

## XX. SENSORY AIDS RESEARCH

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### A. AN ENCODER FOR A GRADE II BRAILLE TYPEWRITER

[This report is a summary of a thesis that was presented by R. J. Dirkman to the Department of Electrical Engineering, May 1960, in partial fulfillment of the requirements for the degree of Master of Science.]

The need for a device with which an operator without a highly specialized knowledge of Braille can transcribe one or more copies of printed material into Braille has long been present.

Standard English Braille is based on a pattern, or cell, containing 6 embossed dots arranged in two columns as shown below. (The vertical and horizontal spacing is 0.1 inch.)

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There are 63 possible combinations of these 6 dots which are used to represent letters of the alphabet, numerals, punctuation marks, signs, common groups of letters, and whole words.

Several levels, or "grades," of Standard English Braille are used. Grade I Braille is uncontracted; a one-to-one correspondence exists between the letters of a standard printed text and its Braille counterpart. Grade II Braille is moderately contracted; a total of 185 contractions includes words and common groups of letters that may be used as parts of words. Grade III Braille is a highly contracted form and has limited usage in applications where a short (coded) notation is convenient. Although strictly not a form of Standard English Braille, Grade One-and-a-Half Braille is used to a large extent for general publications.

The contracted forms of Braille result in space economy. For example, Grade II Braille requires an average of 3.5 cells per word, as compared with 5 cells for Grade I Braille.

An encoding system has been developed to facilitate the translation of text material into Grade II Braille. This system, intended for use with a standard typewriter keyboard, requires that the operator recognize the 185 contractions and remember a few simple rules regarding the formation of words.

The output from the encoder may be either an embossing mechanism which forms the dots of the Braille cell directly, or some form of recording equipment. Although it may seem convenient to produce the Braille in a form directly usable by the blind, several advantages result from the use of punched tape. The tape can be used to operate a

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variety of secondary devices to produce the embossed Braille. These include plate-embossing machines similar to the stereotyper for automatically producing zinc plates suitable for printing Braille copies of the recording, or Braille reading machines that reproduce temporarily the Braille code recorded on punched tape. Each of these devices has been developed, and efforts are being made elsewhere to improve them.

Provision for correction of errors by the untrained (in Braille) operator would be a desirable feature. Since a typed copy of the material is available for proofreading, a punched tape would be advantageous because corrections can easily be made before the tape is used as an input to the auxiliary devices described above.

The encoding system operates as follows. The typist uses the standard keyboard to type uncontracted text material. The simultaneous use of a letter key and the shift key (indicating a capital letter) results in a two-symbol output (the letter cell preceded by the capital cell). When the typist recognizes a contraction, a foot pedal or similar device is depressed. The typist proceeds to type the letters of the contraction exactly as they appear in the English text. Depressing the contraction key or pedal stores all of the English letters of the contraction. These letters are then compared with all of the contractions in the encoder's memory. When the correct one is found, the encoder will punch out the correct Braille cell, or cells, for the contraction. The speed of the

