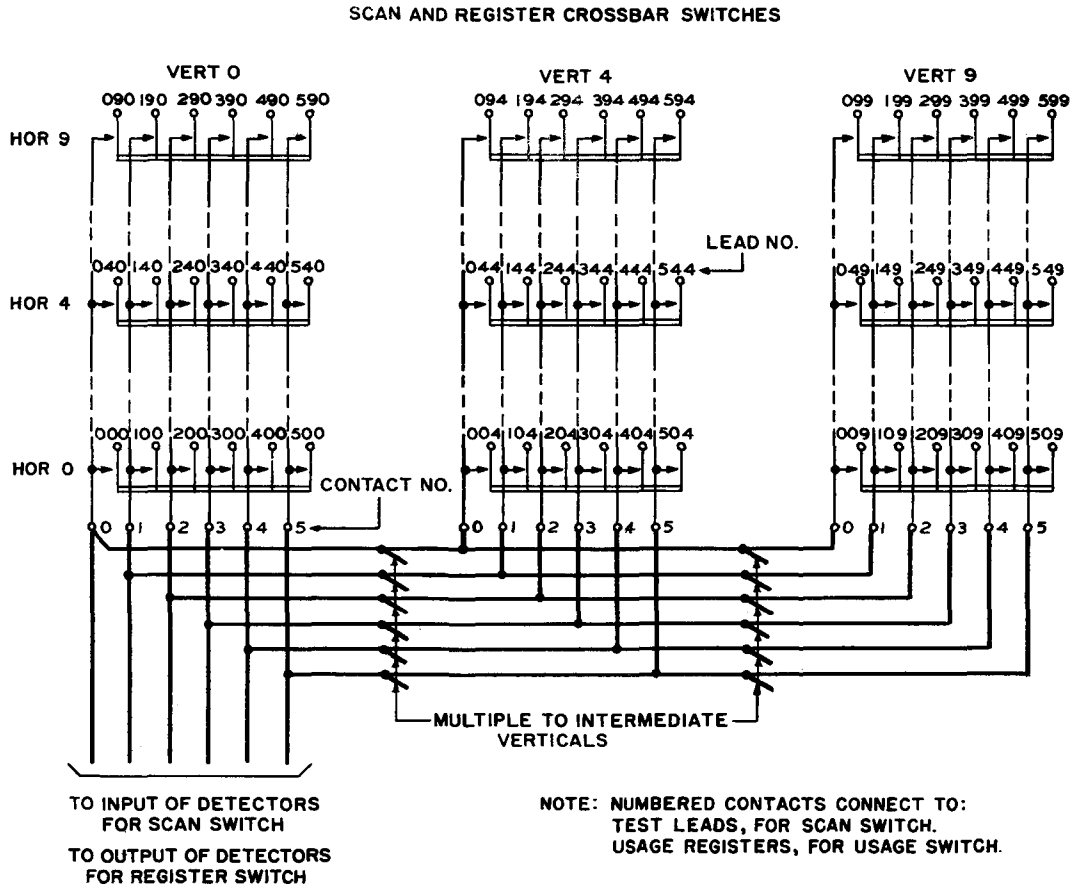

Fig. 2 – Lead Assignment and Contact Multiple

in a second cabinet below the first one. Earlier arrangements provide for a maximum of six frames and use lever-type keys instead of rotary switches.

(b) A rack-mounted panel is available for installation in a 23-inch equipment bay. All control equipment is mounted on a 7- by 23-inch mounting plate.

(c) A control panel formerly used in No. 4-type toll office traffic supervisory racks or cabinets has been discontinued.

3.12 Means are provided in these panels for controlling the functioning of the traffic usage recorder. Keys are provided for the following purposes.

(a) Selecting the recorder unit or portion of a unit to be activated.

(b) Scanning on an automatically or manually controlled basis.

(c) Stopping the recorder at the end of the current scanning cycle.

