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Selective and Consecutively Arranging Triple-Notch Code

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1. FOREWORD

Codes for edge-punched cards can be classified into two kinds, the direct or single-notch code and a combination or multiple-notch code.

The combination code is a method of representing a concept by notching two or more holes. One such method, the *selective code*, is a form of code in which the number to be notched in one field is always made constant, and the cards sorted do not make the errors of the first and second kinds, *i.e.*, the required card drops out and the unrequired card does not.

The number of items I that can be represented by notching the number of holes N in one field with H number of holes, will be

$$I = {}_{H}C_{N} = H!/N!(H-N)!$$

When H is constant, the number of holes N for the most effective, selective code is obtained by $N = H/2$ (where H is an even number), or $N = (H-1)/2$ (where H is an odd number) and the maximum I can be calculated.

In the present article, a method of representing the most effective selective code on two-dimensional paper, and the method of arranging the cards notched by this code in a consecutive numerical order will be examined.

2. STANDARD SORTING FOR CONSECUTIVE ARRANGEMENT

Figure 1 illustrates one of the simplest two-notch consecutive codes.

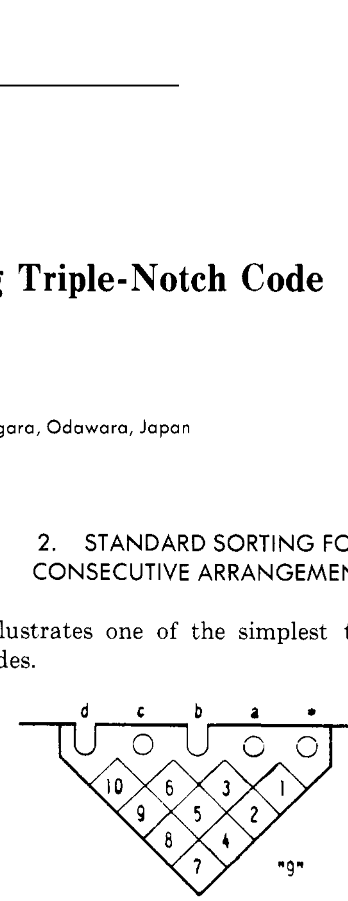

Fig. 1.—Double-notch code.

The way to put the cards notched by this code into consecutive order is to sort the cards at the hole "a"[1]; cards that drop out are replaced on the back of the cards in hand; all the cards are re-sorted at the hole "b", without changing the order of the cards; cards that drop out are replaced on the back of the cards in hand; and similarly with the holes "c" and "d". This would be apparent from Fig. 2.

(1) The hole at the extreme right (marked with * in figures) is not sorted for consecutive arrangement, and the process is started from the next hole, going to the left.

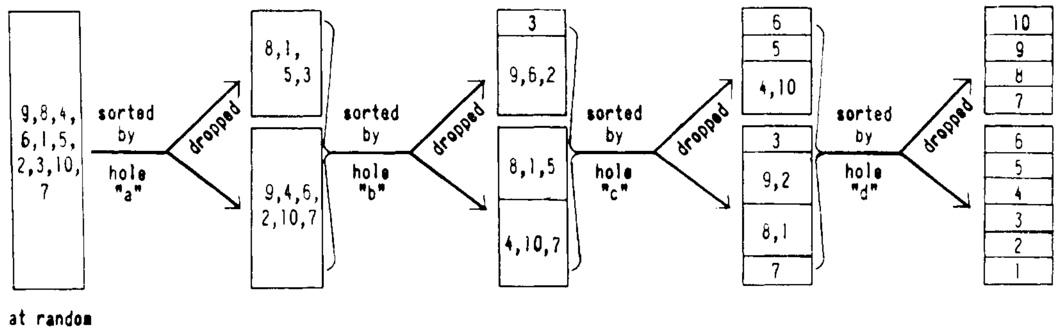

Fig. 2.

