United States Patent [19]

Konya

[11] **3,859,507**

[45] **Jan. 7, 1975**

[54] **AUTOMATIC TICKET PREPARING AND EXAMINING SYSTEM EMPLOYING SEQUENTIAL CODE**

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[22] Filed: **Sept. 18, 1972**

[21] Appl. No.: **290,150**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 825,858, May 19, 1969.

[30] **Foreign Application Priority Data**

May 24, 1968 Japan 43.34712

[52] **U.S. Cl.** ..... **235/61.7 R,** 235/61.8 A

[51] **Int. Cl.** **G06k 5/00**

[58] **Field of Search** ..... 235/61.7 R, 61.7 B, 61.8 A; 340/149 R, 149 A; 283/7, 13

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Attorney, Agent, or Firm—Robert E. Burns; Emmanuel J. Labato; Bruce L. Adams

[57] **ABSTRACT**

An automatic ticket preparing and examining system to be used for a transportation network comprising a ticket preparing device for preparing an ordinary ticket or a season ticket and a ticket examining device for examining each ticket thus prepared upon exhibition by a passenger, both of the devices being provided in each of the stations included in the transportation network wherein a sufficient number of routes or lines each assigned by a route or line code are determined so that each of the stations may be designated by a station code consisting of the route or line code and an address code for the station determined within a specific route or line, the ticket preparing device including means to record on each ticket required information about a starting station, intermediate stations, and a terminating station expressed in the station codes, and the ticket examining device including means for judging the validity of each ticket from the information recorded in the station codes, procedures adapted for said judging being described herein.

