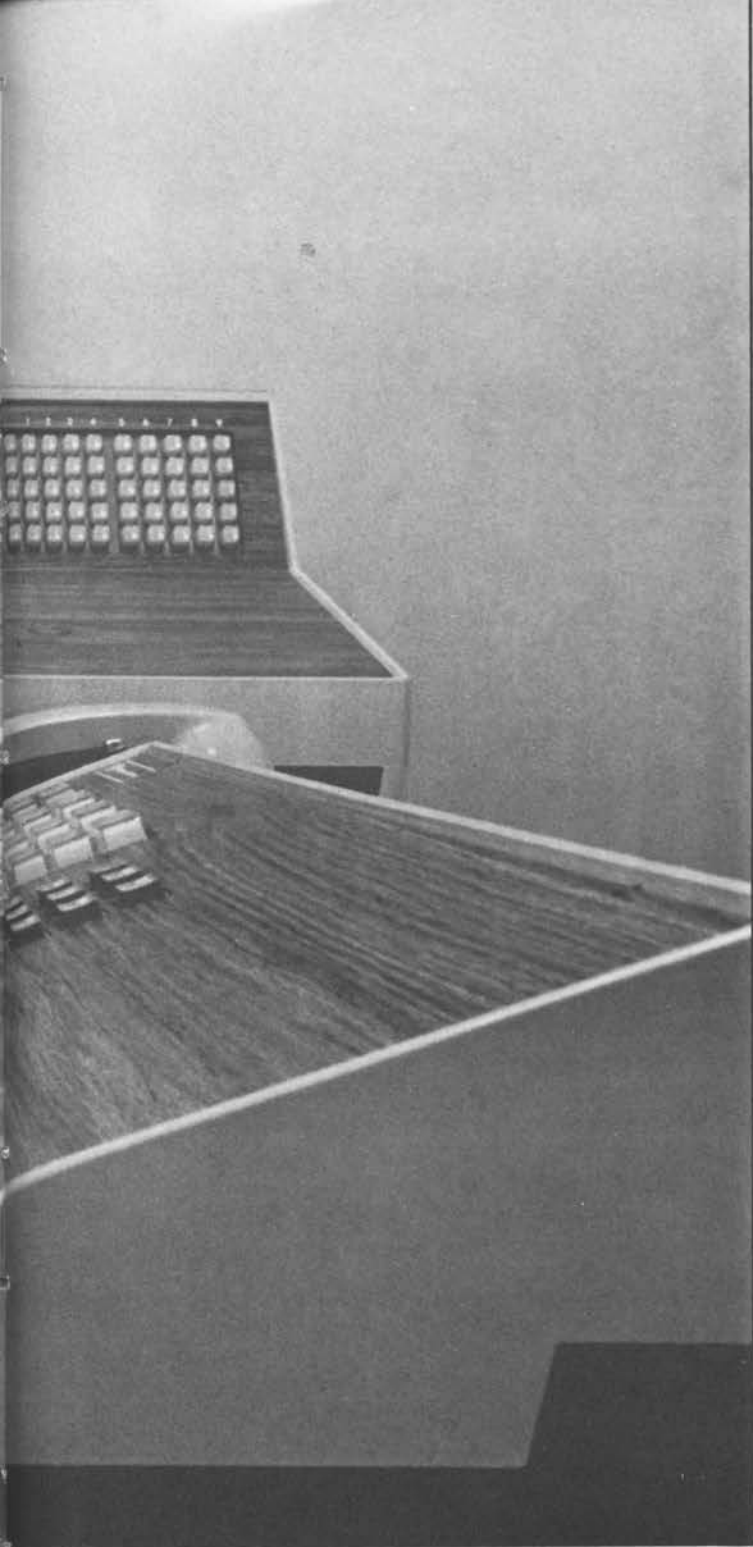*The attendant's console for the new 50A CPS is*
available in three versions. Clockwise from right:
basic console, DSS/BLF (Direct Station Selection/
Busy Lamp Field) console with 100-line capacity,
and a DSS/BLF console with 200-line capacity.

A Versatile Attendant Console For Sma

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Call transfers, private call announcements, conference calls, and many other services are easy for attendants to provide with the new 50A Customer Premises System. For the first time, service features previously available only to larger PBX and centrex customers are economical and practical for business customers of small or medium size.

ller Businesses

Baker, John J. Horenkamp, and Charles Nickerson

THE TELEPHONE ATTENDANT'S CONSOLE is one of the most visible interfaces—as well as one of the most sophisticated—between a business customer and the telephone network. It is not surprising, therefore, that the Bell System attaches great importance to giving the attendant the features necessary to provide efficient services. However, business customers' needs vary greatly, depending on such factors as the size of the company and the type and volume of business.