(d) Control of the photographing time intervals of both usage and other traffic registers.

(e) Making a continuity test of usage leads in a No. 4A or 4M crossbar toll office on idle intertoll trunks and also recording the number of intertoll trunk block connector terminals associated with trunks locked out of service or made busy at the assignment patch bay.

(f) Control of a manual test of proper usage register operation, including detector functioning and cross connections. Lamps are provided for visual indications of the in-

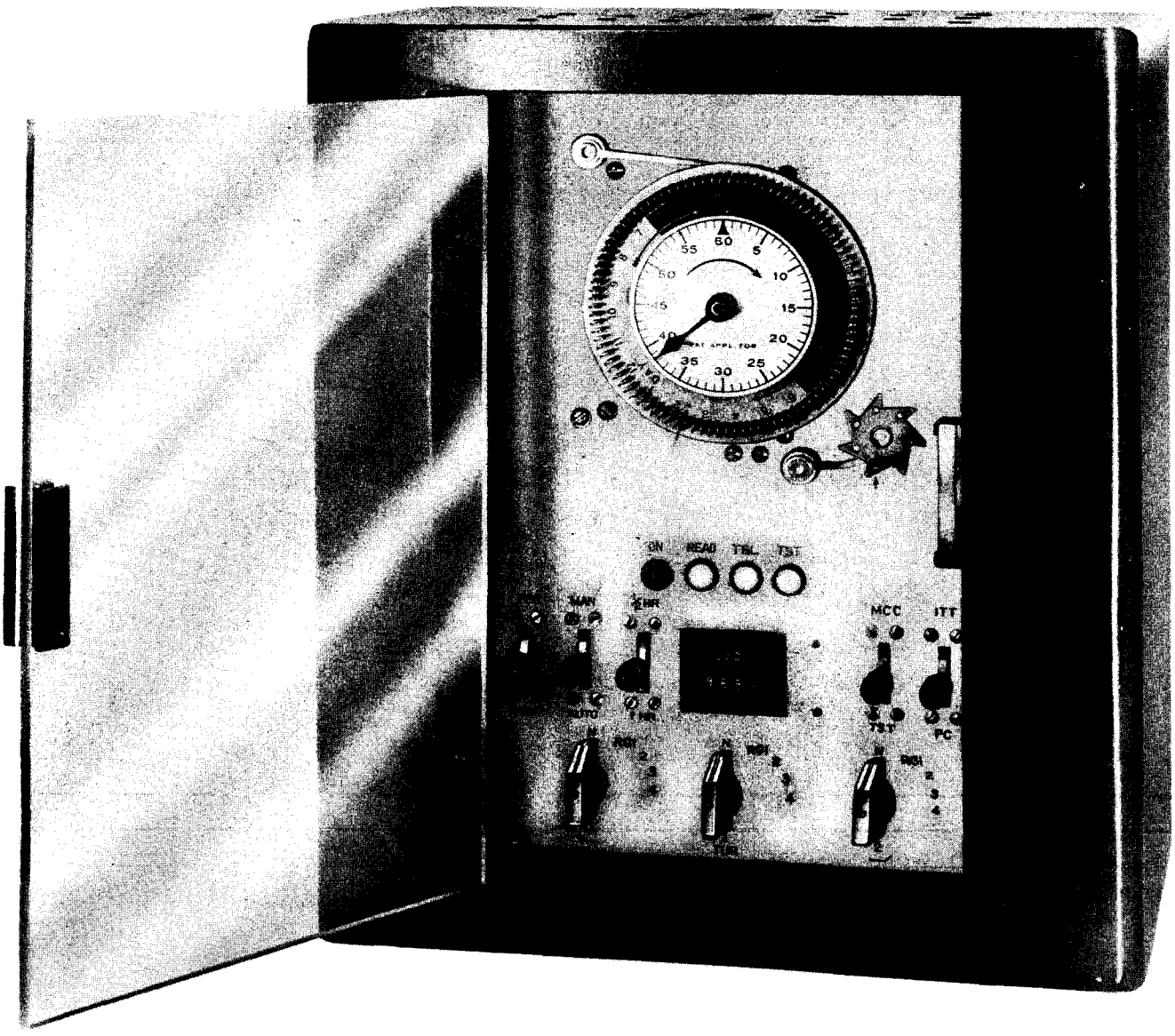

Fig. 3 – Wall- or Column-mounted Control Panel

service, trouble, or testing conditions of the recorder. Other equipment includes a 24-hour, day-of-the-week program timer, and a cycle-counting register.

C. Traffic Registers

3.13 The traffic registers associated with the traffic usage recorder are located in a standard traffic register rack bay generally located in the regular line-up traffic register rack. The maximum number of registers per bay is 300, to facilitate the photographing of 150 per camera unit, and they must be of the 14 type. Three classes of registers are required and are as follows:

(a) ***Cycle-count Registers:*** In general, one cycle-count register is mounted with each group of registers photographed. However, if the registers serve two or more groups of circuits, by reason of the group register feature, two or more cycle-count registers are provided for that register group, one for each group of circuits.