5 Claims, 12 Drawing Figures

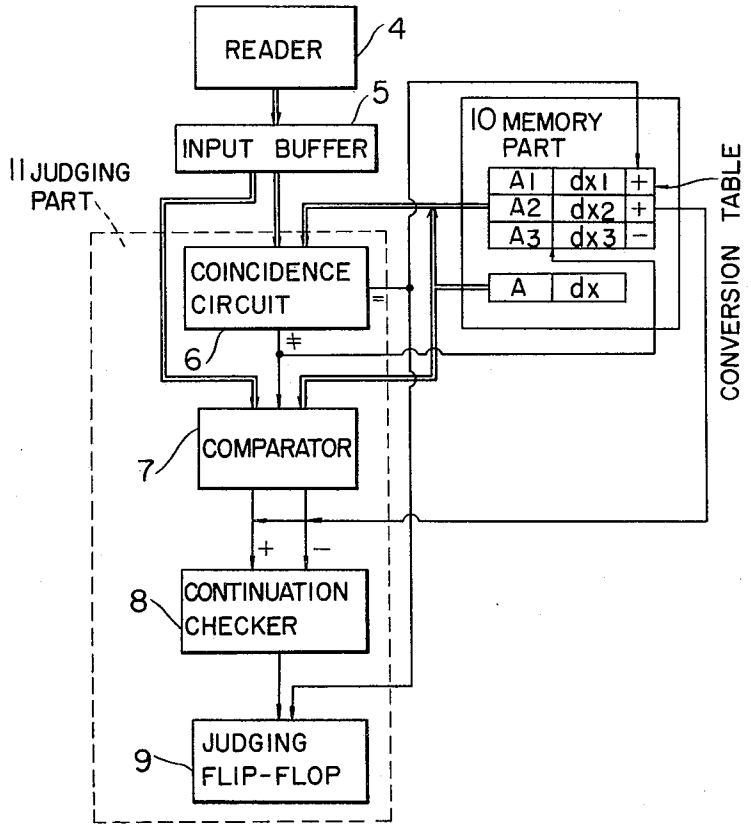


FIG. 1

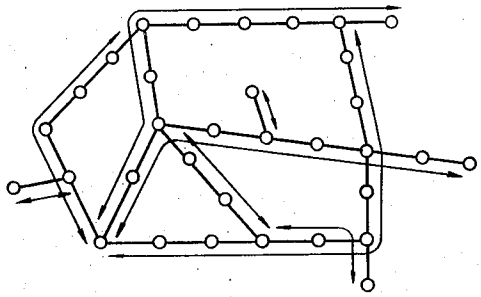


FIG. 2



FIG. 3

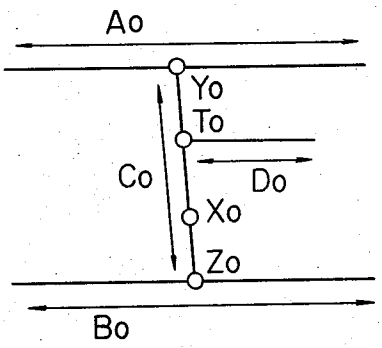


FIG. 4

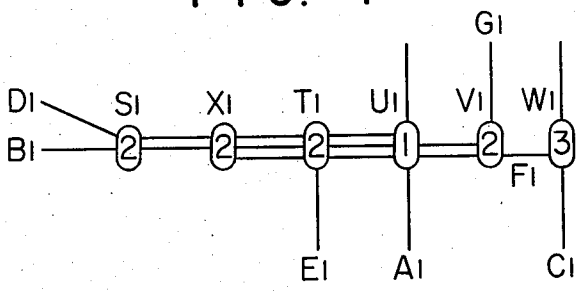


FIG. 5

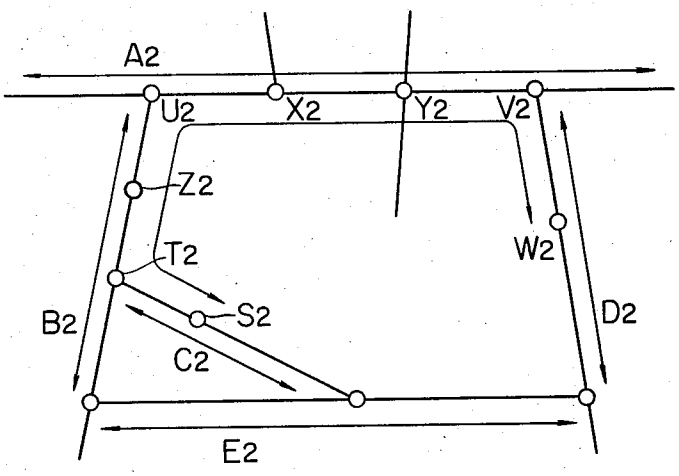


FIG. 6

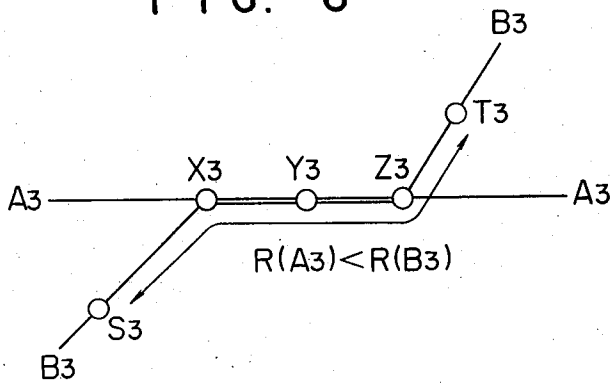


FIG. 7

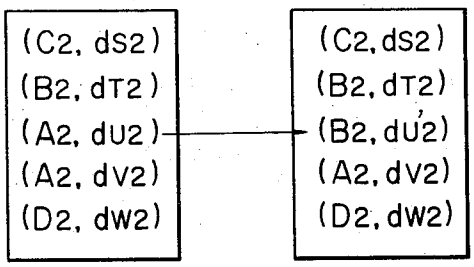


FIG. 8

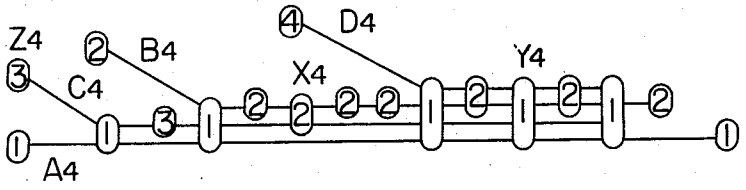


FIG. 9

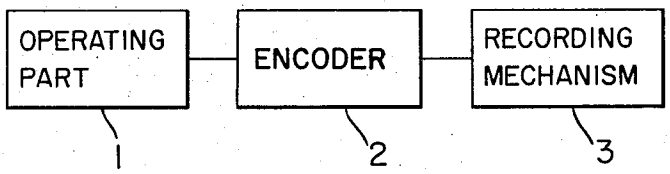

OPERATING PART
ENCODER
RECORDING MECHANISM
1
2
3

FIG. 10

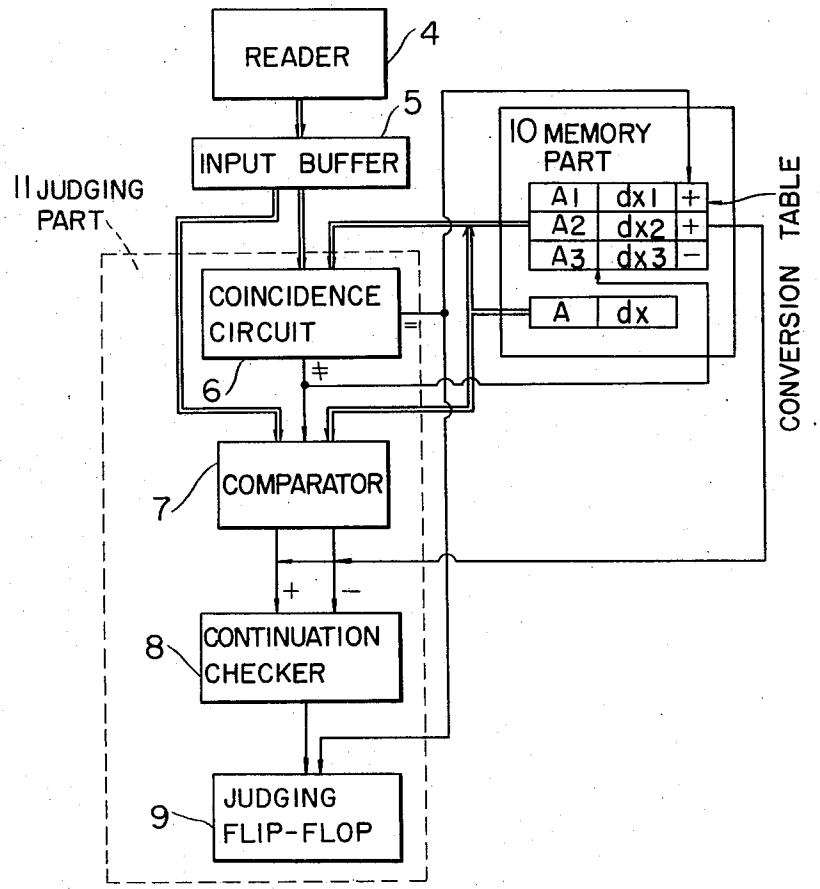

READER
4
5
INPUT BUFFER
11 JUDGING PART
10 MEMORY PART
A1 dx1 +
A2 dx2 +
A3 dx3 −
A dx
CONVERSION TABLE
COINCIDENCE CIRCUIT
=
≠
6
COMPARATOR
7
+
−
CONTINUATION CHECKER
8
JUDGING FLIP-FLOP
9

FIG. 11

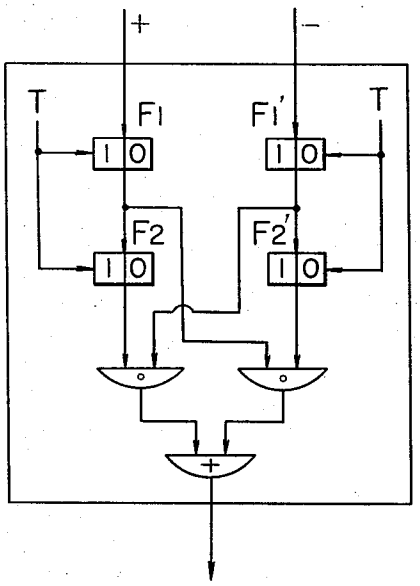
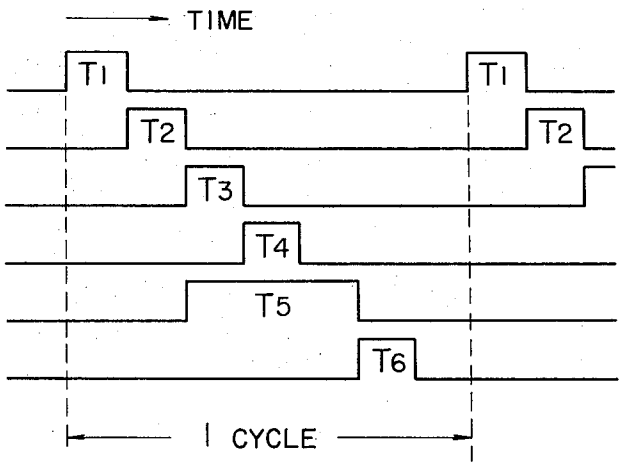


FIG. 12



AUTOMATIC TICKET PREPARING AND EXAMINING SYSTEM EMPLOYING SEQUENTIAL CODE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our copending application Ser. No. 825,858, filed on May 19, 1969, entitled "AUTOMATIC TICKET PREPARING AND EXAMINING SYSTEM EMPLOYING SEQUENTIAL CODE."

BACKGROUND OF THE INVENTION

The present invention relates to an automatic ticket preparing and examining system, and more particularly to an automatic ticket preparing and examining system employing sequential codes.

In a conventional automatic ticket preparing and examining system, for instance, a railway network including various loops is transformed into a network tree including no loops by cutting each of the loops between appropriate two stations. Each of the stations included in the network tree thus transformed is then assigned a code which allows judgement as to whether or not a station is included on a path between two arbitrarily determined stations. On an ordinary or a season ticket, there is recorded information about the two terminal stations of the allowable path for the ticket in coded form and about the cutting points included in the allowable path, and the ticket examining device in each station is thereby enabled to judge the validity of the ticket upon its exhibition by a passenger based on the above described information written in the coded form. However, in the conventional ticket preparing and examining system, there were difficulties such as the inclusion of too many loops in the railway network along with the ever growing size thereof, which inevitably increases the number of bits required for indicating the cutting points of the loops on the ordinary or season ticket, and as the necessity of revising the station codes in a considerable number (in some cases, almost totally) when a station or a line is newly installed or partly modified.

Furthermore, in other prior ticket judging system, it seems that the method of judging (examining) the intermediate points (stations) is identical with the method the terminal points (starting and terminating stations) along the allowable path, namely by the method of judging the legality as to whether or not the data on the ticket contain the code of the judging station itself.

However, if it is intended to apply such a method to a transportation system which allows riding-on and getting-off at any station along the allowable path indicated on the commutation ticket, it becomes necessary to impart codes of all the stations contained in the allowable path onto the ticket. Consequently, the quantity of the necessary information becomes too plentiful to be coded and thus is of no practical use.

