MODIFIED STANDARD OFFICE EQUIPMENT FOR BRAILLE TRANSLATION AND EMBOSSING

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ABSTRACT

Either inkprint or braille can be produced with an IBM Magnetic Card SELECTRIC (R) Typewriter equipped with a read-only translation circuitry and an embosser. Embossing is done on the front side of the paper so the operator can read the information as it is embossed. Information entered at the standard keyboard and recorded on a magnetic card can be played back in both inkprint and braille. The same embosser may be used on other machines with removable type balls, such as the IBM 2741 Communication Terminal Communication Terminal.

INTRODUCTION

An experimental device will be described that provides a simple and direct way to produce a document in either braille or inkprint. The technology for this includes the IBM Magnetic Card SELECTRIC (R) typewriter, translation tables, an embosser, and a modified multi-axis print ball. The embosser is the main contribution, and it can be used with either the magnetic card system or with an IBM 2741 Communication Terminal.

Our efforts were initiated several years ago to research and explore the possibility of embossing on the front side of the paper, in normal left-to-right reading sequence, using a readily available unit of office equipment. The requirement for embossing on the front side of the paper was to facilitate reading the braille without removing the paper from the machine.(1)

Numerous devices were tested and evaluated. A matrix or wire printer was considered since it would be easy to control the individual wires to emboss the document. It was found, however, that there were no matrix or wire printers available on the market or in development that had enough force to actually emboss even lightweight paper, much less the heavier braille paper, which is used for the more frequently used documents.

The IBM Selectric typewriter did have enough force and offered a versatility that would be advantageous. A specially designed multi-axis print ball used in conjunction with a stylus assembly provided good quality braille on the front side of the paper. Experiments were conducted with various grades of paper, and it was found that a durable and high quality braille dot would be possible.

SYSTEM CONFIGUATION

One configuartion for a braille transliteration system includes an IBM Selectric typewriter with a magnetic card system, an embosser mechanism mounted on the typewriter, and self-contained translation tables. Another configuration uses the IBM 2741 Communication Terminal and the same embosser but with the translation tables in a central computer.

IBM SELECTRIC TYPEWRITER

The typewriter used in the system has a standard keyboard for data entry, but as information is entered, it may be printed for operator use in either inkprint or braille. The SELECTRIC typewriter uses a removable typing ball instead of type bars. Different elements (with different type families) may be used on the same typewriter. To accomplish the braille dot impressions, a print ball is modified to include a braille cell, with depressions for each of the six possible dots. This modified print ball is shown in Figure 1. When braille output is required, the ball with the braille cell is used; otherwise a regular ball is in the typewriter.

MAGNETIC CARD SYSTEM

Using the IBM Magnetic Card SELECTRIC typewriter, information entered at the keyboard may be stored for later printout or modification.

The magnetic card system is a word processing system, with a card recorder and reader device.(2) In addition to a temporary memory, which may be altered or changed, it has a more permanent memory--the magnetic card. The magnetic card, shown in Figure 2, is the same size as the punched card used by IBM but is coated with a magnetic material on one side. Information typed into the machine may be recorded on the card in magnetic codes. Each card may contain approximately 5,000 characters. The card can be read by the system, and the information printed out as many times as required, or corrections and changes may be made and the card recorded again. There are two IBM magnetic card systems. With the Magnetic Card System II, the same information may be duplicated on multiple cards for different users.