With these varying needs in mind, engineers at Pacific Northwest Bell in the fall of 1970 studied the attendant facilities available from the No. 1 Electronic Switching System (ESS). They felt that if suitable attendant facilities were available service for small business customers could be provided from No. 1 ESS at a more attractive price. Pacific Northwest Bell engineers, in cooperation with Bell Labs engineers from the No. 1 ESS development area, began work on modified attendant facilities for No. 1 ESS. New facilities were designed, built, and field tested. They proved to match well the service features required by business customers.

Up to that time, attendant facilities from No. 1 ESS central offices were limited to a console controlled by a data link (see *Centrex Service in No. 1 ESS*, RECORD, *November 1968*), or a key telephone set and associated equipment using the call-transfer capability of the No. 1 ESS.

The data-link console provides a wide range of features and is attractive for customers with sophisticated requirements. However, it is very expensive for the small- or medium-sized customer who does not require specialized features. In addition, it requires a relatively large cabinet on the customer's premises. Moreover, there is a maximum limit of 32 data links per ESS.

The key telephone approach, on the other hand, is inexpensive and requires only a small amount

of customer space. However, such equipment provides minimal attendant features and is adequate for only the very small customer with limited need for an attendant.

In addition to the above problems, neither the data-link console nor the key telephone set is able to provide Direct Station Selection (DSS) and a Busy Lamp Field (BLF). (The DSS feature allows the attendant to dial an extension by merely pushing the appropriate button. BLF tells the attendant which extensions are busy.)

Now, engineers at Bell Laboratories have designed a family of consoles and associated control circuitry based on Pacific Northwest's field experience. This equipment embodies the most desirable features of the data link equipment plus optional DSS and BLF features. In addition, it is inexpensive and requires little customer space. The new equipment will serve the small- and medium-sized business customers requiring PBX or centrex service. The equipment is called the 50A Customer Premises System (CPS) and is designed to be used with the No. 1 ESS. Eventually, the system will be used with the No. 2 ESS for smaller central offices when centrex becomes available on that switching system. With the 50A system, there is no switching equipment on the customer's premises. The ESS central office provides control and many test functions (the central office part of the system will be described in a forthcoming RECORD).

The consoles for the 50A CPS come in three sizes (see illustration, page 152): a non-DSS/BLF console for basic PBX and centrex service, a DSS/BLF console that will handle up to 100 lines and a DSS/BLF console that will handle up to 200 lines. The consoles can accommodate handsets or headsets and are equipped with an auxiliary jack for use in training or monitoring. They also have a pleasant-sounding tone ringer with an on-off switch and volume control. The attractively styled housing comes in three different colors, and the face plate is available in five colors plus two wood grains.

The arrangements of the console face plate are also illustrated on page 152. The console keys consist of fourteen "loop" keys, eight control keys, and two spares. The loop keys are so called because they operate very much like the "switched-loop" keys available on other PBX and centrex consoles. This switched-loop operation is one of the major advantages of the 50A CPS.
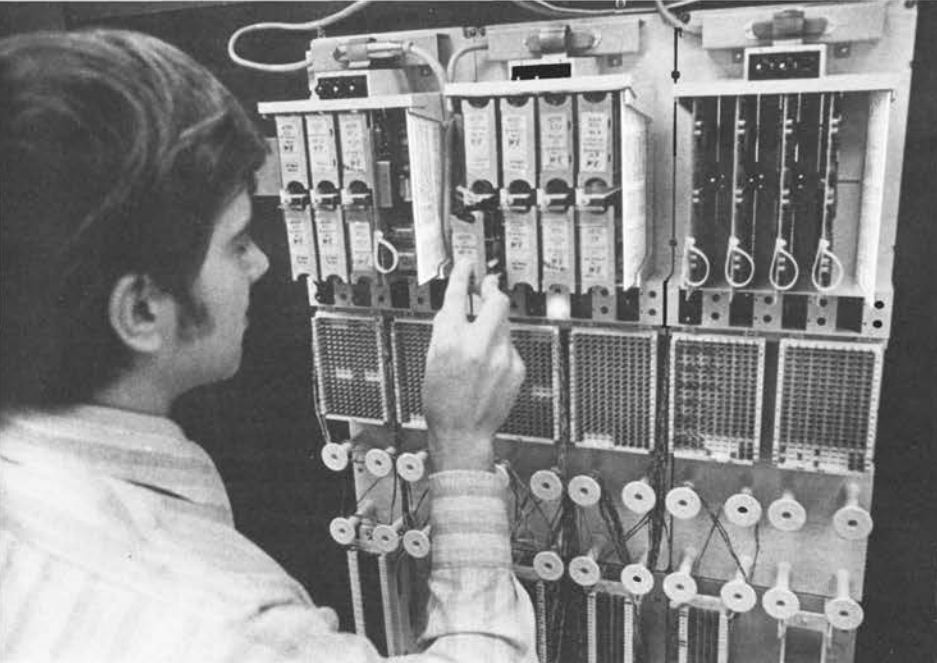
The loop keys can be arranged in groups according to the type of call which can appear on each of the loops in a group. For example, four or five loops might be dedicated to calls to the listed directory number, two or three loops might be dedicated to calls from within the business (dial "0" calls) and perhaps one or two loops might be for Wide-Area Telephone Service (WATS), foreign exchange (FX), or tie lines. This grouping allows the attendant to treat the calls differently and to use a different answering phrase. For most applications, seven or eight loops should be sufficient and the remaining loop keys can be held as spares.