Accordingly, when the automated ticket system is applied to the transportation system as mentioned above, it becomes very important to codify the allowable path by sufficiently few (from a practical point of view) bits of information and to find a reasonable method capable of efficiently judging the legality of the ticket at each station to determine whether the commutor rides on or gets off.

SUMMARY OF THE INVENTION

The present invention aims to overcome the above described difficulties of the conventional automatic ticket preparing and examining systems and to satisfy the important matters of the prior ticket judging system. According to the invention, there is provided an automatic ticket preparing and examining system for transportation network comprising a ticket preparing device and a ticket examining device located at each station of said network, each of said ticket preparing devices being adapted to record information concerning the starting station, intermediate stations and the terminating station on a ticket in the form of codes consisting of a route or line code and an address code and each of said ticket examining devices being adapted to examine a ticket presented to it to see whether or not the codes on the ticket are passable at the judging station and thus to judge the validity of the ticket.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which the same or equivalent parts are designated by the same reference characters.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an explanatory diagram showing an example of lines or routes determined over a railway network;

FIG. **2** is a diagram showing the constitution of a station code to be assigned to a station;

FIGS. **3** and **4** are diagrams employed for the explanation of a senior junction station included in a line or route;

FIGS. **5** and **6** are diagrams showing the description of allowable paths on an ordinary or a season ticket;

FIG. **7** is a diagram showing conversion of the station codes written on the ticket;

FIG. **8** is a diagram on which are indicated sections of lines or routes commonly included in a plurality of lines;

FIG. **9** is a block diagram showing the ticket preparing device used in the invention;

FIG. **10** is a block diagram illustrating the means included in the ticket examining and validating device according to the invention and adapted to carry out a judging method for judging whether or not the two stations corresponding to two continuous station codes appearing on the ticket are located on both sides of the judging station;

FIG. **11** is a block diagram showing the continuity judging part used in the system according to the invention; and

FIG. **12** shows timing relationships caused by a timing mechanism used in the system according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. **1**, the principle of the invention will be explained. The whole or a part of the given railway network is completely covered by a number of lines or routes indicated by arrow marks in the drawing. A "line" or "route" may be herein defined as a railway path connecting any two desired stations and the same station on a partial section of the network may be included in more than two lines or routes. The concept of this "line" or "route" is the extension of the concept of the lines in practical use on the railway, such as the "TOKAIDO LINE" and "SANYO LINE" in Japan,

and accordingly may be determined optionally in accordance with the practically used lines, the amount of traffic, the amount or transportation and various requirements for the railway operation and controls.

For each station located along a route or line, a station code (A, *dx*) as shown in FIG. 2 may be assigned, wherein A is the route or line code designating the route or line and *dx* is the address or address code which is indicative of the relative position of the station along the route or line A, and the values of the address codes assigned to each of the stations along the route or line should constitute a series of numerals successively increasing along the route or line. Thus a station having an address of the smallest numeral along the route (located at one end of the route or line) is called the "reference station" of the route or line.

The above described station code (A, *dx*) is called a "sequential code."

One example of the sequential code uses a kilometer code, wherein the address dx for each station represents a distance in kilometers counted from the reference station. Among other examples of the sequential codes, there are time codes and order codes where the address for each station represents a time period required for travelling from the reference station or a sequential order counted from the reference station, respectively.

It should be noted that when one station is included in two or more routes or lines simultaneously, two or more station codes may be assigned to said one station. Such a station included commonly in two or more routes or lines is called a "multi-code station," and relative to this, a station included merely in a single route or line is called an "ordinary station."

Next, a value R(A) fulfilling the following condition is considered in correspondence with the route or line A, and this value is called the rank of the route or line A.

Condition: Interconnected routes or lines should have respectively different ranks.

Assignment of the ranks to the routes or lines may be done freely except for the above described limitation. For example, the routes or lines may be ranked as **1, 2, 3, ...** depending on the traffics along the routes or lines, lengths of the routes or lines, or degrees of importance of the routes or lines.

The rank represented by a smaller numeral is called higher than one represented by a larger numeral. Let the route or line of the highest rank among the routes or lines including a station *x* commonly be designated by A*x*, the rank of the highest ranked route or line A*x* is also employed for indicating the rank of the station *x*, which is written $r(x)$. Furthermore, the sequential code for the station *x* employing the route or line A*x* of the highest rank is called the "representative code" of the station *x*.

Next, the conception of "senior junction station" is introduced for each of the stations. More particularly, a "senior junction station" with respect to a station *x* is defined as being any station on a line including the station *x* whose rank is higher than the $r(x)$. In the case where the station *x* is an ordinary station, for instance in the network of FIG. 3, when it is assumed that

$$R(Ao),\ R(Bo)<R(Co)<R(Do),$$

then the stations Y*o* and Z*o* are senior junction stations with respect to the station X*o*, but the station To is not a senior junction station with respect to station X*o*.