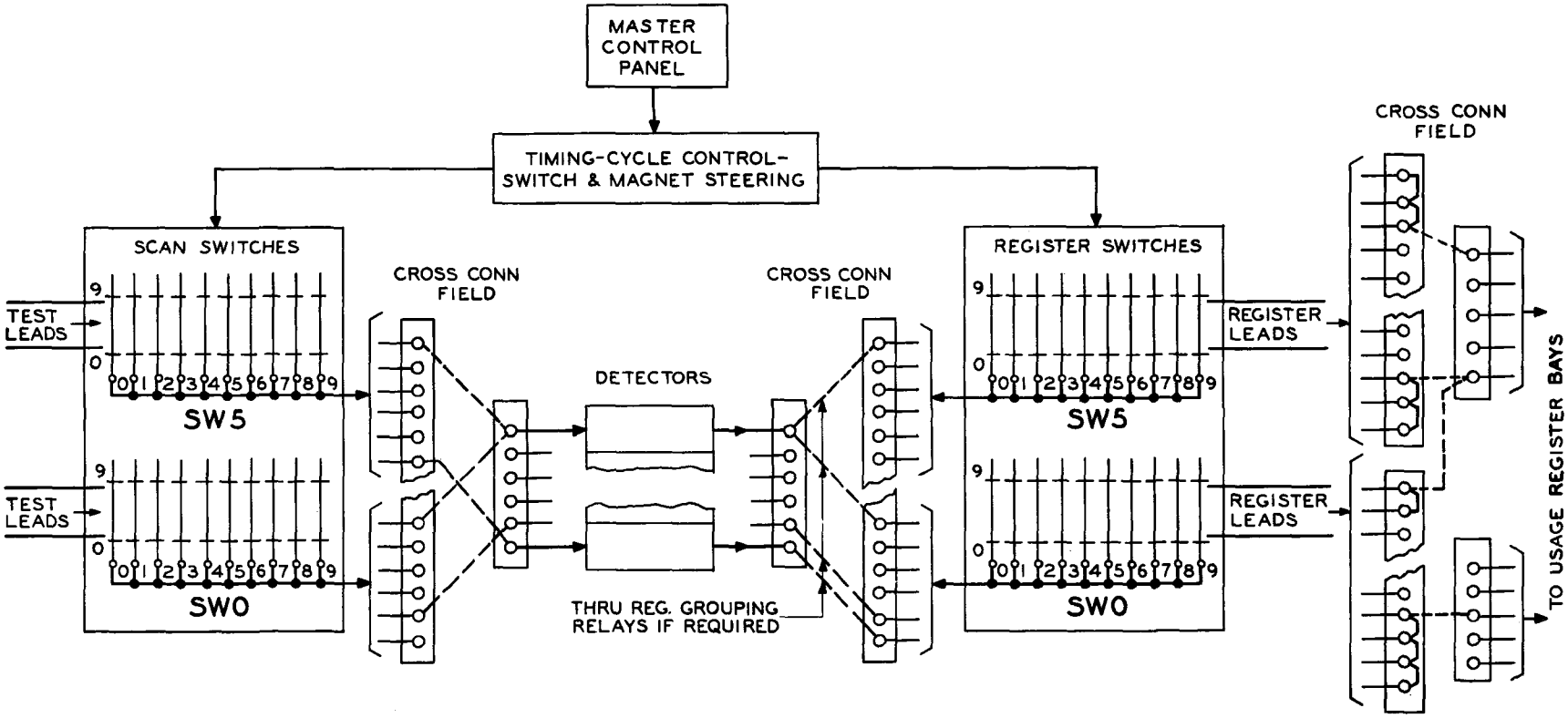

Fig. 4 — Simplified Schematic of the Traffic Usage Recorder

(b) *Usage Registers:* The usage registers are mounted ten per mounting plate and are cabled to the cross-connection fields for association with the circuit groups. Wiring terminations for 600 usage registers are available per traffic usage recorder.

(c) *Detector Group Usage Registers:* Detector group usage registers may be provided to secure total usage on large classes of facilities which are subdivided into many smaller groups for association with regular usage registers. Total usage data is generally required for engineering purposes in connection with originating and terminating channels in dial system offices, and the provision of detector group usage registers not only avoids the necessity of adding together the usage of many small groups, but also permits total usage information to be secured during periods when the individual usage registers are associated with other equipment through the use of the register grouping feature. One detector group usage register may be assigned to a maximum of 300 circuits scanned by a single detector.

D. Auxiliary Program Timer

3.14 When the limited scoring feature is desired, an auxiliary program timer is furnished. This is an industrial type 24-hour time switch mounted in a small steel box and located near the regular control panel. The dial carries the hour marks from 1 to 12 twice repeated and is subdivided into quadrants designated MORNING, AFTERNOON, EVENING and NIGHT to further distinguish between the day and night hours. There is a small slot at every quarter-hour point around the circumference of the dial that serves to position the ON and OFF trippers, which are locked in place with thumb screws. A beehive-type pilot lamp mounted with the auxiliary timer is lighted when the limited scoring period is in effect.

4. METHOD OF OPERATION

4.01 The normal functions of the traffic usage recorder are controlled by the operation of the keys and program timer located on the control panel. 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) Unit operation and register grouping.

(c) Excluding registration of made-busy intertoll trunks in No. 4A and 4M toll offices.

A. Scanning and Registering

4.02 The SCAN switches described in 3.03 are used to connect test leads from the various circuits to be measured to the detector circuits for the recognition of busy conditions present on these leads. Each cycle of operation starts with the closing of the lowest-numbered crosspoints on the first pair of SCAN and REGISTER switches and is progressive (one crosspoint at a time) across each horizontal level and proceeding upward through each switch pair, in turn, on the frame. The six circuits associated with the operated crosspoint of the SCAN switch are tested simultaneously for idle or busy conditions. The six detector circuits will function when connected to test leads having busy conditions on them and operate the associated usage registers through the REGISTER switch crosspoints and the cross-connection field. The closure of scanning and registering contacts is advanced in synchronism, from crosspoint to crosspoint, by the timing and cycle-control circuits and steering relays, completing a cycle through all crosspoints within a period of 100 seconds. Fig. 4 is a simplified schematic of the traffic usage recorder.