The operation and hardware associated with the

The 50A Customer Premises System is designed to provide the service features needed by many business customers, with a minimum of equipment on the customer's premises. The customer only needs to make room for an attendant's console (shown in foreground) and associated control equipment (visible through door in background).

New modular panel units house the common circuitry, loop circuitry, and line-busy circuit. The modules are designed to be mounted on a wall in the customer's equipment closet. A flexible printed circuit at the rear of the module links printed-circuit boards at the top to quick-connect terminal blocks at the bottom. A convenient slot for simplified installation and trouble-shooting instructions is provided at the right end of each panel. The unit shown here is a demonstration model at Bell Labs in Holmdel, New Jersey. Engineer Frank Wyatt inserts a circuit card.

50A CPS is similar in many respects to key telephone equipment. It is therefore constructive to examine the limitations imposed on an attendant using key telephone equipment and then to contrast these limitations to the flexibility of operation of the 50A CPS.

Consider how a typical call is handled by an attendant using a key telephone set. A customer calls the listed directory number of the business and tells the attendant to which of the stations in the business he or she wishes to be connected. The call first appears on the key telephone set as a flashing lamp on one of the keys and an accompanying audible signal (usually a buzzer or bell). The attendant answers by depressing the key. After the calling party gives the desired extension the attendant flashes the switchhook to activate the call transfer feature of No. 1 ESS. When dial tone is returned, the attendant dials the desired party. The attendant now has a choice of actions:

• The attendant can go on-hook. In this case, the associated key on the set goes dark and the attendant loses control of the call. This is particularly disturbing if the called party does not answer since the calling party is charged for the call when the attendant answers. For the businessman this is undesirable.

• The attendant can remain on the call until the called party answers. This procedure is very inefficient: it prevents the attendant from doing other work or from answering other calls on the set. In addition, when the attendant hangs up after the called party answers, the talking path between the called party answers, the talking path between the calling and called parties is briefly interrupted. This interruption occurs when No. 1 ESS switches the call from the three-port circuit associated with call transfer to a simple connection between the calling and called parties.
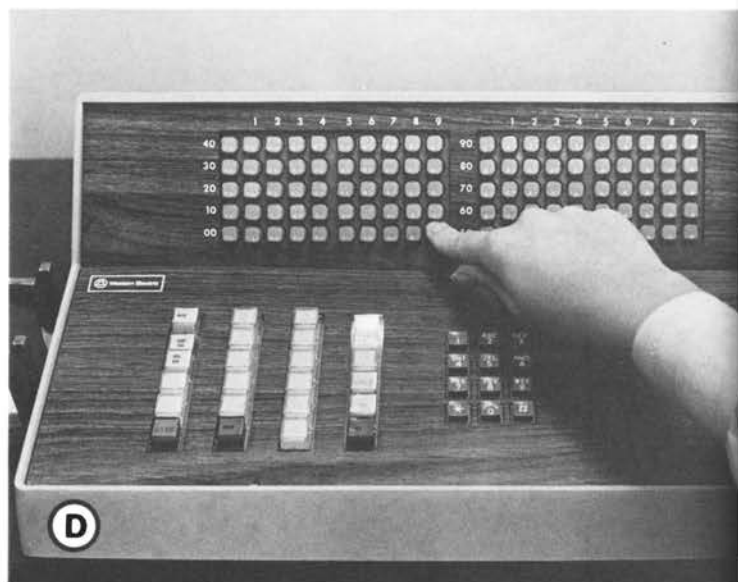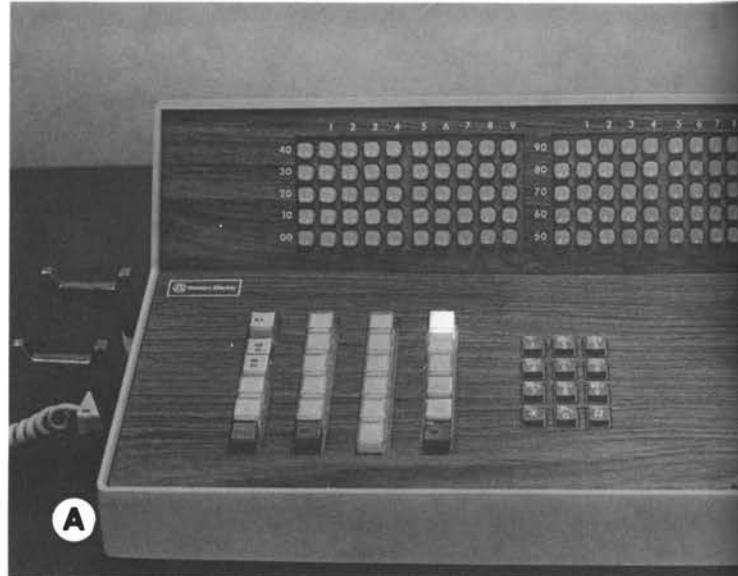
• The attendant can put the call on "hold." However, the attendant must continually monitor the call to see if it has been answered. After the call has been answered, the attendant must disconnect; this will cause the same brief interruption in speech mentioned above.