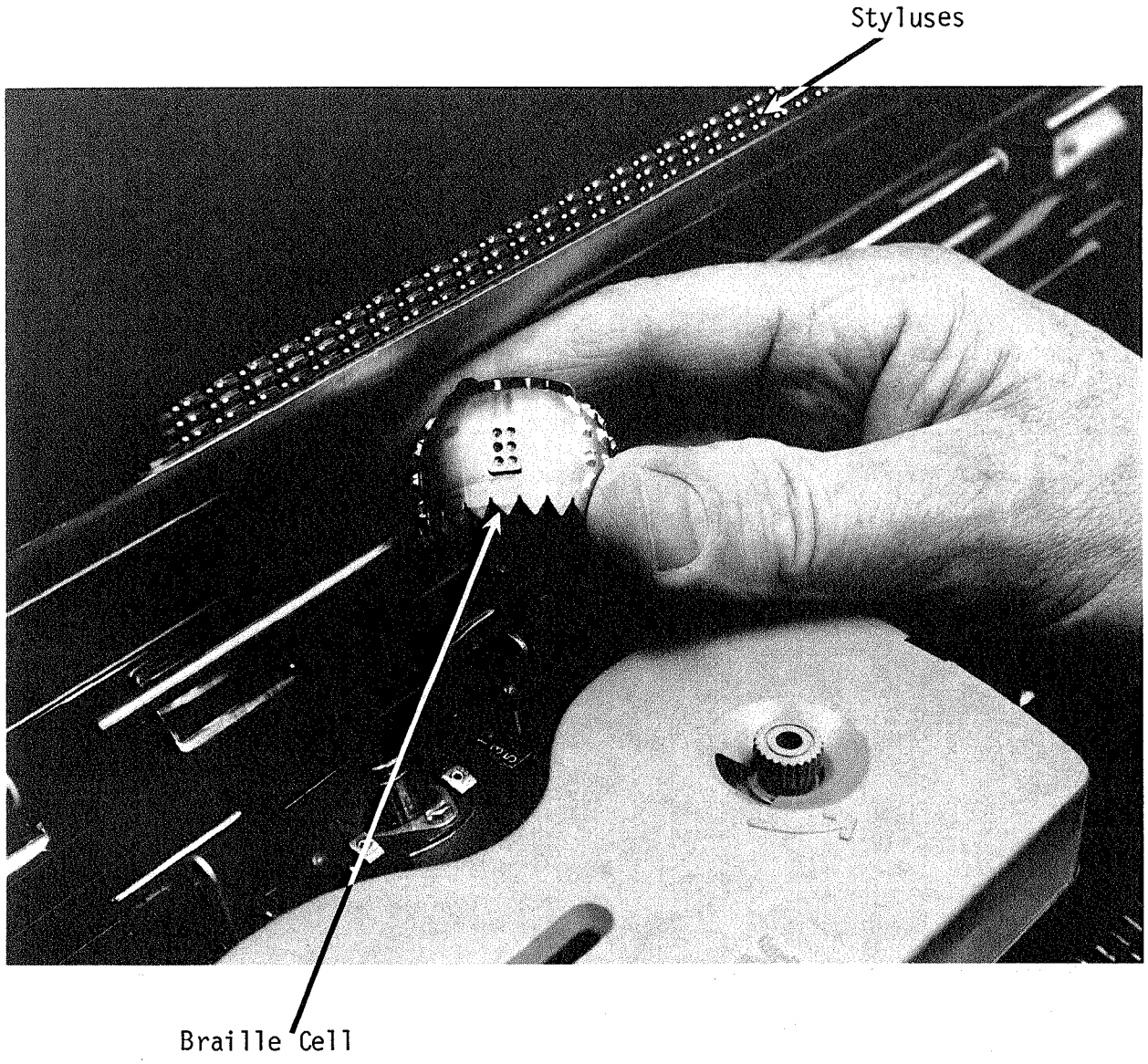

Figure 1. SELECTRIC Typewriter Ball with Braille Cell

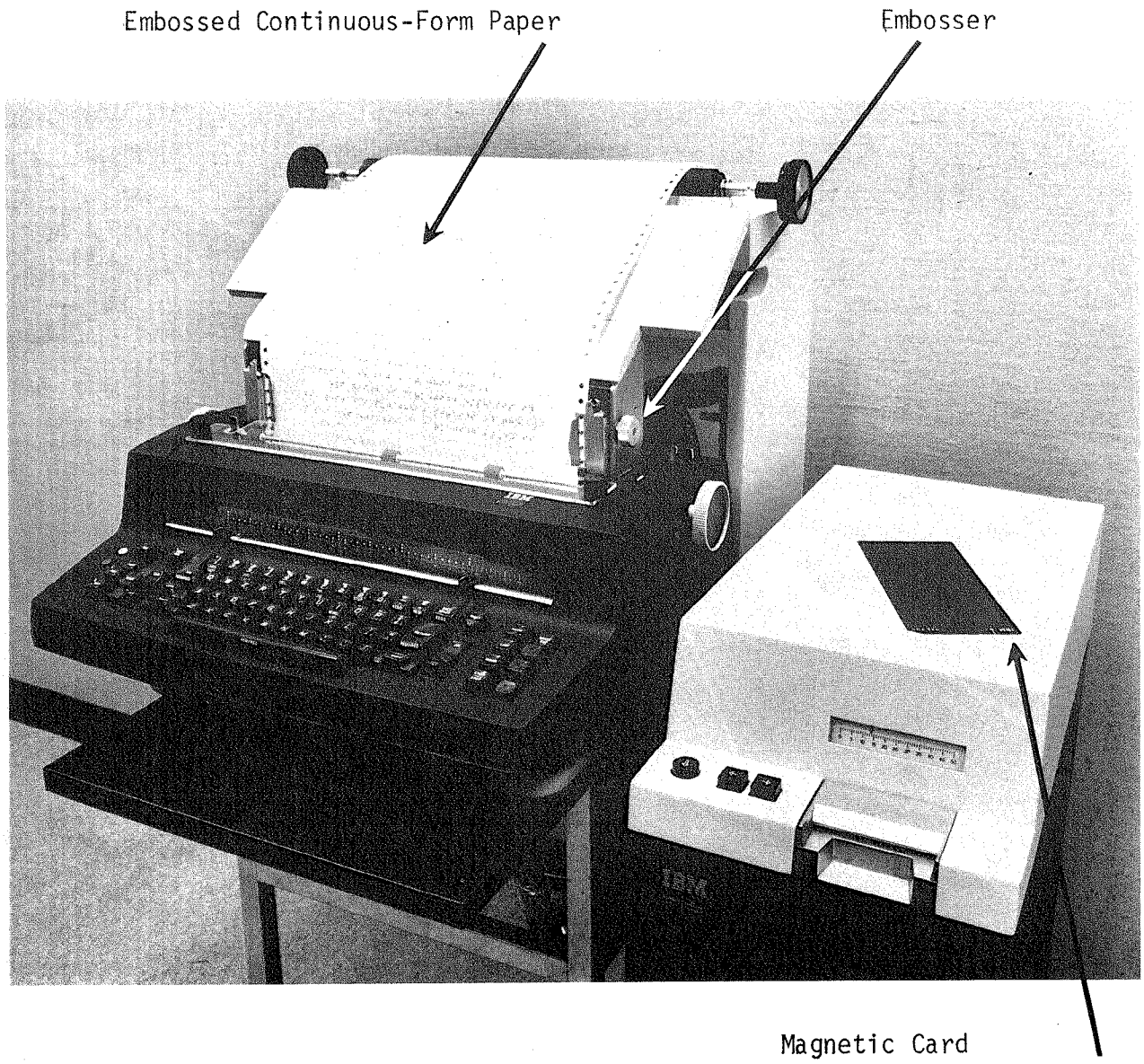

Figure 2. IBM Card SELECTRIC Typewriter with Braille Embosser

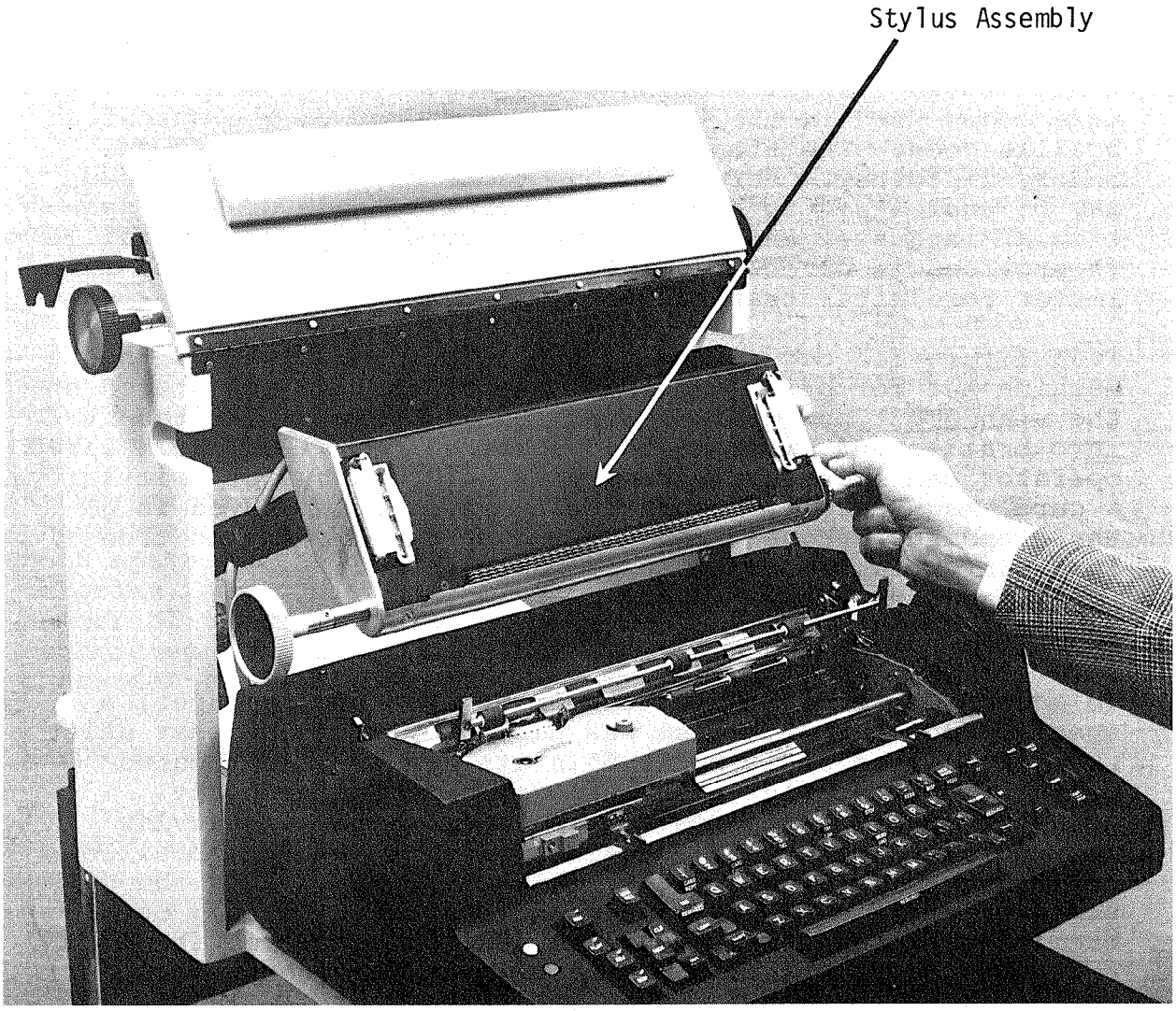

Figure 3. Braille Embosser Showing Stylus Assembly

Information recorded on the magnetic card can be played back in either braille or inkprint.

TRANSLITERATION TABLES

A high-speed transliteration table converts the normal tilt/rotate codes used in the SELECTRIC typewriter to the specified braille code. The transliteration tables are in read-only-memory circuitry. More than one table may be provided and may be customized to a particular braille code or to a particular language, including a programming language. Braille is provided in direct single-cell translation; that is, in letter for letter translation.

Transliteration occurs during the output function. With the machine set for braille output, as information is entered on the standard typewriter keyword, the machine translates it into braille and embosses the paper, so the visually impaired operator can immediately read what has been typed. Similarly, a card, magnetically recorded with information keyed in at the standard keyboard, can be read by the system and translated into braille, with its embossed output.