B. Unit Operation and Register Grouping

4.03 One frame selection key (hand-operated rotary switch) is provided for each recorder frame in an installation. This key has four operated positions designated RG1 to RG4. In addition to selecting the particular recorders which will function during a given record period, these keys also control the register grouping feature, which permits up to four different groups of test leads to be associated with the same usage registers. Lever-type keys are used for this purpose in earlier installations. With the key operated to the RG1 position, the registers can be used to record the usage on certain groups of circuits, while the same registers can be reused for other groups with the key in the RG2 position, and for still other groups in RG3 and RG4 positions. This feature makes

possible a considerable saving in traffic registers when circumstances permit taking records on various facilities at different times. Provision is made in the cross-connection field for placing different circuit groups under control of any of the RG1 to RG4 key positions. These groupings may comprise all circuits associated with one or more SCAN switches, or any combination of portions of one or more switches, within the limitation that each 100 like-numbered contacts on any switch cannot be split. Group splitting may also be provided between two or more recorder units in consecutive order by specifying optional wiring which makes effective only the lowest-numbered operated RG key. With this arrangement, higher-numbered frames are inoperative when a record is being taken on a low-numbered frame.

C. Excluding Registration of Made-busy Intertoll Trunks — No. 4 System

4.04 In No. 4-type crossbar toll offices, intertoll trunk groups handling out-going traffic are usually arranged so that trunks may be added to or taken from the group on a temporary basis merely by patching at the assignment patch bay. In order that usage measurements may properly reflect the current condition of each group, trunk block terminals wired to patching jacks should be connected at the traffic usage recorder. Because it is not desirable to record as usage the busy conditions placed on the test leads when intertoll trunks are made busy either at the patch bay or by being locked out of service at the test desk, a special busy condition is provided for these circumstances. This busy condition is positive 24-volt potential instead of the usual busy ground, and the traffic usage recorder detectors are arranged normally to recognize this condition as an indication not to score the usage register. However, by operating the PBR key at the control panel, the detector arrangement may be changed so that ***only*** made-busy trunks will be scored on the usage registers, as a means of checking the number of trunks out of service.

Setting Program Timer

4.05 The program timer furnishes a pulse to start each hourly measurement period when the recorder is under automatic 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, as many times during the day and for as long a period as required.

4.06 When connected initially or whenever reset, the timer is set to the correct time of day by turning the minute hand in a clockwise direction, as indicated by the arrow on the dial, until the proper hour of the day or night lies opposite the 60-minute index, then advancing the hand the proper number of minutes past the hour. In order that usage measurements be taken as closely as practicable between the hours indicated by the program timer, the latter closes the starting circuit 1-1/2 minutes in advance of the indicated time. This compensates for a delay interval which has been introduced in the scanning control circuits before the first scanning cycle begins, in order to provide a warm-up period for proper functioning of the detector circuits.

4.07 When setting the timer, the notched day wheel should also be set by turning it in a counterclockwise direction until the letter representing the current day of the week is aligned with the index mark when the wheel comes to rest under control of its own centering mechanism. It should be noted that the letter X is used to indicate Sunday.

4.08 The program for automatic operation is set up by adjusting time selector tabs on the perimeter of the hour dial. In their normal position these tabs project outward to the limit of their travel. 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 at the top of the dial, the time selector pawl should be raised to avoid possible damage. 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 3 hours are to be recorded in the morning, 9:00 through 12:00 o'clock, pins opposite 9:00, 10:00, and 11:00 in the daytime field are pushed in. If the hours were 9:30 through 12:30, pins opposite 9:30, 10:30, and 11:30 in the daytime field would be pushed in.

4.09 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 day cutout pins in the day wheel holes which represent those days of the week. A holiday occurring during the week can be omitted in similar fashion.

Preparation of Cameras

4.10 The cameras associated with the recorder contain exposure counters as a means of insuring that sufficient film remains for the pictures to be taken. They also provide for the insertion of a designation card to identify the record.

Verifying Traffic Register Association

4.11 A check of detector operation and the number of cross connections to each usage register can be made by having the recorder complete but one scanning cycle with the test (TST) key operated. This type of record may be particularly useful prior to the measurement of trunk usage where there is frequent change in the make-up of groups.

