



*The CALL-A-MATIC telephone has an excellent memory. It remembers up to 500 telephone numbers which may be selected from anywhere in the country, and dials any one at the push of a button.*

*The CALL-A-MATIC telephone—a new automatic-dialing telephone with a 500-number built-in directory—will speed up TOUCH-TONE calling for Bell System customers.*

# A Phone With a Built-In Directory

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OUR STEADY MOVEMENT TOWARD a pushbutton world marks us as people who like to do things quickly and easily. The CALL-A-MATIC® telephone responds to these wants. It makes telephone calling quicker and easier by “remembering” up to 500 numbers and automatically dialing any selected one at the push of a button.

Repertory dialing—automatic dialing of pre-recorded numbers—is not new. Card dialers have been designed at Bell Laboratories for both rotary-dial (RECORD, *October 1961*) and TOUCH-TONE® calling (RECORD, *July-August 1963*) telephones. Their capacity is limited, however, because the cards are too bulky to store more than 30 or 40 of them in the set. The MAGICALL\* dialer stores as many as 1000 numbers for rotary dialing. The CALL-A-MATIC set fills the need for a large-capacity repertory dialer for TOUCH-TONE calling.

The telephone customer can use the CALL-A-MATIC phone either as an ordinary TOUCH-TONE telephone or as a repertory dialer. He records his repertory of names on a directory tape made of polyester film. The tape is carried by two storage drums, and a plastic window between the drums reveals a portion of it containing 13 names and

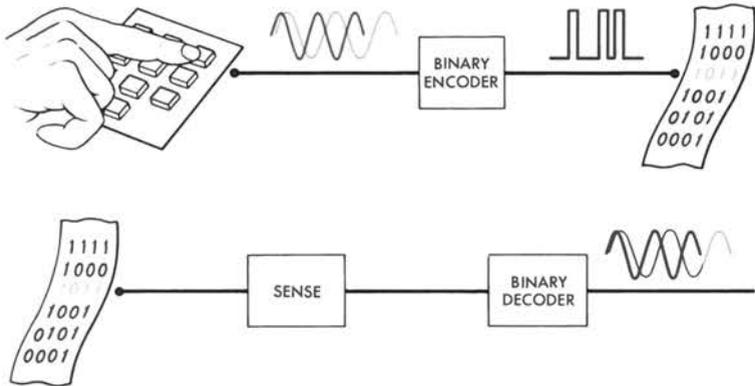
numbers. A customer can write on the directory tape in the set or remove it and type the names and numbers.

Since the entire directory unit is removable, customers who want a repertory larger than 500 names can use more than one. A department store with many accounts, for example, might find several units useful.

Because the CALL-A-MATIC repertory dialer is a TOUCH-TONE set, dialing consists of generating a series of digit signals composed of two audible tones at specific frequencies—the TOUCH-TONE format. The numbers are stored on magnetic tape, and the tape's movements are synchronized with those of the directory tape so that each name space on the directory tape corresponds to one memory slot on the magnetic tape. When the customer selects one of the names written in the directory, he automatically selects the correct number on the magnetic tape. Each memory slot holds enough digits to permit direct distance dialing from the repertory even from PBX lines where “outside-line access” and control digits are necessary.

Lifting a “record-reset” button prepares the CALL-A-MATIC phone to store a number on the magnetic tape. The customer selects an entry space, lifts the button momentarily and then dials the

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The binary encoder translates the TOUCH-TONE signals to binary form for storage on the four-track magnetic tape. The decoder converts the binary information into signaling tones for dialing.



Two finger wheels are used to look up numbers in the CALL-A-MATIC phone's directory. Setting the upper wheel causes a motor to run the directory tape to one of 50 positions, 10 spaces apart in the directory. The lower wheel is geared to the drums that carry the directory tape; it moves the tape manually for selecting the individual space desired. Both wheels are disabled while a customer is trying to record a number in the repertory or place a call.

number with the TOUCH-TONE dial. He can make a normal call and record the number at the same time by lifting the button and taking up the handset before starting to dial. This is called the "simultaneous call and record" feature.

Because the frequency and amplitude of the TOUCH-TONE signals must be very precisely con-

trolled, they are stored on the magnetic tape in binary form rather than simply as recorded tones. The generated frequency must be within 0.5 per cent of the correct value to be identifiable as a TOUCH-TONE signal. The simple binary decision—whether the magnetic flux is or is not reversed—can be made with mechanical equipment that is cheaper and easier to manufacture than the equipment that would be required for satisfactory performance with recorded tones. The diagram on page 26 shows how translation is done. The encoder translates pushes of the TOUCH-TONE buttons to binary information representing the digits and stores it on a four-track magnetic tape. A recording head moves along the tape from one digit slot to another, storing the digits as they are dialed.

When a customer finishes recording a number, he pushes down the record-reset button. This resets the memory and erases any remaining digits that were previously recorded. If the customer forgets to reset the phone, the CALL-A-MATIC set does it automatically after a short time. An electronic clock in the set effectively pushes the record-reset button. The clock operates while digits are being recorded, allowing 9 seconds between digits before resetting automatically.