Let us see how this typical call is handled in the 50A CPS (illustrations, pages 156-157). The call appears as a flashing lamp on one of the loop keys. For our typical call, the attendant answers the call by depressing the loop key. After determining to whom the caller wishes to talk, the attendant depresses the CC (Call Control) key and the 50A CPS automatically sends out a timed "flash" (equivalent to briefly depressing and releasing the switchhook) to the central office. The automatic timing relieves the attendant of the burden of deciding how long to flash. The ESS responds with dial tone to the attendant. For non-DSS consoles, the attendant then uses the TOUCH-TONE® keys to dial the desired extension. If the console is equipped with DSS, the attendant merely depresses the proper key and automatic circuitry inside the console sends out the Touch-Tone pulses corresponding to the desired extension.

If the called extension is idle and audible ringing is returned to the console, the attendant has the ability to release the attendant's telephone

USING THE 50A CPS

Series of photographs shows the simple procedure for handling a typical incoming call with the 50A Customer Premises System. The 100-line-capacity version of the console is used here. (A) The call appears as a flashing lamp on one of the loop keys. (B) The console attendant answers the call by depressing that key. The attendant determines to whom the caller wants to speak, then (C) depresses the CC (Call Control) key. The Electronic Switching System in the central office responds by providing a dial tone. (D) The attendant depresses a key corresponding to the desired extension on the DSS/BLF (Direct Station Selection/Busy Lamp Field) display. (E) The attendant depresses the RLS (Release) key, and can then do other tasks while receiving visual indications of the progress of the call. (F) When the called party answers, the appropriate key glows steadily on the DSS/BLF display and the light on the loop key extinguishes.
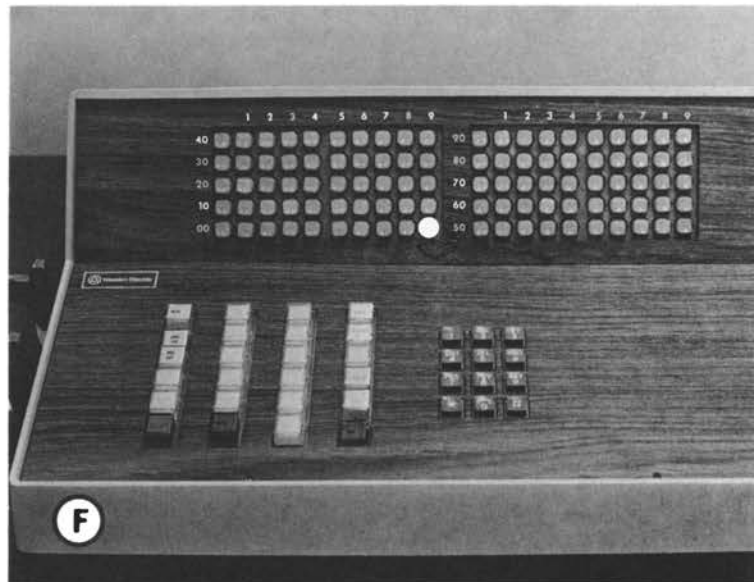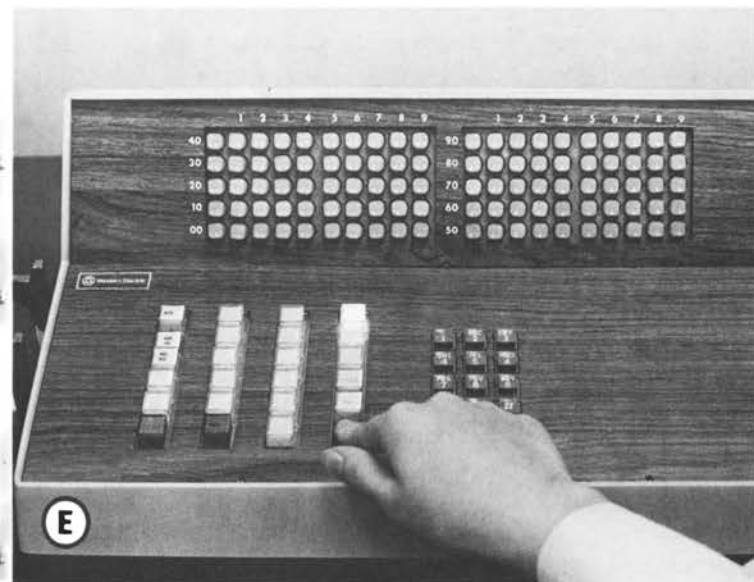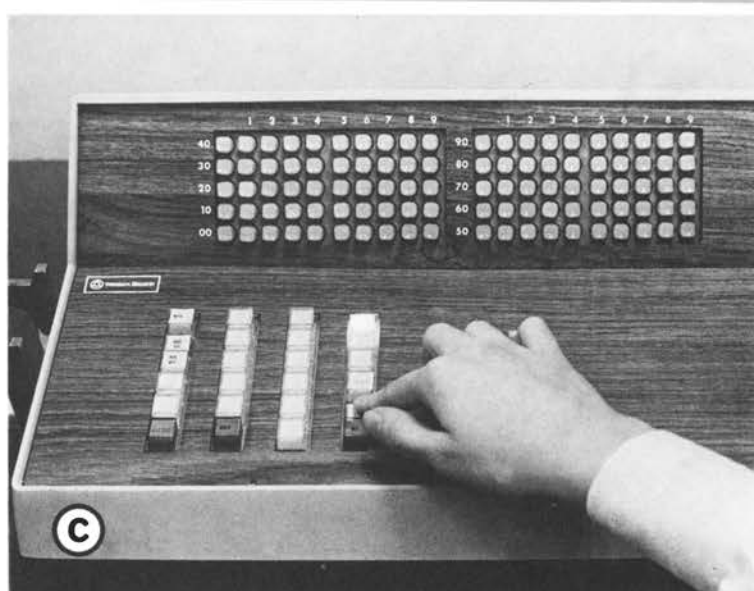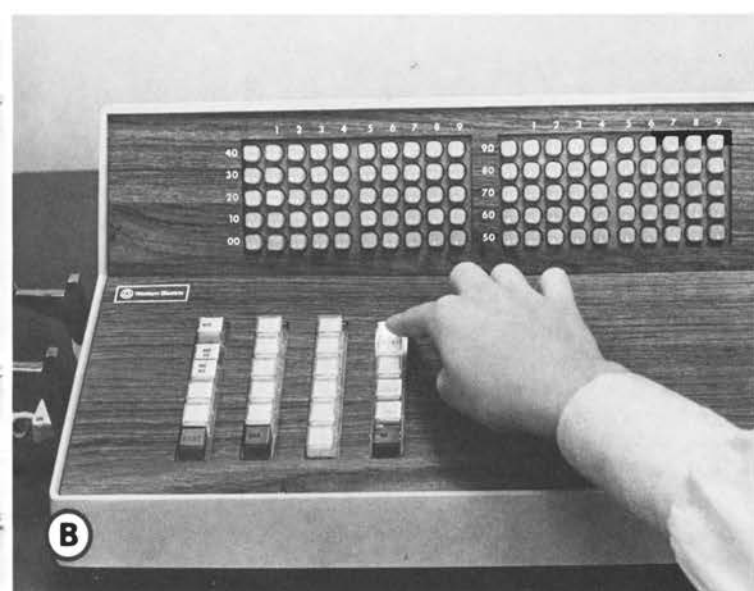
from the call (in addition to options associated with the key telephone set as described earlier in this article). This feature is similar to the hold feature except that the attendant receives a unique lamp signal and if the called party answers, the loop lamp will go dark and the loop will be free to handle other calls. If the called party does not answer, the attendant can re-enter the loop and take a message or try a different extension. This feature is activated whenever the attendant depresses the release key or goes to another loop key. When the attendant is no longer required on a call, he or she frees the loop for new calls by depressing the disconnect (DISC) key.

