By using key telephone system circuits, Bell Labs engineers have built a call distributor that is economical for small businesses. Much smaller than its predecessors, the 4A is, nevertheless, available with many attractive features, such as transfer and overflow.

A Small Call Distributor Based On the Key Telephone

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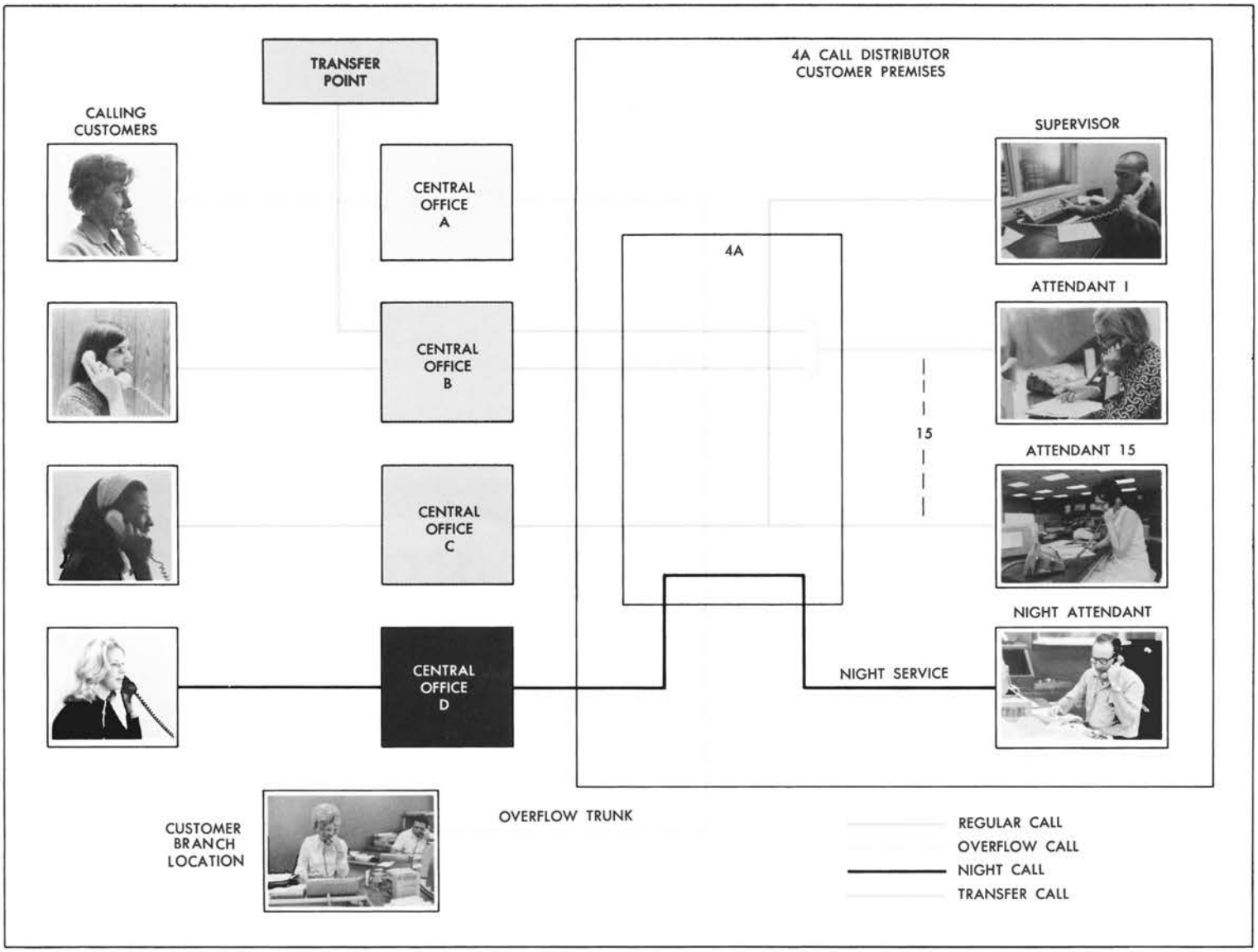
IN THE LATE 1950's, department store managers began urging consumers to "shop by telephone." To accommodate the volume of calls, therefore, stores needed an efficient system for distributing them among attendants. The job of the attendants was to handle requests by customers over the phone in the order that the calls came in.

This kind of system had already been considered by Bell System Operating Companies and recommended by an AT&T study. The study indicated that other businesses in addition to retail stores—airlines, public utilities, mail order houses, and repair bureaus—needed such a service. A new system was therefore introduced by the Bell System in 1962—the 2A Automatic Call Distributing System (ACD). The 2A system was not intended to handle a large volume of calls. For businesses requiring a system with a greater call-handling capacity, the 3A ACD was introduced at about the same time. And since then, there's been an ever-increasing demand for call distributing systems (see *No. 5 Crossbar Automatic Call Distributor*, RECORD, *December 1968*).

