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Aizawa et al.

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[54] **TERMINAL COMMUNICATION CONTROL SYSTEM AND METHOD**

[75] Inventors: **Tetsuya Aizawa**, Kawasaki; **Taketoyo Sawada**, Sagamihara; **Yoshihiko Tauchi**, Yokohama; **Tsutomu Kawamata**, Tokyo; **Hiroshi Saya**, Yokohama, all of Japan

[73] Assignees: **Nippon Telephone & Telephone Public Corporation**, Tokyo; **Fujitsu Limited**, Kawasaki, Japan

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[30] **Foreign Application Priority Data**

Dec. 26, 1970 Japan 45/118994

[52] **U.S. Cl.** **340/172.5**, G05b/13/02

[58] **Field of Search** 340/172.5

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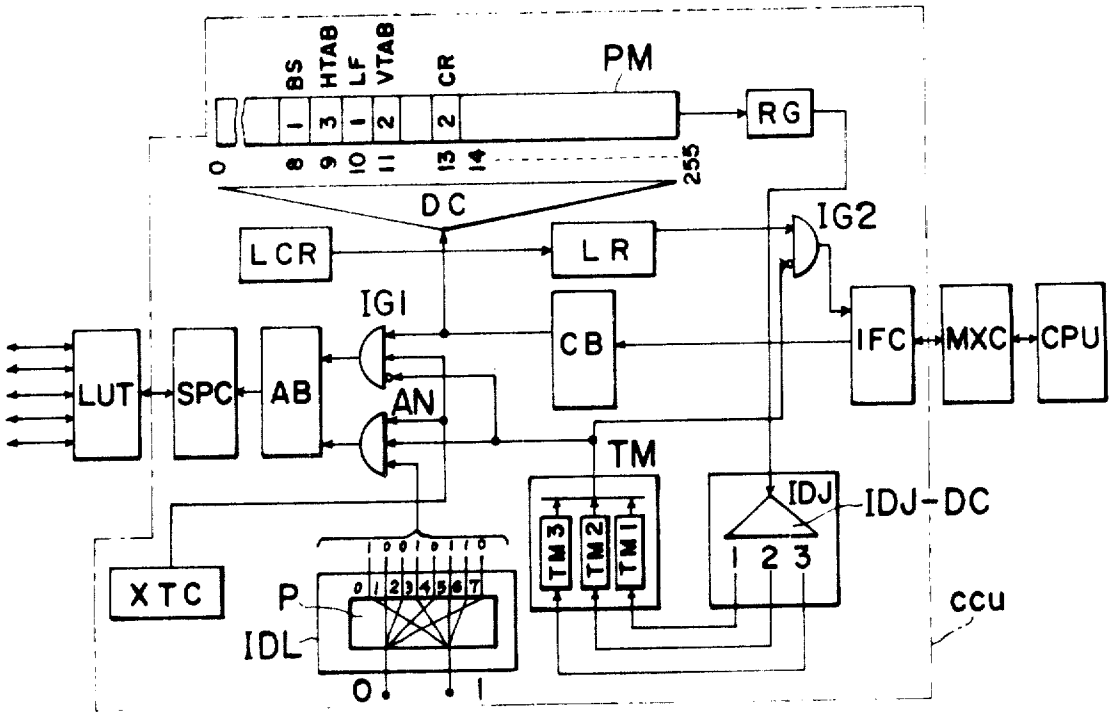
Primary Examiner—Paul J. Henon
Assistant Examiner—Paul R. Woods
Attorney—Staas, Halsey & Gable

[57] **ABSTRACT**

In a data processing system, a communication control system for terminal equipment, such as a typewriter, receives and processes control codes for that terminal equipment for controlling the operation thereof and, particularly, automatically inserts idle codes immediately after certain control codes such as for controlling line feed, tabulation, and carriage return operations. Control codes received by the control system from a central processing unit are collated with character classification information stored in a memory of the control system for detecting and identifying the predetermined control codes. For each such identified control code, a signal-inserting circuit is actuated for inserting an idle code of prescribed length immediately thereafter and thus prior to the next successive control code, to afford sufficient time for proper operation of the terminal equipment. Through use of the invention, programming requirements of the central processing unit are greatly simplified and the length of data required to be transmitted is minimized.