The CC key is used to send a flash to the ESS. The first operation of the CC key signals for a transfer dial tone. In this capacity the CC key is like the "start" key in many consoles. The CC key is also used to disconnect the ESS register in case of a dialing error or to remove the busy tone when a busy extension is dialed. In this capacity, the CC key is like the "release-destination" key in many consoles.

The console is equipped for "one-way manual splitting," used when the attendant wishes to announce the call privately to the called party. The attendant activates the feature by depressing the split key when a call-transfer dial tone is present. The split key is very similar to the "exclude-source" key in many consoles.

Operation of the NITE key sends a signal to the ESS to put the system into night service. Circuitry in the 50A CPS ignores changes in the NITE key when the attendant's headset or handset is not

plugged in. This prevents the system from coming out of night service if the NITE key is accidentally released.

The Position Busy (PB) key is used only when there are two or more consoles. When the PB key is operated, a signal goes to the ESS to make the loops terminated on that console appear busy. Alternately, when the attendant removes the headset or handset from the console jacks, the position-busy feature becomes activated.

The attendant can set up a conference call on any of the loops by use of the CC key and by dialing the desired telephone numbers. This feature is made possible by a new generic program—Centrex 6—for No. 1 ESS.

The lamps associated with the two spare keys or any of the spare loop keys can be used as Trunk

Group Busy (TGB) lamps. TGB lamps tell the attendant when all trunks in a particular group are busy. This is useful for control of facilities such as Wide-Area Telephone Service (WATS) lines.

The elements of the system are illustrated on page 159. The function of the loop circuitry is to detect ringing, monitor the loop key, control the loop lamp, and provide the hold and release features. The common circuitry controls timing and the automatic flash on the active line, as well as the logic associated with the night key. The line-busy circuit, which is optional, monitors a line for an off-hook condition and lights the corresponding lamp on the DSS/BLF.

The equipment is housed in new modular panel units designed initially for key telephone applications. These units are designed to be physically

compatible with the new color-coded backboards used to mount quick-connect terminal blocks which terminate stations, consoles, and central office pairs (see *Connective System for Customer Premises*, RECORD, *August 1972*).