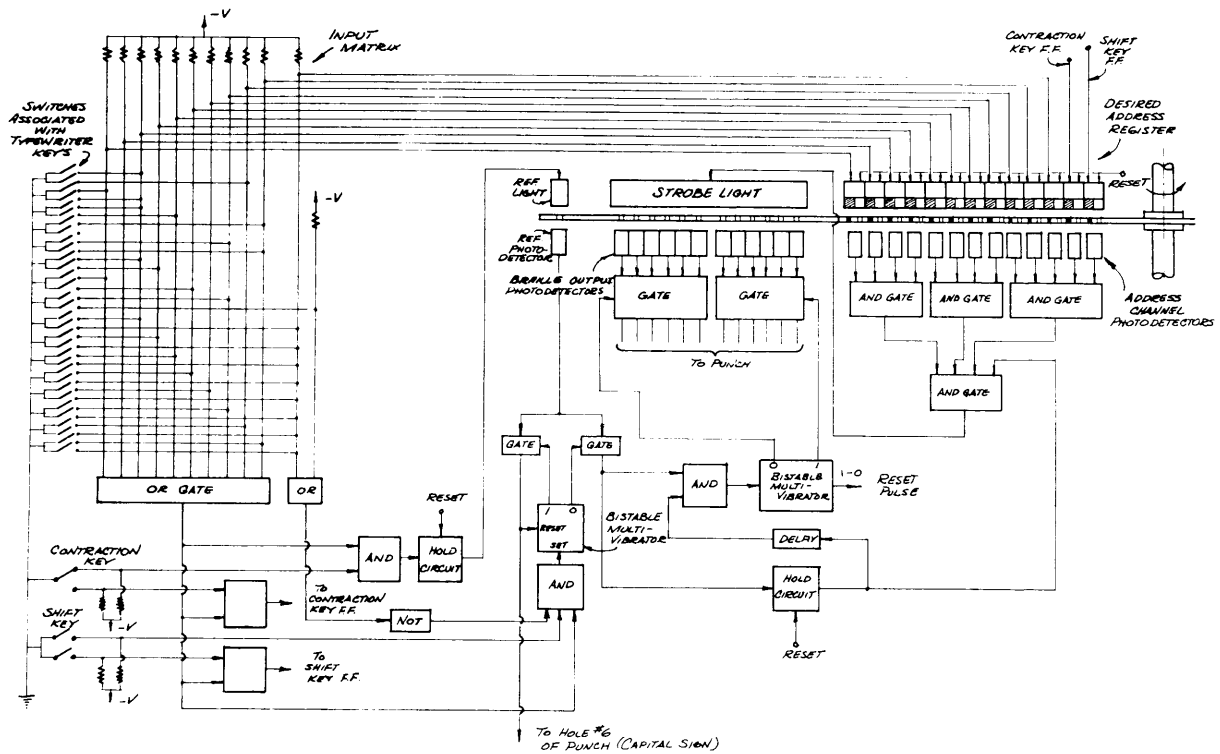


Fig. XX-1. Complete encoder system.

Braille output is sufficient to require no special pause on the part of the typist. It is anticipated that a typist with reasonable training will be able to use such a device at nearly normal typing speed.

The block diagram of the encoder is shown in Fig. XX-1. The keys of the typewriter activate switches that set up the typed symbols in an eleven-bit input code matrix. The machine memory consists of a photographic disk that is rotated at constant speed. The input code lights the right- or left-hand member of a binary light coding address. When a coincidence between the input code and the disk's light and dark coded areas occurs a strobe light is activated. At this time, the disk is in such a position that the proper Braille embosser output code is under the strobe lamp. Thus the correct symbol is printed out. If more than one symbol is required, as in the case of a contraction, the coincidence between input code and rotating disk will remain for several disk positions and the correct sequence of symbols will be printed in order. After a letter or contraction has been printed, the address register is reset and a new input code accepted. Many of the blocks in the diagram of Fig. XX-1 are required only for correct timing.

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#### B. TACTILE STIMULATION OF THE FINGERS AS AN INFORMATION INPUT TO THE BLIND

A device has been constructed that permits the presentation of various patterns of poke probes to the eight fingers (thumbs are excluded). Compressed air is valved by an arrangement of flexo tape and brass plates. The air then actuates pneumatic plungers which force the poke probes against the fingers. An arrangement of six probes per finger permits the use of the Braille code for alphanumeric characters.

Preliminary tests were conducted with the following presentation pattern. A single

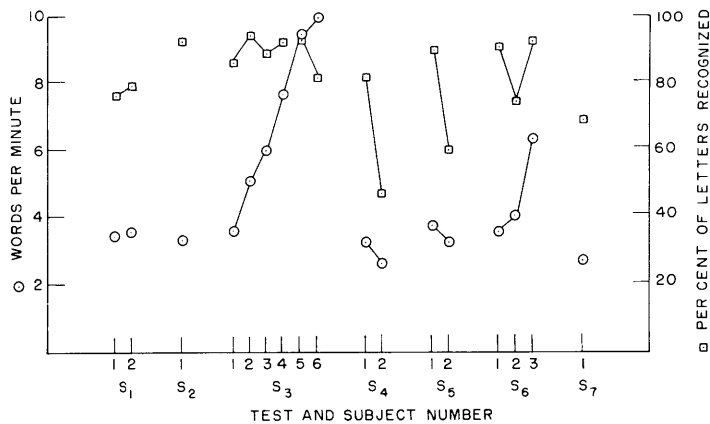


Fig. XX-2. Test results.

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letter is presented to one finger at a time; the little finger of the left hand receives the first stimulus, and the other fingers are stimulated sequentially from left to right. This presentation scheme is realized with the aid of essentially two separate air valves. One valve uses only the seventh hole of the flexo tape and selects the finger to be stimulated, while the other employs the other six holes to determine the letter to be presented to a particular finger.

Seven blind subjects were given from one to six tests, each of which consisted of the presentation of 14 three-letter words and nonsense syllables drawn from the first 10 letters of the alphabet. Successive tests were conducted at speeds of 18, 26, 33, 42, 51, and 60 letters per minute, with the exception of the tests for subject No. 1, in which the speed of the first two tests was 18 letters per minute. Reading rates in words per minute are arrived at by multiplying the percentage of letters recognized by the speed in letters per minute and dividing by five. The results of these tests are shown graphically in Fig. XX-2. The percentage of letters recognized that was achieved demonstrated that the blind subjects were able to transfer a considerable amount of their knowledge of the Braille code to the stimulation patterns presented by this device. Two of the subjects exhibited a marked increase in reading rate with a substantially constant recognition percentage. This indicates that further tests should be conducted to determine the reading rates at which their learning curves saturate.

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