EMBOSSER

To accomplish embossing on the front side of the paper, a special embosser mechanism was designed. The embosser unit, shown in Figure 3, is mounted in its own console located behind the typewriter. It includes a stylus assembly operated by six solenoids. These operate the six stylus bars corresponding with the six dots of a standard braille cell pattern. It provides for 40 cells per line in the standard braille configuration and spacing. Setting up a braille pattern to represent the desired character is accomplished by operating the solenoids, projecting the desired dots forward and then impacting the type ball, with its dot depressions, against the protruding pins. Forming the paper over the protruding pins provides raised dots on the front of the paper. See Figures 1, 2 and 3. The embosser hardware design will be described in more detail later.

Embossing on the front side of the paper is an improvement over some previous approaches where the embossed dots appeared on the back of the paper, and/or embossing had to be started at the bottom of the paper.

A non-emboss control allows the operator to draft a document without embossing and without advancing the paper. If a playback is needed, the machine is set for embossed output, and the machine plays back the last line, allowing the operator to locate the last entry or a possible error. This

reduces the amount of paper used, and still provides the communication capabilities that a visually impaired operator may require.

ONLINE OPERATIONS

The magnetic card system will communicate with a central processing computer, when fitted with a communication feature. This provides the user with interactive communication with a computer. The computer output would be translated and printed out with the braille embosser. In this case, the system becomes a braille embossing terminal.(3)

Besides the magnetic card system, another major hardware configuration was explored. This was a braille terminal using the IBM 2741 Communication Terminal connected to a central processing computer. In this case, the computer acts as the translator and controlling unit.

Either of these two devices could be used, especially by programmers, for online interactive communication. With both systems, the output could be in either braille or inkprint. If connected to a central processor, there are a number of programs that may be used to convert English to contracted braille. (With the magnetic card system, only character-for-character translation is possible.)

HARDWARE DESCRIPTION

The braille embosser is an electromechanical device that is substituted for the standard typewriter platen. This mechanism, somewhat taller than the standard platen,pivots down from its own console in back of the typewriter and replaces the platen.

STYLUS ASSEMBLY

The embosser contains the primary stylus assembly and six solenoids that operate each of the six stylus bars. See Figures 1 and 3. Each stylus bar contains the same unique braille dot in all 40 positions of the line; thus, when a unique dot arrangement is called for, the selected number of the six solenoids operate to set up the stylus bars required. This process projects the stylus bar forward toward the type ball with its dot depressions. Simultaneously, the element is operated toward the stylus. In so doing, the paper, which is between the ball and the stylus, is formed over any protruding dots in the particular position that the ball is located. Thus, although the unique dot positions have been established in all 40 possible positions of a line, only the position in alignment with the ball is embossed. Immediately after the embossing has been completed, the typewriter carrier

moves to the right and the stylus bars return to their normal position, or if required for the next braille combination, are again projected forward.

HORIZONTAL SPACING

One of the major mechanical considerations is the horizontal spacing of the braille cell. Normal typing occurs at either 10 or 12 pitch, which means 10 or 12 characters per inch of horizontal spacing. Braille, because of its larger size, (necessary for feeling the dots rather than seeing a small printed character) requires 4 pitch spacing; that is, 4 cells per inch. This represents one of the major conflicts between inkprint and braille modes on the same piece of equipment. This requirement is satisfied with a lead screw escapement. (These are generally used for the magnetic card system machines.) In place of the normal rack with equally spaced teeth, it is provided with a rotating screw or spiral shaft, and the carrier is moved left-to-right and right-to-left by following the threads of this lead screw. The amount of rotation of the lead screw determines the horizontal displacement of the carrier and a corresponding location of the embossing on the paper. Since the lead screw is controlled electronically, we can alter the control circuits to provide either 10 or 12 pitch inkprint or the 4 pitch braille spacing.