14 Claims, 2 Drawing Figures



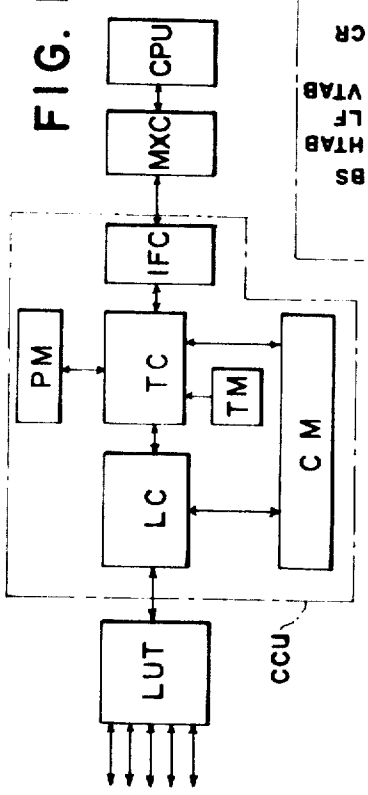

CPU
MXC
IFC
PM
TC
TM
LC
CM
LUT
CCU

FIG. 1

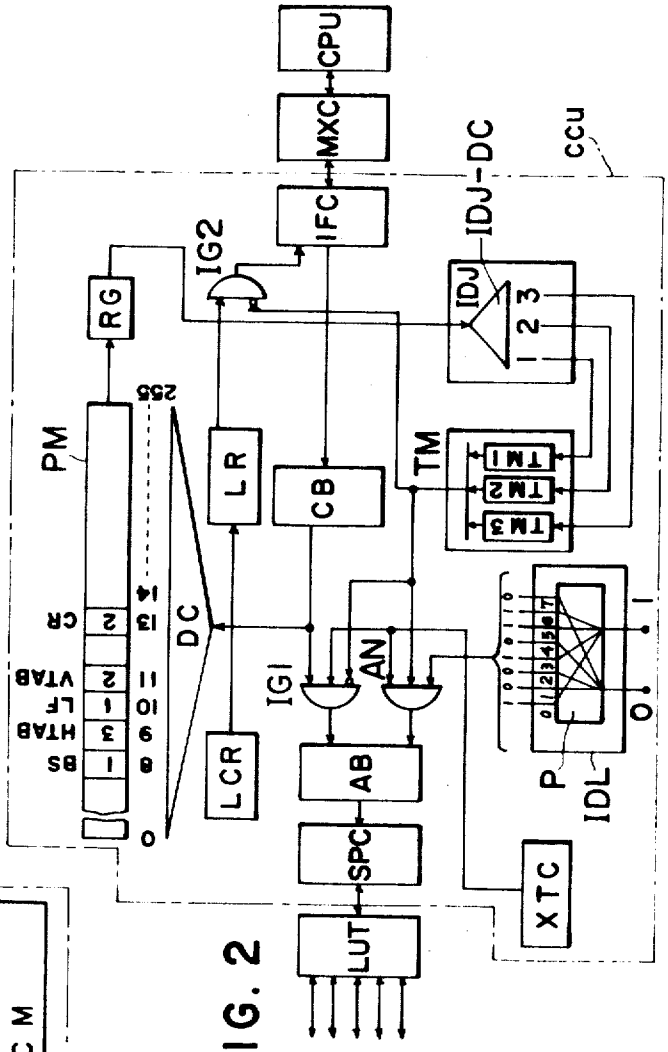

CPU
MXC
IFC
IDJ-DC
CCU
IG2
RG
IDJ
1 2 3
PM
255
LR
CB
TM
TM1
TM2
TM3
CR
VTAB
LF
HTAB
BS
DC
IGI
AN
LCR
AB
SPC
LUT
XTC
P
IDL
I
O

FIG. 2

TERMINAL COMMUNICATION CONTROL SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

This invention relates to data processing systems and, more particularly, to a communication control system for use therein, for receiving and processing data for control of terminal units such as typewriters or other equipment.

State of the Prior Art

A terminal unit, such as a typewriter, of a data processing system performs a number of different functions or operations in response to various, different control codes applied thereto. These include the functions of typing individual letters or characters, as well as various non-typing functions, such as return, line feed, tabulation, and back space operations. In general, each of these non-typing functions requires a longer operating time than that for the operation of typing an individual letter or character. For simplicity, all of the non-typing functional codes are referred to hereinafter by the general term, typewriter control code.