4.12 Such a record is best made under manual control. Depending on the arrangement of traffic registers, the proper unit selection keys are first operated to the desired RG1 to RG4 position. If each recorder unit has its own complement of registers, all may be checked simultaneously, and a unit selection key (RG1 to RG4) should be operated for each recorder unit. When register grouping is used as described in 4.03, separate checks may be made for each grouping of facilities, operating only the proper group key to activate the desired unit on each cycle.

4.13 The test key (TST) and camera control key (1/2 HR or 1 HR) are also operated. The test lamp (TST) remains lighted as long as the test key is in the operated position, and a simulated busy condition is placed on the input of all detectors. When a scanning cycle is made under this condition, with all register connections in perfect order, a registration is made on the proper register each time an associated terminal is scanned, whether or not the circuit normally connected to it is actually busy or idle at that instant. The total scorings on a register during 1 cycle should, therefore, agree with the number of circuits assigned to that register.

4.14 To start the scanning cycle, the manual (MAN) key is operated, lighting the ON lamp. At the end of 100 seconds, an initial picture of the traffic registers is taken and the cycle register (CYC) will operate. A group cycle register (GCC) will also operate in each camera group corresponding to the operated RG keys. As soon as the cycle register operates, the STOP key is thrown, which lights the READ lamp. Both the ON and READ lamps remain lighted until the scanning cycle is completed, whereupon the READ lamp is extinguished. If a photograph is desired at this point, the manual camera control key (MCC) is held in the operated position for about 2 seconds. The initial photograph of the registers is taken automatically as a result of the operation of the camera control key (1/2 HR or 1 HR). The operation of the STOP key causes scanning to be suspended at the end of the first cycle. All keys are now restored to normal, the manual key (MAN) first to avoid starting another cycle.

Automatic Operation

4.15 Controls for automatic operation are set some time before the first hour of measurement is to begin. The program timer will be set up, as previously described in 4.08, by pushing in one time selector tab per hour desired. The unit selection key for each recorder unit is operated to the proper position (RG1 to RG4) to associate the desired groups of facilities with the recorder. If register grouping is not involved, the key can be operated to any off-normal position. Should the automatic program which has been established comprehend the use of the same registers for recording one set of facilities during certain hours and a second set during other hours, it will be necessary to change the setting of the unit selection keys some time between the conclusion of the record on one set and the start on the other set. The camera key (1/2 HR or 1 HR) is operated to take pictures at either half-hourly or hourly intervals, as desired. If other traffic registers are to be photographed on the schedule set up on the program timer, the peg count key (PC)

is also thrown so that these registers and associated cameras will be activated during the scheduled period. Lastly, the AUTO key is operated.

4.16 The recorder now awaits the arrival of the scheduled starting hour on the program timer, whereupon the ON lamp lights and a 100-second cycle timer is started. At the end of a 100-second delay period, the initial picture is taken by the cameras and the cycle register (CYC) operates. A group cycle register (GCC) will also operate in each camera group controlled by the operated unit selection key in any of its RG1 to RG4 positions. As the next 100-second cycle begins, scanning starts and progresses automatically, repeating every 100 seconds for the duration of the scheduled period and operating the cycle registers at the start of each cycle. The READ lamp lights at the beginning of every eighteenth scanning cycle, while at the end of the cycle it is extinguished and a picture is taken if the 1/2 HR key is operated. If the 1 HR key is operated, the picture is taken at the end of every thirty-sixth scanning cycle. At the conclusion of each programmed record period, the ON lamp is retired and scanning stops until the program timer reaches the start of a succeeding period. When the record is completed, all keys are restored to normal.

Manual Operation

4.17 Records can be taken under manual control when, for any reason, it is not convenient or possible to use automatic control. For example, if a record is desired for a period that does not begin on any quarter hour or a record covering an interval not of a half-hour duration or multiple thereof, manual control would be used.