The modular panels, designed for wall mounting on the customer's premises, are plastic moldings 18½ inches high, 8½ inches wide, and 6 inches deep (see illustration, page 155). A flexible printed-circuit backplane links the printed-wire board connectors at the top of the modular panel to the "quick-connect" terminal blocks at the bottom. The modular panels also house power distribution fuses, terminate the power and interpanel signal cable, and provide a slot for a card containing simplified installation instructions and a troubleshooting guide. The panels provide a combined circuit pack designation space and locking tab arrangement (to prevent the circuit packs from vibrating out of their connectors), and they are designed to accept a cover (planned for future
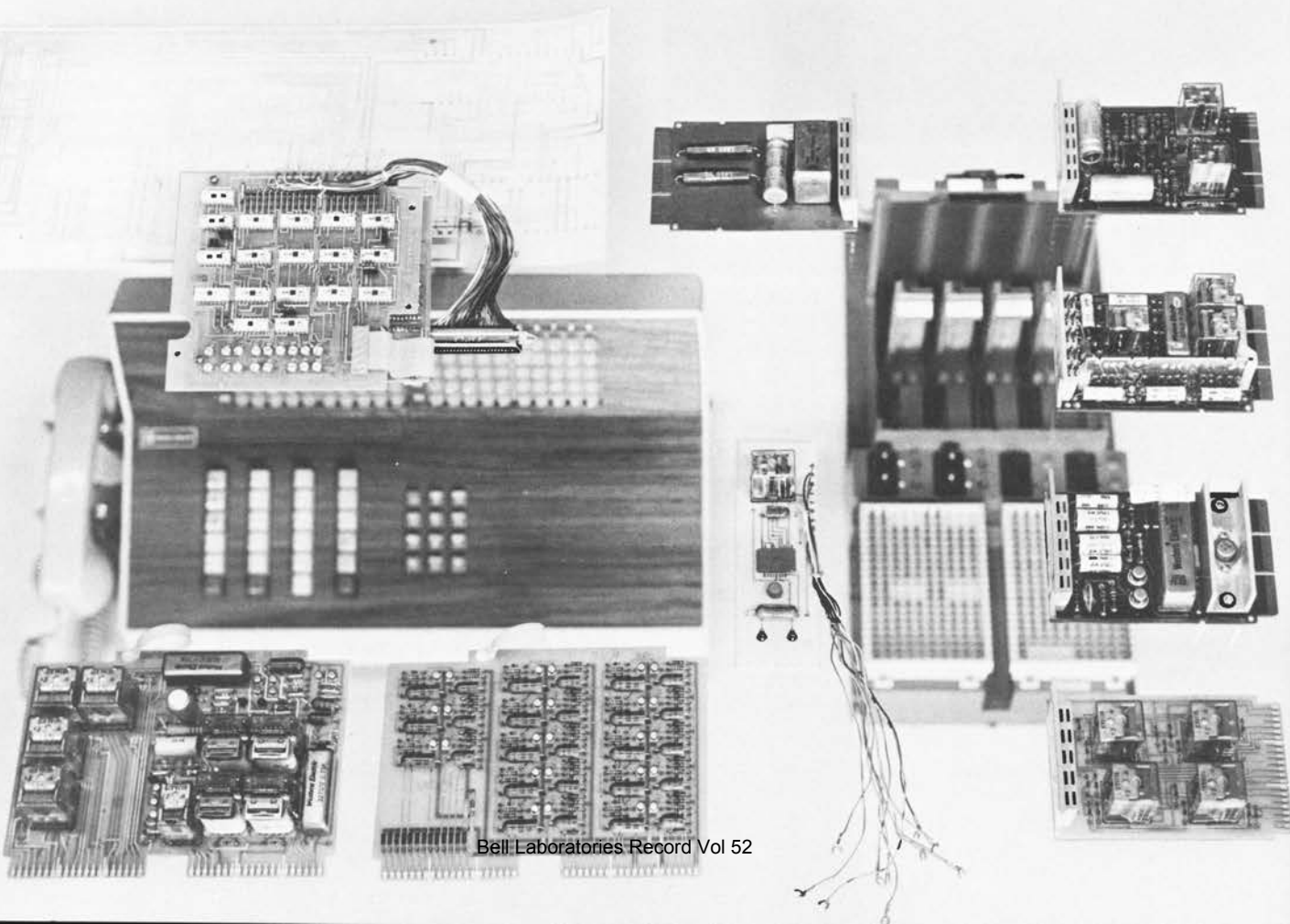
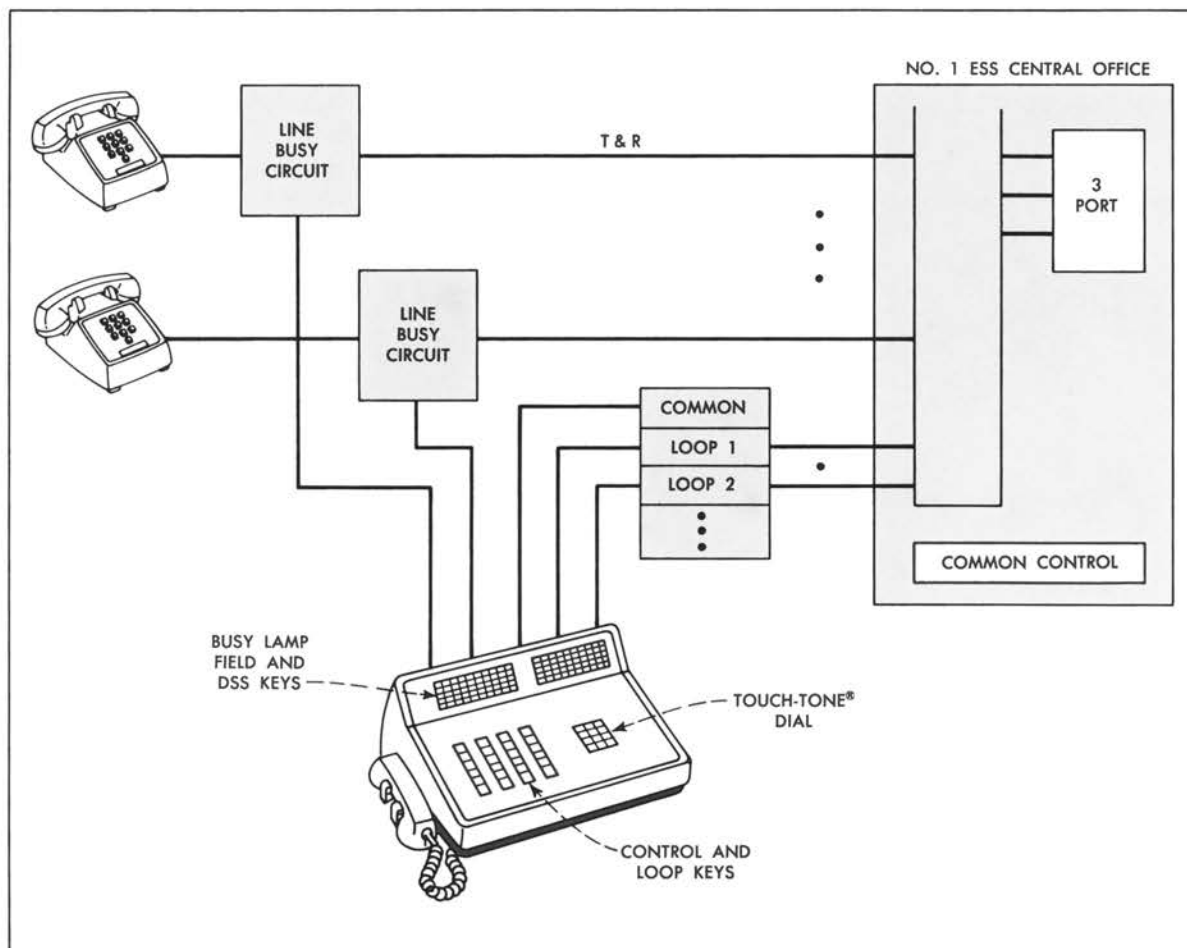manufacture) that will be used when a 50A CPS installation is not located in an equipment closet.