Typically, each of these functions, be it a typing function or a non-typing function, is identified by a corresponding, specific code consisting of one character presented in a suitable code. Accordingly, if the typewriter control codes are supplied successively at the normal character transmitting time intervals, the typewriter cannot perform its function satisfactorily. In conventional data processing systems, this problem is overcome by an operation performed within the central processing unit of the basic data processing system. More specifically, the central processing unit, when transmiting typewriter control codes together with letter or character codes, operates to insert one or more idle codes immediately after each typewriter control code. The idle codes are selected such that they do not interfere with the typewriter operation and thus have no control effect thereon. Accordingly, the idle codes are selected to provide a sufficient operating time to enable the specific typewriter control function required to be performed by a given control code. The insertion of such idle codes by the central processing unit, however, increases the amount, or length, of the data required to be transmitted and presents an additional burden in the development of the associated software for the central processing unit.

The present invention overcomes these and other defects of prior art systems and particularly is directed to obviating the requirement, in conventional data processing systems, of providing the idle codes as aforedescribed; more specifically, the present invention comprises an improved communication control system which controls the terminal unit and automatically inserts idle codes to assure proper operation of the terminal unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 comprises a block diagram of a data processing system with which the communication control system of the invention may be utilized; and

FIG. 2 comprises a more detailed block diagram of the communication control system of the invention, as incorporated in the data processing system of FIG. 1.

SUMMARY OF THE INVENTION

In accordance with the invention, the communication control system is utilized in a data processing system for receiving control codes from a central processing unit and presenting them to a terminal unit for control of the operation thereof. The communication control system includes a permanent memory for storing a character classification table. Character request circuits generate a character request signal for requesting transmission of a character code from the central processing unit. When received, the code is stored in a character buffer in the control system. That character is decoded and collated with the prestored characters of the classification table of the permanent memory to identify whether the code represents the operation of typing an individual character or letter, requiring what may be termed a standard time interval, or whether it comprises a typewriter control code representing a non-typing function of the terminal unit, and thus requiring a greater operating time than that for typing a character or letter. When a typewriter control code is identified, timing means are enabled for inserting an appropriate number of idle codes subsequent to the typewriter control code in an assembly buffer, thereby to afford sufficient time for the control function to be performed. The character request circuitry then requests a further character code from the central processing unit in timed relationship to the control code currently being processed, whereby the further control code is received in proper timed relationship with respect to the control function required by the previously received control code. In the event that a control code, as received, is recognized by the collation function as not comprising a typewriter control code, and thus only requiring the operation of typing an individual letter or character, the control code is processed without the insertion of idle codes and a character request signal is transmitted immediately to the central processing unit.

The control system of the invention therefore provides for the automatic insertion of idle codes by recognition of each character code, as received, and thus the corresponding function to be performed. Accordingly, the insertion of idle codes by the central processing unit as in conventional prior art systems is obviated, greatly simplifying the necessary software employed in th central processing unit and reducing the length of the data required to be transmitted.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 there is shown a block diagram of a data processing system incorporating a communication control system in accordance with the invention. Particularly, there is provided a central processing unit CPU which transmits data through a multiplexing channel MXC to the communication control system CCU and, particularly, to an interface circuit IFC of the latter. This data comprises various control codes requiring respectively corresponding functions to be performed by the terminal equipment, for example a typewriter, such as the function of typing specified, individual letters or characters as well as non-typing functions such as return, line feed, tabulation, and back space. The data is processed through a communication control circuit TC and a line circuit LC to an output line unit LUT for actuation of the terminal unit in accordance with the code. Additionally, the line unit LUT has plural output

lines connected with corresponding plural terminal units and these lines transmit and receive information between the line unit LUT and each terminal unit. In an illustrative embodiment of the invention, each of the circuit blocks CPU, MXC, IFC, TC, LC and LUT as shown in FIG. 1, may take the form of the corresponding circuits as disclosed in U.S. Pat. Nos. 3,337855 and 3,341,818.

The control system CCU furthermore includes a permanent memory PM storing a character classification table affording, in a collation-type operation, identification of each received typewriter control code. A timer TM then operates to provide the necessary timing interval to permit proper operation of the terminal unit in response thereto, as is more fully described in relation to FIG. 2. Alternatively, the timing control may be performed by a character counter provided in a temporary memory CM. In such an embodiment, the number of idle codes subsequent to each typewriter control code are counted thereby to establish the required duration of the timing interval.

Referring now to FIG. 2, and assuming the communication control system to be on line with the central processing unit, as performed in conventional manner, a line character requesting circuit LCR activates a character requesting circuit LR to produce a character request signal. This signal is supplied through the normally enabled gate IG2 to an interface circuit IFC for transmission through the multiplexing channel MXC to the central processing unit CPU. In response thereto, the unit CPU transmits a character code through the multiplexer channel MXC to the interface circuit IFC of the communication control system CCU. The character code transmitted from the unit CPU to the character buffer CB may be either a typewriter control code or a code for the operation of typing an individual letter or character. The character code thus received is transferred to the character buffer CB for temporary storage, the output of the buffer CB supplying the character code both to a second normally enabled gate IG1 and a decoder DC.