In the case where the station *x* is a multi-code station, any station Y included in a subset {K*i*1, K*i*2, ... K*i*m} of a set of routes or lines {K1, K2, ... K*n*} including the station *x* and satisfying the following relation:

$$r(Y) < \min \{R(Ki1),\ R(Ki2),\ \ldots\ R(Kim)\}$$

is called a senior junction station of the station *x*. For instance, in FIG. 4, assmuming the ranks of the routes or lines A1, B1, C1, D1, E1, F1 and G1 are **1, 2, 3, 4, 5, 6,** and **7,** respectively, the rank of each station can be expressed by the numeral written in a circle indicating the station. Thus, the stations U1 and W1 are considered to be senior junction stations of the station X1.

A ticket preparing device can prepare an ordinary or season ticket which may bear information concerning terms, distinction of sex, adult or chile, school attended, classes, and the railway fare. The ticket also includes information according to the invention such as representative codes of the stations where the allowable path changes the route or line and which are recorded in the order they appear along the allowable path of the ticket. This information is recorded so that an examining device of the ticket can automatically read out such information as mentioned above.

The ticket preparing procedures will now be more fully described with reference to FIG. 5. It will be supposed that a network includes routes or lines A2, B2, C2, D2, and E2, and that the allowable path for the ticket is as indicated by S2, T2, U2, V2, and W2 in the same drawing. Then, the representative codes (C2, $d\mathrm{S}_2$), (B2, $d\mathrm{T}_2$), (A2, $d\mathrm{U}_{2)_{,(A2,}}$ $d\mathrm{V}_2$), and (D2, $d\mathrm{W}_2$) are written on the ticket in the order they appear in the allowable path for the ticket. It is herein assumed that the rank of the route or line A2 is higher than the ranks of the routes or lines B2 and D2, and the rank of the route or line B2 is higher than the rank of the route or line C2. The station codes should be recorded only for the junction stations where the allowable path changes the route or line, and the junction stations such as X2, Y2 and Z2 where the allowable path remains on the same route or line are not required to be recorded on the ticket.

Likewise, as indicated in FIG. 6, there are stations such as X3, y3, and Z3 having representative codes for A3, the rank of which is higher than the line B3 on which the allowable path between the stations S3 and T3 are indicated by the arrow-mark. However, on the ordinary or season tickets, merely the codes (B3, $d\mathrm{S}_3$) and (B3, $d\mathrm{T}_3$) are recorded and the codes for the other three stations are omitted.

Next, a method for judging the validity of the tickets at a ticket examining station will be described.

It will first be assumed that the ticket examining station is an ordinary station X in the route or line A designated by the code (A, *d*X). If a senior junction station Y of the station X is found among the description on a ticket, the code (B, *d*Y) for the station Y is changed into a code (A, *d*Y′) expressed by employing the route or line, code A along which route or line the station X exists. Then all of the station codes described on the ticket are scanned for the inclusion of the route or line code A, and if two of such codes including the route or

line code A are found consecutively such as (A, $d1$) and (A, $d2$) and the relation:

$$d1 \leq dX \leq d2, \text{ or } d1 \geq dX \geq d2$$

exists between the addresses of $d1$, $d2$, and dX, the ticket is judged to be valid, and when the route code A does not appear commonly for two consecutive station codes, or even when it appears that there is no such relation as described above between the addresses of the stations, the ticket is judged to be invalid.

For instance, when an ordinary or season ticket having an allowable path as shown by S2, T2, U2, V2, and W2 in FIG. 5 is examined at a station Z2 for its validity, a code (A2, dU2) representing the senior junction station U2 of the station Z2 is converted to (B2, $dU2'$) as in FIG. 7, and the following conditions:

$$dT2 \leq dZ2 \leq dU2', \text{ or } dT2 \geq dZ2 \geq dU2'$$

are satisfied, so that the ticket is judged to be valid at the station Z2.

Next, description will be made in connection with the judgement at a simple junction station such as T2, U2, X2 or Y2 in FIG. 5, said simple junction station being included in a multi-code stations, but being not included in the section used commonly for routes or lines more than two routes or lines. When the station X is a simple junction station, it is assumed that the station X belongs to a plurality of routes or lines such as H1, H2, H3, ... Hk passing through the station X and the station codes of the station X are expressed by (H1, dX^1), (H2, dX^2), ..., (Hk, dx^k) corresponding to said H1, H2, ..., Hk. All of the station codes indicated on a ticket are converted as described before in connection with the ordinary stations. Each route code in the code series thus converted is checked. If two codes having the same route or line code are consecutive and said route or line code is coincident with any one (for instance Hi) of the H1, H2, ..., Hk, said consecutive codes are (Hi, d_1') and (Hi, d_2'). In this case, if the following relation exists between said stations $d_1' \geq dx^i \geq d_2'$, or $d_1' \leq dx^i \leq d_2'$, the ticket is judged to be valid. However, when no such code appears commonly for two consecutive station codes, or, although it appears, when the code does not coincide with H1, H2, ... or Hk, or the above described relation is not satisfied, the ticket is judged to be invalid.