Now we are introducing an economically priced system even smaller than the 2A. The system, known as the 4A, gives the Bell System several models of call distributors from which a customer can choose one to fit his particular needs.

The design of the 4A departs from that of the other call distributors because it is built around a key telephone system (see *Advances in the 1A2 Key Telephone System*, RECORD, *October 1970*). Although many circuits from the key telephone system have been incorporated into the 4A, the new call distributor is not, however, a converted key system—their designs and functions differ substantially. But, by using key telephone system circuits in the 4A, engineers at Bell Laboratories have been able to build a call distributor economically attractive for small businesses.

Here's how the 4A and its predecessors—the 2A and 3A—compare. The 2A and 3A are switch-



A call starts when a customer (left) dials the directory number of a business using the 4A call distributing system. The central office (center) switches the customer to a trunk serving the 4A. The system recognizes the incoming call, places the call in queue, and alerts the attendant(s) (right) by lighting a lamp associated with the incoming trunk on each attendant console. If other calls are waiting in line, this call will wait for an attendant until it reaches the top of the queue. The next available attendant will answer the call. Once an attendant is reached, the customer requests whatever service he requires. When an attendant is unable to handle the customer's needs, the customer can be directed to a third party by using the transfer feature. The attendant depresses a transfer key, placing the customer on hold, depresses the pickup key of an idle central office or PBX *line, and dials the directory number of the third party. When the third party answers, the attendant depresses an add-on key, which joins the three parties together in a conference call. During peak traffic periods, the supervisor can put the system into a mode called overflow. Then an incoming call which meets a busy condition of the 4A will be routed to a branch office for service.*

ing machines that automatically connect any one of numerous input trunks (which interconnect the call distributor with the central office) to one of many attendants who receive telephone calls. The 4A, by comparison, cannot do any switching itself. When a call is received by the system, a lamp lights on the attendant's console. The attendant then must depress a key to connect the trunk to the console. The 2A and 3A systems are considerably larger and more complex. They require many bays of switching equipment to handle incoming calls. The 2A, for example, handles up to 56 incoming trunks and 60 attendant positions; the 3A handles up to 198 incoming trunks and 200 positions. By contrast, the 4A serves 20 incoming trunks and up to 15 attendant positions.

The concept of the 4A system originated from a study by Bell Laboratories comparing the cost of a large system, such as the 3A, to that of a key telephone system. The difference in cost was significant enough to urge engineers at Bell Labs to consider the key telephone system as a basis for

a new call distributor. According to the study, new call distributor circuits could be added to the standard key telephone system, and the cost of the new system would be below the cost of the existing ACD systems. In addition to the savings, the new system would be more compact. Both advantages result because neither a switching matrix nor its associated common control circuitry is needed. The switching function is fulfilled by the keys on the attendant CALL DIRECTOR® sets.

Before describing in detail how the 4A works, let's first examine how the 2A and 3A process calls. A call distributor queues the incoming calls in groups. This task is performed by a simple "gating" circuit. When the system receives a call, the gate closes and allows no more calls to pass until the first call has been answered by an attendant. After the first call is answered, the gate opens and allows all waiting calls, which have in the meantime accumulated outside the gate, to pass and be answered by attendants. If all waiting calls were not passed as a group, a memory would be needed to determine the position of each individual call in the queue. After the calls pass, the gate closes again, and remains closed until all calls that passed have been answered. No trunk can be handled twice in succession while another trunk has a waiting call, because the system automatically takes that trunk out of the queue as soon as it has been serviced. When calls are waiting in a group, each is handled according to the numerical order of the trunk on which it has arrived—each trunk being arbitrarily numbered in a fixed sequence.

The 4A system operates somewhat differently from the 2A and 3A since it lacks the switching equipment of the larger systems. In the 4A, a similar gate circuit handles incoming calls, but the trunks are not placed in queues to await their turn. Instead, calls entering the gate circuit, in the order of their arrival, light a particular lamp on the attendant's call director sets. The attendants are therefore visually informed of each succeeding call that should be answered. The attendant may answer the longest waiting call or may answer a priority line if its lamp is lit. Priority lines can be established by color-coding those lamps according to their importance to the system. These lines are often set up between customers transacting large volumes of business so that their calls need not wait in a queue.

The question naturally arises, how does the attendant determine which calls are in the group being serviced and which calls are new arrivals waiting in the queue? The first call into the system causes the appropriate lamp to flutter, or switch on and off quickly. As this call is being serviced, succeeding calls cause the appropriate lamps to flash. When the initial call has been answered, the flashing lamps of the next waiting calls begin to flutter. The following calls will again flash until all previous calls are answered.