Some customers may just depend on the clock to reset the phone. The ability to reset manually could even have been omitted, but the 9-second wait might be a nuisance to someone recording a long list of numbers one after the other.

To dial a number from the repertory, the customer selects the right entry and pushes the "call" button. The tape head scans the tape quickly (a 7-digit number is dialed in less than a second) and reads out the digits to the binary decoder. The decoder controls two oscillators, one for each frequency group, that produce the two tones of the TOUCH-TONE signal. Another electronic clock, operating in conjunction with the decoder, controls the length of each signal and ensures adequate time between digits.

When a customer in a PBX dials an outside number, there is usually a short wait for the second dial tone after the "outside-line access" digits are dialed. To record an outside number in the CALL-A-MATIC phone's memory, the customer pushes the "wait" button after recording the access digits, causing a special "wait" digit to be recorded. Then he records the rest of the number. Subsequently when he dials the number from the repertory, the CALL-A-MATIC phone dials the access digits and then stops. The customer starts it again by pressing the call button when he hears the second dial tone.

Sometimes temporary "night-line" service in a PBX requires by-passing a recorded access code. In this case the customer pushes the call button before lifting the handset. The access digits are dialed but not transmitted to the central office. Then he lifts the handset, waits for dial tone, and pushes the call button to dial the desired part of the number automatically.

The real challenge in designing a large-capacity repertory telephone is to make finding any name in its directory easy. A 500-name directory obviously demands some kind of mechanized searching.

To be of any value at all, a continuously-running motor—the kind that is controlled by a push-button and runs while the button is pressed—would have to move the names past the window too fast for reading. A slower-moving mechanism would take too long to get through the directory. The CALL-A-MATIC phone therefore has a series of pre-selected "rest" positions throughout the directory, each position corresponding to 10 spaces in the directory. The pre-selecting device is a 50-position thumb wheel called the Directory Selector. The customer sets the wheel to one of its positions, and the directory runs quickly to the 10 spaces corresponding to that position. The desired name should be in one of the 10 spaces, visible under the window, where it can be readily moved into the exact dialing position with a second thumb wheel that moves the directory manually.

The rest positions of the Directory Selector are usually identified by letter combinations, representing the first letters of last names, which are printed on a strip of pressure-sensitive tape wrapped around the wheel. The letter combinations on the standard Directory Selector tape supplied with the CALL-A-MATIC set were chosen after a careful study of the statistical distribution of names in major-city telephone directories. The idea is organizing the directory so there will be no overflowing of the 10-space sections—having too many names in some sections and only a few in others. Not surprisingly, and despite some individual variations, there is almost perfect correlation among the directories of various major cities. Unusual requirements can be met by special selector strips, which the customer can prepare himself.

The standard selector strip also has five sections that are identified by numbers. Experience with repertory dialing in past field trials has revealed that not all users arrange their lists alphabetically. Some order at least part of the list numerically, or in subgroups that can be identified and associ-

ated numerically. For example, a bank executive may put the telephone numbers of branches under his direction in a subgroup ordered according to branch number, the telephone numbers of building contractors in a second group, and so forth. This is a convenient arrangement for groups of numbers that the customer calls frequently, and for calling each member of the group in sequence. The standard selector strip has a total of 50 numerically-indexed spaces. A customer who needs more can prepare his own Directory Selector strip, which may be wholly numerically indexed.

The five numbered sections of the standard strip can also take up overflow from filled sections in the alphabetical listing. In this case the customer would have to remember where he put the names.

The use a customer gives a repertory directly measures the designer's success in making it convenient and easy to use. A field trial at Greensburg, Pennsylvania, showed that an average of about 30 per cent of all calls made with a CALL-A-MATIC phone originated in the repertory. Some customers made as many as 8 or 9 calls out of 10 from the repertory, indicating that the CALL-A-MATIC phone is indeed convenient and easy to use.

The controls of the CALL-A-MATIC telephone were designed to anticipate trouble. Electrical and mechanical interlocks prevent accidentally erasing numbers or dialing wrong numbers. For example, a customer can't engage the wheel to move the directory tape manually while he is recording; otherwise the numbers in adjacent slots might be erased. The directory tape cannot be cycled electrically while the customer is dialing or recording. Furthermore, the record control circuit is electrically disabled while a call is being made from the repertory to avoid improperly recording information. To prevent damage to the directory tape, a switch removes power from the scanning motor while the faceplate is off and the tape exposed.

Although initially introduced as a 6-button business phone, a CALL-A-MATIC phone for single-line use will be manufactured soon. A built-in speakerphone transmitter and amplifier can be used with either set. A mounting for an internal buzzer for special signaling needs is also available.

The CALL-A-MATIC telephone, offering a practical and useful expansion of Bell System repertory dialing service, illustrates the continuing efforts to make the telephone fill more people's communications needs more fully.