Finally the judging method in a general multi-code station such as X3, Y3, and Z3 in FIG. 6 will be explained. When the station X is a multi-code station, routes or lines in which the station X is included may be indicated as H1, H2, H3, ..., Hh, and the corresponding station codes for the station X are expressed as (H1, dX^1), (H2, dX^2), ..., (Hh, dX^h). The ticket is read, and if station code (B, dY) of a junction station Y which is senior to the station X is found on the ticket, said station code (B, dY) is converted to a plurality of station codes (Hil, dY^1), (H$i2$, dY^2), ..., (Him, dY^m) corresponding to a plurality of routes or lines H$i1$, H$i2$, H$i3$, .., Him passing through the station Y. In addition, if a station Z which is not a senior junction station of the station X but is included in more than two routes or lines H$j1$, ..., H$j2$, ..., Hjl within the routes or lines H1, H2, ..., Hh is present, (such a station as the station Z being called a multi-junction station), its code (C, dZ) is converted to (H$j1$, dZ^1), (H$j2$, dZ^2), ..., (Hjl, dZ^l) corresponding to the above described routes or lines. Other station codes on the ticket are not converted.

Then, the following codes of two groups after conversion corresponding to consecutive two codes on the ticket:

$$(M1, d1^1), (M2, d1^2), ..., (Mp, d1^p)$$

$$(N1, d2^1), (N2, d2^2), ..., (Nq, d2^q)$$

are compared with the following group of codes for the station X:

$$(H1, dX^1), (H2, dX^2), ..., (Hh, dX^h),$$

and when a common route or line code Hi = Mj = Nk exists and

$$d1^j \leq dX^i \leq d2^k, \text{ or } d1^j \geq Dx^i \geq d2^k$$

is satisfied, the ticket is judged to be valid, and if not, the ticket is judged to be invalid.

The above described judging procedure principally includes the judging procedure described above at the ordinary station and at the simple junction station as specific cases. The above described judging method at the multi-code station will now be described more fully with reference to FIG. 8.

The ranks of the routes or lines A4, B4, C4, and D4 shown in FIG. 8 are 1, 2, 3, and 4, respectively and the ranks of the stations are indicated in each of the circles representing the stations.

a. When an ordinary or season ticket bearing a starting station code (C4, $dZ4^3$) and a termination station code (A4, $dY4^1$) is judged on its validity at a station X4, then, because the station Y4 is a senior junction station of the station X4 and the station X4 is commonly included in the routes or lines B4 and C4, the codes recorded on the ticket are converted as follows;

$$(C4, dZ4^3) \rightarrow (C4, dZ4^3)$$

$$(A4, dY4^1) \rightarrow (B4, dY4^2), (C4, dY4^3).$$

Since the route or line code, commonly included in these converted station codes and in the station codes (B4, $dX4^2$), (C4, $dX4^3$) for the station X4 is C4, existence of a relation

$$dZ4^3 \leqq dX4^3 \leqq dY4^3, \text{ or } dZ4^3 \geq dX4^3 \geq dY4^3$$

is checked along the route or line C4, and, since the relation exists in this case, the ticket is judged to be valid.

b. When in the route (Z4 − X4), a ticket bearing a starting station code (C4, $dZ4^3$) and a termination station code (B4, $dX4^2$) is judged on its validity at a station Y4, then, although the station Y4 does not have any senior junction station, the station X4 is included in the route or lines B4 and C4 together with the station Y4, and for this reason, the codes written on the ticket are converted as follows;

$$(C4, dZ4^3) \rightarrow (C4, dZ4^3)$$

$$(B4, dX4^2) \rightarrow (B4, dX4^2), (C4, dX4^3).$$

Since the route or line code commonly included in these converted station codes and in the station codes (A4, $dY4^1$), (B4, $dY4^2$), (C4, $dY4^3$), and (D4, $dY4^4$) for the station Y4 is C4, existence of a relation

$$dZ4^3 \leq dY4^3 \leq dX4^3 \text{ or } dZ4^3 \geq dY4^3 \geq dX4^3$$

is checked. However, since there is no such relation existing in this case, the ticket is judged to be invalid.

Because of the simplicity of the above described judging method, realization of a ticket examining device which carries out such a method is considered to

be simple, and, therefore, the detailed organisation of the examining device will not be necessary.

However, for the purpose of clarifying the embodying manner of the system according to the invention, concrete illustrations of the ticket preparing device, ticket examining and validating device used actually in the system will be described in the following in connection with FIGS. **9** to **12.**

The present invention comprises devices for preparing tickets and examining them at a series of different stations and the invention does not reside in the details of specific components of the system but rather the overall combination of components. The invention includes a ticket preparing device and a ticket examining and validating device. The ticket preparing device is constructed to accomplish the following results:

1. The available route information is recorded, in accordance with travel sequence, as the code of starting station, codes of intermediate stations changing the middle route, and code of the terminating station.

2. The station codes mentioned in item (1) above constitute codes of the type corresponding to the route or line code and address code. Particularly, in the case of the station having more than two codes, the representative code is used.

3. Automatically reading-out the coded information.

Accordingly, as the recording method, any one of the conventional magnetic, optical (printing system), and mechanical (perforating system) methods may be adopted. In actual practice, the magnetic recording method has been adopted in the case of embodying this invention.