The system uses nine different circuit packs (see the illustration above). Two of these are existing designs used in the 1A2 Key Telephone System and seven are new circuit-pack designs for the 50A CPS. Solid-state electronic circuitry is used extensively in the circuit packs and makes it possible to put the automatic dialer circuit pack (for Direct Station Selection) inside the console.

Ease of maintenance was a major consideration in the design of the 50A system. The modular panels have several built-in maintenance features. The loop lamps on the console are duplicated in the panels, so that maintenance personnel can determine which loops are active and thus avoid interfering with a call in progress. In addition, the panel lamps aid in testing the system, since the console will normally be located remotely. Lead designations and installation patterns are compatible with existing key system practices so that

Superimposed on an attendant console and a modular panel are the circuit packs used in the 50A Customer Premises System. Clockwise from top left: Direct Station Selection (DSS) automatic dialer (resting on the flexible printed-circuit back-plane), trunk-group-busy lamp driver, hold detector circuit, key telephone line circuit, flutter lamp rate generator, loop control circuit, split key circuit (with long lead wires), line busy circuit, and—at the lower left—common control circuit.

Elements of the 50A Customer Premises System. The loop circuitry detects ringing, monitors the loop key, controls the loop lamp, and provides the hold and release features. The common circuitry controls timing, the automatic flash, and the logic for the night key. The line-busy circuit lights the appropriate lamp on the Busy Lamp Field when a line is off-hook. Circuitry in the console outpulses TOUCH-TONE® *multifrequency signals when a Direct Station Selection, or* DSS, *key is depressed.*

they will be familiar to the installer. To make the installer's job easier, printed wiring boards, lamps, fuses and connecting blocks are arranged to make their interrelationships obvious. Making the cross-connect field an integral part of the modular panel (illustration, page 155) results in a significant reduction in installation effort and cost.

Power is supplied by a wall-mounted power unit with connectorized cables—again, for ease of installation. Because the customer's extensions are connected directly to the central office, they are independent of the power on the customer's premises. In case of power failure, the attendant's equipment is the only customer premises equipment affected. Unless otherwise programmed, the 50A CPS will cause the ESS to go into the night-service mode when power fails. Alternatively, the

attendant can be provided with a nickel-cadmium battery backup system that permits console operation for about four hours. (The DSS and BLF features, however, are not backed up.) Because only the attendant's equipment needs backup power, the entire system can be made immune to customer-premises power failure at modest cost to the customer.

The 50A CPS has already been used by customers across the country—in the World Trade Center in New York and in Seattle, Minneapolis, and Phoenix. The first production 50A CPS (manufactured by Western Electric) was put into service in October 1973. Favorable customer reactions give every reason to expect the small, easily maintained 50A CPS to fulfill its promise of meeting the needs of the smaller customer. □