Let us call this method of sorting the *standard sorting for consecutive arrangement.*

3. TRIPLE-NOTCH CODE

The most effective, selective code when the available number of holes H is 6 or 7 is to notch three holes ($N = 3$); and it requires three-dimensional representation to indicate three notches. The simplest of such methods is the one shown in Table I but methods other than that will be described in this section.

The first to be taken up is the method shown in Fig. 3. A number to be represented (or a number smaller than and nearest to that to be represented) is notched by the top line, and the difference between the number notched and the number to be represented is notched by the middle line with a plus sign (+) (if the number required is not found, then the number smaller than and nearest to that number is used). If there is no difference, +0 is notched. Finally, the difference between the sum of the two numbers notched and the number to be represented is notched by the bottom line marked with ±. If there is no difference, then ±0 is notched. To read the number from the notched holes, the number on the top line is read from the left-hand notch, that on the middle line from the central notch, and that of the bottom line on the right-hand notch, the sum of these numbers being the number represented.

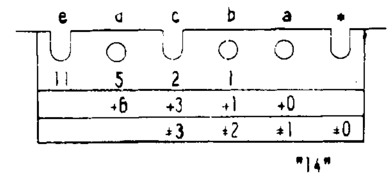

Fig. 3.—Triple-notch code (2).

The foregoing method is a breakdown of a triple-notch code into three single-notch codes, while the methods described below are broken down into one double-notch code and one single-notch code.

The method shown by Fig. 4 is to represent a number by the sum of the numbers indicated by the direct code of four holes at the left and that by the double notch code of five holes of triangular indications at the right. To read the number from the notches, the number from the left-hand notch is read on the direct code and the number from the two right-hand notches on the triangular indication is added.

The method shown in Fig. 5 is to represent a number by the sum of the number indicated by two notches out of five holes on the left-hand triangular indication, and

Table I. Triple-Notch Code (1)

Number	e	d	c	b	a	*
			hole			
1	–	–	–	+	+	+
2	–	–	+	–	+	+
3	–	–	+	+	–	+
4	–	–	+	+	+	–
5	–	+	–	–	+	+
6	–	+	–	+	–	+
7	–	+	–	+	+	–
8	–	+	+	–	–	+
9	–	+	+	–	+	–
10	–	+	+	+	–	–
11	+	–	–	–	+	+
12	+	–	–	+	–	+
13	+	–	–	+	+	–
14	+	–	+	–	–	+
15	+	–	+	–	+	–
16	+	–	+	+	–	–
17	+	+	–	–	–	+
18	+	+	–	–	+	–
19	+	+	–	+	–	–
20	+	+	+	–	–	–

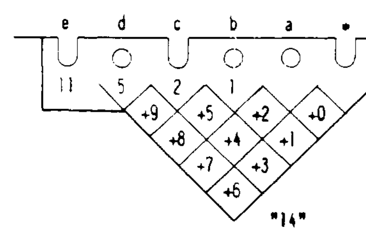

Fig. 4.—Triple-notch code (3).

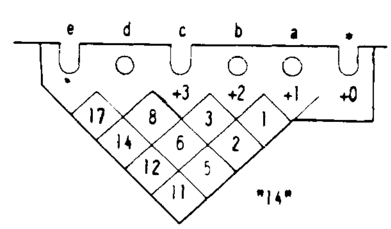

Fig. 5.—Triple-notch code (4).

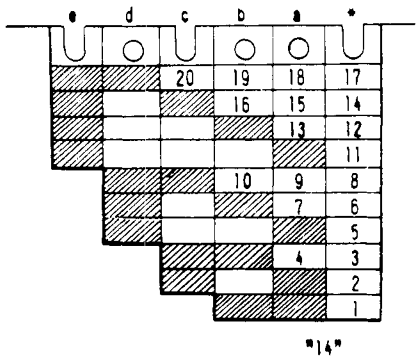

Fig. 6.—Triple-notch code (5).

the number by one notch out of four holes of the direct code on the right. This is the reverse of the method shown in Fig. 4, which is easier to understand.