The device for preparing the ticket satisfying the conditions (**1–3**) as mentioned above fundamentally comprises an operating part **1**, an encoder **2**, and a recording mechanism **3** as shown in FIG. **9.**

In the operating part, there are provided station-name keys corresponding to all stations located in the objective section of the system under consideration and function keys or numeral keys which are used for producing inputs adapted for ticket kinds, effective periods, sex distinction, discrimination between adult and child and the like.

The ticket preparer puts in the necessary route information as the inputs by pressing successively the station-name keys in accordance with the condition (1) as mentioned above. Then the encoder forms a station code (representative station code) corresponding to the pressed station-name key, and sends out the thus formed station-code into the recording mechanism.

The ticket-examining and validating device includes means for carrying out a judging method for judging whether or not the two stations corresponding to two continuous station-codes appearing on the ticket are located on both sides of the judging station. Accordingly, such conversion of the code of the senior junction station as mentioned already is not always necessary in order to perform the above-mentioned judging method. For example, when the station-code (B) appeared on the ticket is coincident with the code of the senior junction station viewed from the judging station, it is only necessary to confirm that the station-code (B) corresponds to which side of the judging station and value comparison between the codes is not necessary. Accordingly, it is necessary that the judging device retain in memory only the code of the judging station itself and a conversion table adapted to make it correspond to position information of one bit indicating the fact that the position of the code of the senior junction station viewed from the judging station is located at a particular side of the judging station.

FIG. **10** illustrates the device adapted to embody the judging method as mentioned above and the device comprises a reader **4**, an input buffer **5**, a memory part **10**, and a judging part **11** shown by dotted line.

The reading-out system of the reader corresponds to the recording system of the ticket preparing device. In the memory part, the code of the judging station itself and the senior junction station conversion table are memorized. The judging part is composed of a coincidence circuit **6**, a comparator **7**, a continuation checker **8**, and a judging flip-flop **9.** In FIG. **10**, data flowing is indicated by double arrow lines and control signals are indicated by single arrow lines. In the drawing, the timing mechanism is omitted, but the timing relationships are shown in FIG. **12.**

The case in which the judging station corresponds to an ordinary station will be simply described as follows. The case corresponding to multicode station is substantially the same.

The station codes such as (**B1**, dy_1), (**B2**, dy_2), ... (Bn, dy_n) representing the route information on a ticket are read out one by one at a time **T1** by means of the reader and then supplied to the input buffer. Capacity of this input buffer is designed so as to store the codes of one station only and the informations stored therein are retained for a period corresponding to one cycle described below.

At the succeeding times **T2** and **T3** coincidence between the station-code (B*j*, *dyj*) in the input buffer and the self station-code (A, d*x*) is tested in the coincidence circuit. If $Bj = A$ and $dyj = dx$, the judging flip-flop is made to be on and the judgement is completed. If $Bj = A$ and *dyj* *DX*, at the time **T4**, the value of *dyj* and that of dx are compared in the comparator circuit and a setting signal is supplied to either one of + and − input terminals of the continuity judging part in accordance with the result of the comparison.

On the other hand, in the case of B*j* A, the coincident state between (B*j*, *dyj*) and (A*i*, *dxi*) (code of senior junction station) is tested at the time **T5**; and when (B*j*, *dyj*) is coincident with any (A*i*, *dxi*), a setting signal is supplied to either one of + and − input terminals of the continuity judging part in accordance with position-information + and − corresponding to said (A*i*, *dxi*) in the conversion table. In the cases except the cases as mentioned above, no setting signal is imparted. One cycle is completed by the supply of the setting and resetting signals to the continuity judging part, and then the succeeding input code is read out.

The continuity judging part is a component part capable of finally judging whether or not two stations indicated by two continuous input codes (B*j*, *dyj*) and (B_{j+1}, dy_{j+1}) are respectively located at both sides of the judging station (A, *dx*).

This continuity judging part may be, for example, composed of four flip-flop circuits as shown in FIG. **11.** T corresponds to the time during which a timing signal **T6** can trigger each flip-flop circuit. When a dignal is supplied to the + and − input terminals of the continuity judging part, the flip-flops **F1** and **F'1** are respectively set and reset or reset and set in accordance with the applied signal, and simultaneously the original information of the flip-flop circuits **F1** and **F'1** are re-

spectively shifted into the flip-flop circuits F2 and F'2, respectively. Respective setting and resetting of the flip-flop circuits F1 and F'1 are attained in the case where the station represented by the input code (B*i*, *dyi*) is located at the side directed to increase of the address when viewed from the judging station. As will be clear from the drawings, when both F1 and F'2 are in set states or both of F'1 and F2 are in set states, that is when two stations corresponding to two continuous input codes are located at both sides of the judging station, the output of the continuity judging part becomes ON.

In some prior ticket judging systems, it seems that the method of judging (examining) the intermediate points (stations) is identical with the method of judging the terminal points (starting and terminating stations) along the allowable path, namely by the method of judging the legality as to whether or not the data on the ticket contain the code of the judging station itself.

However, if it is intended to apply such a method to a transportation system which allows riding-on and getting-off at any station along the allowable path indicated on the commutation ticket, it becomes necessary to impart codes of all the stations contained in the allowable path onto the ticket. Consequently, the quantity of the necessary information becomes too plentiful to be coded and thus is of no practical use.