A number of other features are available to customers using the 4A call distributor. These features include: 1) city identification, 2) delayed-call announcement, 3) call transfer, 4) night transfer, 5) overflow, 6) supervisory control, and 7) traffic monitoring.

City Identification: Each incoming trunk, specified by a lamp on the attendant's console, is labeled by number or is color-coded to indicate the city where calls originate. The same trunk group handles all calls from a particular city.

Delayed-Call Announcement: When any calls have been waiting for a specified length of time —generally about three or four rings—a tape-recorded announcement is automatically switched on with a message for the customers. The customers may then either abandon their calls or remain on the line until attendants are able to answer. During an announcement, the status of the calls remains unchanged on the attendant sets until each call can be answered by an available attendant. The message is recorded on a small magnetic-tape recorder which has a three-minute running time. The machine automatically stops, rewinds at the end of a message, and plays the message again if the call is still waiting at the end of the specified interval. The tape recorder is controlled by a supervisor, who can dictate a message, play back the recording as a check, or take the recording out of the call distributing system.

Call Transfer: Two kinds of call transfer are available—1) a transfer within the system from

FEATURES OF THE 4A CALL DISTRIBUTOR

- QUEUING OF CALLS
- DELAYED-CALL ANNOUNCEMENT
- CALL TRANSFER
- SUPERVISORY CONTROL
- TRAFFIC MONITORING
- CITY IDENTIFICATION
- NIGHT TRANSFER
- OVERFLOW
- PRIORITY CALLS

John Evans of Bell Labs tests a 4A call distributing system from the supervisor's console (foreground) at a laboratory in Holmdel, N. J. The equipment is compact and easy to transport.

attendant to attendant or from attendant to supervisor, and 2) a call transferred out of the system. When a customer's call must be transferred, the attendant places the call on "hold," calls the desired attendant or supervisor on an intercom, and instructs the person to pick up the appropriate line. In the second kind of transfer, the call must again be placed on "hold" to allow the attendant to choose another trunk within the system. The attendant then calls the desired party over this trunk. As soon as the party can accept the call, the attendant pushes the ADD-ON key on the console, connecting the two calls. The attendant can, if necessary, join the conversation in conference or can disconnect from the line on the console and proceed to the next call.

Night Transfer: This mode of operation is useful after normal business hours. The system routes incoming calls from the possible 20 trunks to one of three trunks. Night personnel on duty may then accept messages from calling customers.

Overflow: Functioning similar to night transfer, the overflow feature routes calls to attendants at other locations via a special trunk when all attendants at one location are busy. Overflow is controlled by the supervisor, who monitors the traffic. This feature enables the supervisor to distribute the load of calls better among other locations. A call will not be routed to overflow, however, if attendants are able to accept calls. As long as an attendant's headset is plugged into the console or the IN key is depressed, a supervisor is aware that an attendant is ready to accept calls.

Supervisory Control: In addition to controlling night transfer, overflow, call transfer, and delayed-call announcement, the supervisor exercises three other functions. On the supervisor's console is a RINGER-CUTOFF key which, when depressed, cuts off all of the ringing tones signaling incoming calls, for quieter operation. Since the supervisor has no switch hook with which to hang up, a RELEASE key serves this function. When it's depressed, all keys on the console return to their normal, non-operating position. The supervisor's console also contains a field of monitoring keys—one for each attendant—which can be used for training purposes. The supervisor can monitor an attendant without interfering with the attendant's function.

Traffic Monitoring: This feature is designed to help a business assess the amount of traffic it can expect to handle with the number of trunks it has in service and the number of attendants at call distributing sets. Depending on the kind of business, demands on the system may vary greatly, either daily or from season to season. During a busy season, for example, the calling traffic may change dramatically. Therefore, in the ACD's now offered by the Bell System, measuring systems are provided. From these measurements, a business manager can determine how many trunks and attendants will be needed.

The 4A system can provide information on: 1) incoming traffic, 2) transfer traffic, 3) overflow traffic, and 4) attendant status. Electronic circuits, called totalizers, can be applied to any of these categories of traffic to give a measure of the total amount of traffic in the system for that particular category. To count the number of calls on any particular trunk, message registers are used.

Other measurements are made on the attendant status. Attendant status is indicated as either manned (ready to accept calls), busy, or idle (no one at attendant console). Three measurements are possible: 1) a traffic usage recorder measures the total number of minutes each attendant is busy, 2) a message register counts the number of times an attendant's status changes from idle to busy, and 3) a totalizer counts the entire call-handling activity of all attendants.

The 4A system has been tested in three locations across the country—by TWA in Philadelphia, the Repair Service Bureau of the Chesapeake and Potomac Company in Baltimore, and the Social Security Administration in Milwaukee. Customer reaction has been favorable. In addition, AT&T is demonstrating the new system around the country. The 4A call distributor—small, easily constructed, and economical—will soon be a standard Bell System offering.