Fig. 6 shows a triple-notch code represented as such without breaking it down.[2] This method is used by notching one hole above the number to be represented and further notching two holes above the shaded area on the same line as the number to be represented. To read the number from notched holes, the two left-hand notches are followed down until both rectangles are shaded on the same line and the number to the right on that line and downwards from the right-hand notch is the number to be represented. This method may also be indicated as shown in Fig. 7.

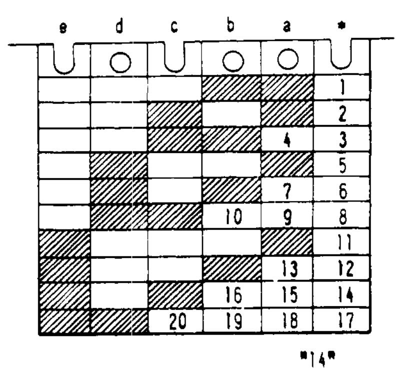

Fig. 7.—Triple-notch code (6).

The methods represented in the foregoing Fig. 3–7 all have the same holes notched for a certain number, although the method of representation is different.

To place the cards notched by these codes in the order of consecutive numbers, they should be submitted to the standard sorting for consecutive arrangement from "a" to "e."

Comparative examination of these methods will next be made. The method shown in Fig. 3 requires a minimum space for notation, but two additions must be made and that is not practical. The method of Fig. 6 (Fig. 7), on the contrary, requires no addition to be made and the number can be read directly, but a large space is necessary for notation of the code. This method has the advantage of being capable of indicating a concept other than numbers. The methods of Fig. 4 and 5 are intermediate to the foregoing, the code can be printed in a comparatively small space, and a simple addition has to be made only once.

The foregoing triple-notch methods can all be extended to over six holes and the result can also be submitted to the standard sorting for consecutive arrangement. With seven holes, $I = 7.6.5/3.2 = 35$.

The method shown in Fig. 8 is a modification of that shown in Fig. 4, the triangular indications in the latter having been changed into the 7.4.2.1.SF code. The number nearest to and smaller than that to be represented is notched by the upper code and the difference is notched by the lower code. The lower code cannot be extended to more than five holes, so that the method shown in Fig. 8 cannot be extended to more than six holes. It may, however, be extended to the method shown in Fig. 9 with the understanding that the lower code cannot be changed. By this method, $H = 7$ will give $I = 30$, and $H = 8$ gives, $I = 40$, leaving some combinations not used.

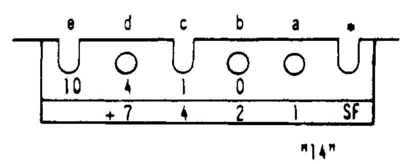

Fig. 8.—Triple-notch code (7).

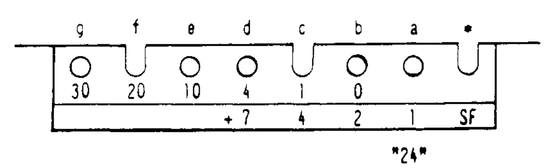

Fig. 9.—Extended triple-notch code.

These methods also can be submitted to the standard sorting for consecutive arrangement.

4. CONCLUSION

The methods herein illustrated are merely fundamental methods of representing selective triple-notch codes. They should be modified on use to fit each purpose and can be extended to multiple-notch codes, such as quadruple, quintuple, and so on, by some modification. Detailed descriptions for such multiple-notch codes have been made by the author in the monograph cited.[2]

Grateful acknowledgement is made to Miss Dorothy U. Mizoguchi for cooperation in preparing this manuscript.

(2) The basis for this code was devised by Mr. Shigeo Nakamura (K. Hirayama, M. Masuyama and S. Nakamura, "Theory and Practice of Edge-Punched Cards" (in Japanese), Nankodo Publ. Co., Tokyo, 1957) and the order was established by the present writer by changing the order of notching the items so as to facilitate consecutive arrangement.