Accordingly, when the automated ticket system is applied to the transportation system as mentioned above, it becomes very important to codify the allowable path by sufficiently few (from a practical point of view) bits of information and to find a reasonable method capable of efficiently judging the legality of the ticket at each station to determine whether the commutor rides on or gets off. The invention has proposed to satisfy the important matters as mentioned above and the important characteristic features of the present invention reside in the manner of imparting the information of the allowable path to a ticket and in the method of judging the legality of the coded ticket.

Preparation of a ticket and automatic examination of the same for a allowable path including a loop are made possible by the use of the above described writing and judging procedure of the ticket. Furthermore, the processing of a ticket for starting from or arriving at a station included in a circular line of a city, or the processing of a coupon for starting from or arriving at an area can be carried out as follows.

A code representing an area is newly provided, and a ticket on which some of the station codes to be recorded on the ticket are replaced by said area code is prepared. The ticket examining device in a station included in the area is so arranged that a ticket is judged to be valid if the area code is found on the ticket, and if not, the ticket is judged through the ordinary procedure as described above. Furthermore, the same device in a station not included in the area but included in a line directly connected to the area first converts the area code to a station code for a station connecting the line to the area, and then follows the ordinary procedure.

For the purpose of comparing the above-described system with the conventional systems with respect to the required bits for expressing the allowable path on the ticket, the Japanese National Railway lines and private railway lines in and outside of Tokyo (including about 500 stations, fundamental loops of from 50 to 60, and a number of lines near 100, length of a line being less than 100Km.) will be considered. In the conventional system, assuming a station code requires 12 bits, from 74 to 84 bits are required for indicating the allowable path on the ticket. On the other hand, in the system according to the present invention, 17 bits are required for one code when kilometer code is employed, hence from 34 to 85 bits are required for the same purpose, the mean value of the required bits being less than that of the conventional system. In the above estimation, the maximum number of transfers employing one ticket is assumed to be four.

When the comparison is carried out further for the entire network of the National Railway and privated railways in Japan (including 8,000 stations, about 300 fundamental loops, and nearly 500 lines), since more than 16 bits are required for expressing a station code in the conventional system, the bit number required for the ordinary ticket or season ticket reaches approximately 332 bits. On the other hand, in the system according to the present invention, when it is assumed that 22 bits are required for one station code, **22** $(n+1)$ will be required. Here, n represents the number of different lines included in the allowable path for the ticket, n being, in ordinary case, in a range of from 1 to 3 and, in rare cases, reaches 5. More particularly, the number of bits required for a ticket is, in an ordinary case, from 44 to 88 bits and, in rare case, about 132 bits.

As is apparent from the above description, the system according to the present invention makes possible the representation of the allowable path with a smaller number of bits than in the conventional system except where the network is of extremely small scale, and the required number of bits does not increase greatly even in the case where the railway network is of larger scale.

In the conventional system, most of the station codes and thereby the preparing and examining devices of the tickets must be remarkably modified when some of the stations or lines are newly increased or changed. However, in the present invention, the alteration accompanying the increase or change of the station or lines, in principle, does not affect the codes of other stations of other lines.

Furthermore, since the route or line code is included in all of the station codes, identification of stations included in different lines belonging to different networks such as the National Railway lines or private railway lines can be easily carried out.

In addition, since the kilometer code is employed in most of the cases (except where the area code is employed), the railway charge can be calculated by a simple procedure if the kilometer codes for the starting station, intermediate stations, and the terminating station are employed in the ticket preparing station. In this case, no register or memory is required in the ticket preparation device therein.

What is claimed is:

1. A ticket examination and validation device for examining and validating tickets for a transportation network comprising:

a. a reader for reading station codes representative of route information on a ticket for a transportation network;

b. a memory for storing therein the station-codes of the station of the transportation network at which

the ticket is being examined, and a senior junction station thereof; and

c. a judging part comprising coincidence and comparator circuits to test for coincidence between the station-codes read by said reader and the station-codes stored in said memory, a continuation checker to determine if two stations represented by two consecutive station codes appearing on the ticket are located on opposite sides of the station of the transportation network at which the ticket is being examined, and a flip-flop switched on when the station-codes on the ticket are representative of a route passing through or ending at the station at which the ticket is being examined.

2. A ticket examination and validation device according to claim **1**, wherein said reader comprises means for reading station-codes representative of a distance measured from the stations corresponding to the respective station-codes to a reference station of the transportation network.

3. A ticket examination and validation device according to claim **1**, wherein said reader comprises means for reading station-codes representative of stations in a portion of the transportation network having the same transportation fee.

4. A ticket examination and validation device according to claim **1**, wherein said reader comprises means for reading station-codes indicating a relative priority of the stations represented by the station codes.

5. A ticket examination and validation device according to claim **1**, wherein said reader comprises means for reading station-codes representative of route information comprising station-codes of a station of origin, intermediate stations changing the route, and a terminating station, the station codes being of the type comprising a route code and a station address code.

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