4.18 The proper unit selection keys (RG1 to RG4), the camera key (1/2 HR or 1 HR), and the peg count key (PC) are operated in the same manner as described under automatic operation. Scanning is started at the desired moment by operating the manual (MAN) key. The ON lamp lights as the MAN key is thrown, and an initial photograph is taken at the end of a 100-second delay period. Scanning will progress automatically as long as the MAN key remains operated. Half-hourly or hourly pictures will be taken automatically, provided the camera control key is in the 1/2 HR or 1 HR operated position.

4.19 At the beginning of every eighteenth scanning cycle, the READ lamp lights. This is the signal to operate the STOP key if an exact half-hour period, or multiple thereof, is desired and manual register readings are to be taken. It also serves as a warning to prepare to take readings at the end of the current cycle. When that scanning cycle is completed, the READ lamp goes out and a photograph of the registers is taken automatically if the 1/2 HR key has been operated.

4.20 For a record other than an exact half-hour or multiple thereof, the STOP key is operated at any desired time. In this case, the READ lamp lights as the key is thrown and goes out on completion of the current scanning cycle. At that time, the manual camera control key (MCC) is held operated for about 2 seconds to photograph the register readings for the end of the measurement period, or readings are manually recorded if cameras are not used.

4.21 At the conclusion of the desired measurement period, all keys are restored to normal, the manual key (MAN) first, extinguishing the ON lamp.

Operation on Trouble Condition

4.22 If any recorder unit should fail to complete a scanning cycle within the allotted 100 seconds, the trouble lamp (TBL) will light at the control panel, and operation of that particular frame will cease. This condition locks in to a release key (AR) on the jack and lamp panel of the frame in trouble, which may be identified by the appearance of a frame trouble lamp on the same jack and lamp panel. The fact that usage data on circuits associated with this frame is incomplete will be indicated by failure of the associated cycle count registers to score 36 cycles for that hour. After the AR key has been momentarily operated, scanning on the frame which was in trouble will resume at the start of the next scheduled hour, assuming the trouble has been cleared or is intermittent in nature. In the interim, a guard lamp will be lighted on the jack and lamp panel, and the TBL

lamp will remain lighted at the control panel as an indication that scanning is interrupted on one or more frames. In earlier installations, trouble on one frame of a recorder group causes all frames to restore to normal, and it is necessary to restart operation by releasing and re-operating the MAN or AUTO key at the control panel, following the operation of the AR key on the frame.

Setting Auxiliary Timer

4.23 When it is necessary to set the auxiliary timer to the correct time of day, the dial is turned in a counterclockwise direction as indicated by the arrow until the proper hour of the day or night lies opposite the index mark. It should be set about 5 minutes ahead of the time indicated by the regular program timer to insure proper synchronization. The ON tripper should be attached to the dial at the point corresponding to the beginning of the desired recording period. This must be the same 15 minute point within the hour at which the regular program is set to start, but not necessarily the same hour. For example, if the regular program starts at 9:30, the limited scoring period may start at 9:30, or 10:30, etc. The OFF tripper should be attached to the dial at the point 15 minutes before the end of the limited scoring period, which is always some whole number of hours.

5. MAINTENANCE AND TESTING FEATURES

Maintenance Features

5.01 The maintenance features included are as follows:

(a) ***Trouble Conditions:*** When a recorder of a group fails to complete a scanning cycle as described in 4.22, progress of scanning in that frame will be blocked at the point where the time limit was reached. The record of progress thus preserved may assist in locating the cause of failure. Other frames in the group will continue to operate, and the camera control functions will not be affected. Similar failures in older installations cause all frames to restore to normal, and camera operation to be suspended.

(b) ***Scan Control at the Recorder Frame:*** A test jack (TST) is provided on each recorder frame. Plugging a No. 32A test set into this jack will start the scanning function of the particular unit independently of the keys at the master control panel. The TBL lamp at the control panel will light when any recorder unit is so controlled.