VERTICAL SPACING

Vertical spacing also needs to be adjusted for braille output. Typing is normally done at six lines per inch. Braille has the minimal requirement of two and one-half lines per inch. Since this is an odd dimension and presents operator problems when using continuous form paper, it was decided to emboss braille with a vertical spacing of two lines per inch. Our experiments showed that the two lines per inch is very satisfactory and, in some cases, superior to the closer two and one-half lines per inch. It also facilitates the use of continuous-form paper and the alignment of the form-feeding tractors.

OTHER ALTERATIONS

Other changes made to the magnetic card system to facilitate its use by visually impaired operators were the addition of tactile scales to show the margin or carrier positions, and the substitution of an audio alarm for some of the signal lights. Besides these, a small tactile display would be useful to inform the operator of peculiar situations. For example, if the machine runs out of paper or the typewriter ribbon ends, the audio signal could alert the operator to an

abnormal condition, and the tactile unit could then be sensed, identifying the type of problem that occurred. This same tactile unit could be used during the inkprint mode if a blind operator wished to verify a single character or two.

Besides the six dot braille cell configuration, two other configurations, the eight dot vertical and the nine dot horizontal might be used. The additional dots would be used to identify additional braille codes, capital letters and other special symbols. Neither would alter the arrangement of the basic six dot cell.

APPLICATIONS

Application With A Communication Terminal

With the braille embosser on a communication terminal connected to a central computer, the visually impaired programmer can enter programs text and other material into the system. Responses from the computer (error messages, printouts, and the like) can be produced in braille. The work can be checked while it is still in the machine because it is being embossed on the front of the paper. Thus, the visually impaired programmer is offered the advantages that are currently available to the sighted programmer using an online terminal. Such a device does require some minor modifications to the programming interface.

One of the significant opportunities with a braille output device connected to a central computer is the interrogation of various data bases. The many online data bases that are currently available in the United States could be interrogated from remote locations, and the output produced in braille. As an example, there are many visually impaired lawyers who would benefit from the capability of interrogating a data base and receiving braille output, or, in their daily work, of receiving, from their secretary, a braille copy of various documents or briefs.

Application With Word Processing Systems

With the Magnetic Card System II equipped with an embosser, the visually impaired operator can enter and correct documents. If an inkprint copy is needed, it is only necessary to swing the embosser out of the way, put the standard platen back into the machine, and set the machine to play back the magnetic card in inkprint. The visually impaired operator can then send the inkprint copy to a sighted individual. The device may be used in the opposite direction; that is, a sighted person can type in inkprint and record on the card. Letters, memorandums or reports can be corrected and updated, and then, when a braille

copy is needed for a visually impaired associate, the embosser unit can be dropped into place and the card played back. The machine, using a translation table, will automatically translate the document, recorded on the magnetic card, into the braille code and emboss the paper as required.

The magnetic card system, with a communication feature, can be used as a braille-embossing terminal if online (connected to a computer), or offline (not connected to a computer), as a secretarial machine. It can be used offline by programmers to record various programming codes or text material and then, after this has been organized and structured,it can be transmitted to a computer, thus requiring a very limited amount of online connect time.

A significant advantage of the magnetic card system is the portability of the recorded card. Various estimates indicate that embossed braille is approximately 50 times more space-consuming than the printed version. Mailing it is often a problem as the braille can be damaged unless carefully packed. A magnetic card, on the other hand, can be mailed in a plain envelope, at low cost, with little damage anticipated.

Since magnetic cards can be created on one magnetic card system and played back on other magnetic card systems, they may be distributed and printed out at different locations in braille, as required. This opens up many opportunities in library and educational areas for producing braille documents in small volumes.

Conclusions

Two prototypes have been built and tested by visually impaired users. One was the IBM 2741 Communication Terminal, which has been used for over two years as a programming and data input/output terminal by a blind scientist. The other was a simulated IBM Magnetic Card II machine that provided, by means of a translation table, the inkprint-to-braille transliteration required for a typist. The machine could produce either braille or inkprint. Use of these prototype machines demonstrated that they are practical and advantageous for the visually impaired.

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