(c) ***Circuit Advance:*** By means of the TST jack, it is possible to disable, at any point in a scanning cycle, the automatic advance of scanning and permit advance by key control, one crosspoint at a time.

Testing Features

5.02 The testing features included are as follows:

(a) ***Detector Testing:*** The TST key at the master control panel, when operated, places a busy condition on the inputs of all detectors of the associated recorders. This feature can be used to check detector output, continuity of the crosspoint contacts for all REG switches, grouping field cross connections, and register operation, as described in 4.10 through 4.16. The TST lamp at the control panel will be lighted when the TEST key is operated. Detectors in No. 4A or 4M toll offices may be tested for their ability to recognize the special positive 24-volt busy condition described in 4.04 by operating the PBR key in conjunction with the TST key.

(b) ***Detector Output Identification:*** On each recorder frame, a set of six to twelve lamps (designated 0 to 11) are associated with the detector outputs, as connected to the REGISTER switches, when the TST jack is used in the manner described in 5.01. These lamps indicate the busy condition (lamp lighted) or idle condition (lamp dark) of the circuits connected to the corresponding detectors as the contacts of each crosspoint are closed.

(c) ***Detector Retest:*** While the TST jack is in use as described in 5.01, the RR key on the jack and lamp panel is effective to permit repeated operation of the detectors after scanning has been halted on any desired crosspoint. When the RR key is depressed, all detectors that may have operated immediately following the crosspoint closure will be restored to normal, and when the key is released, each detector is permitted to respond

to a busy condition, if present, on the associated scan switch contact. This feature is useful in verifying the test lead to a particular circuit and in checking that the proper traffic register operates.

(d) ***Idle Trunk Test Feature:*** In No. 4-type crossbar toll offices the ITT key is provided at the control panel for making a continuity check of the test leads to idle trunk circuits. This feature is furnished only in the No. 4 system because many of the connecting facilities in other systems present an open-circuit idle condition, which precludes a continuity check of their usage leads. When the recorder is operated for one full cycle under manual control with the ITT key operated, a set of relay detectors will be substituted for the regular detectors and will record the number of circuits found idle in each group. It is intended that this test be made in a period of minimum traffic and that it be followed immediately by a cycle with the ITT key normal so that the circuits busy in service will be recorded. A third cycle may then be run with the PBR key operated to record trunks plugged busy or locked out of service. The total scorings on each usage register for the three cycles should then equal the number of circuits connected to it, except for groups in which a change in the status of some circuit may have taken place in the interval between scans.

(e) ***Automatic Cross Detection:*** This feature is intended to check for the presence of a cross between adjacent fixed contact members (solid vertical bars) of the crossbar switches. In the course of testing, the ability of the ground-busy detectors to operate is also checked. A cross test is made at the end of each regular scan cycle. On one half of the tests, ground is applied to the input leads of detectors 0, 2 and 4; all detectors are enabled, with no cross points closed, and a check is made at the detector outputs to see that detectors 0, 2 and 4 operated. If a ground appears at the output of detectors 1, 3 or 5, however, a falsely-grounded odd-numbered contact or a cross between even- and odd-numbered contacts in either the SCAN or REGISTER switches is indicated. All register grouping relays are operated during the test to insure that all register switch vertical contacts are checked. During subsequent tests the grounds are applied to the odd-numbered detectors, and the checking pattern is reversed so that all six ground-busy detectors and all combinations of vertical contacts are checked. Since ground-idle or battery-busy detectors are required for certain circuits on some TUR frames, the cross test provides for transferring the vertical contacts normally associated with these detectors to the ground-busy detectors during the period of testing. Failure of a detector to operate when required, or the appearance of a false ground or cross, will operate the frame trouble relay and block further scanning. Either the DF (detector failure) or the XV (crossed vertical) lamp on the frame lamp and jack panel will be lighted to show the nature of the failure. Specific location of the trouble may then be made by the application of standard maintenance tests.