The decoder DC operates in conjunction with the permanent memory PM, the latter having stored therein a character classification table identifying each of the typewriter control codes, as distinguished from the codes relating to typing of characters or numerals. Decoder DC operates to decode the character code received thereby for addressing the permanent memory PM; thus, the decoded signal from the decoder DC accesses the address of the permanent memory PM. In the event that the decoded character is not a typewriter control code, i.e. the decoded character represents a typing function code, no output is produced from the permanent memory PM because no corresponding information in said address to the typewriter control code has been stored beforehand. Thus, it is determined that the operation to be performed is, for example, typing of a character or numeral and which is accomplished in a standard time interval. Thus, no additional time is required. Accordingly, the assembly buffer AB which receives the code from the gate IG1 supplies the code to a serial to parallel converter SPC and then to the line unit LUT for activation of the terminal unit.

In the event that the character code is a typewriter control code, such as line feed, return, tabulation or back space of a typewriter, the information corresponding to the specific typewriter control code, such as the signal "1", "2" and "3", indicating the idle code insertion interval, is read out from the permanent memory PM and stored in a register RG. The information corresponding to the specific typewriter control code has been stored at the address of the memory which was addressed by the decoded character code. An idle code insertion judging circuit IDJ responds to the information stored in register RG to determine the additional time required for the thus identified function to be performed by the typewriter. The circuit IDJ then controls timer TM in accordance with that function. That is, the idle code insertion judging circuit IDJ decodes the information stored in the register RG by an inner decoder IDJ-DC to control a timer TM. The timer TM has a number of timing circuits TM1, TM2 and TM3 and a selected one of the said circuits is activated in response to the output of the circuit IDJ.

More specifically, the actuation time of the timer TM as established by the circuit IDJ may be for any of a plurality of periods of different lengths of time in excess of the standard time interval, and depending upon the specific typewriter control code as identified by the output from the permanent memory PM. For example, the actuating period for the return operation of the typewriter can be set to be longer than the actuating period for a back space operation. Thus, the character classification table may produce an appropriate output representing a comparatively longer timer actuation period for a return code while producing an output representing a comparatively shorter timer actuation period for a back space code.

The output of timer TM is supplied to the disable inputs of the normally enabled gates IG1 and IG2 and thus for the duration of its actuation, disables those gates. Accordingly, the character requesting signal from the circuit LR is inhibited from being applied to the interface circuit IFC for the duration of that timing period. Similarly, transfer of any further character code from the character buffer CB to the assembly buffer AB is inhibited by disabling of the gate IG1.

The output of the timer TM is, as well, applied to AND gate AN. Therefore, when both the output of the timer TM and the transmit timing signal applied periodically from a transmit timing controller XTC appear, an idle code from the idle code generating circuit IDL is applied to the assembly buffer AB through the AND gate AN. As shown in the drawing, the idle code generating circuit IDL selectively controls the output levels on the eight output lines thereof, in accordance with an eight bit idle code. Specifically, each output line is connected with input lines labelled 0 or 1 through a patchboard P. Therefore, the output 0 or 1 appears at each of the output lines thereby establishing the idle code output signal.

Upon termination of the timer actuation period, the inhibit gates IG1 and IG2 again are enabled to permit the aforedescribed transfer of the character request signal from the circuit LR through interface circuit IFC and, as well the transfer of the character from the character buffer CB to the assembly buffer AB.

In summary, therefore, the communication control CCU of the invention operates to insert automatically a suitable idle code or codes immediately after each typewriter control code without necessitating any operation at the central processing unit CPU. As a result, accurate data transmission and efficient data processing are assured.

Numerous alternatives to the specific system as disclosed will be apparent to those skilled in the art. For example, as an alternative to use of timer TM, a character counter or an output code counter may be utilized to establish the desired time interval for operation of the typewriter in response to each control code. With such a counter, the number of idle codes inserted immediately after each typewriter control code are counted, and the typewriter operating period corresponding to each of these control codes may be determined by regulating the number of idle codes following the typewriter control codes. A character counter to perform this counting operation may be provided in the temporary memory CM(FIG. 1) which may be incorporated in the line circuit LC (FIG. 1). As a further alternative, a long mark signal, or other suitable signal may be employed in lieu of the idle code or idle codes to afford the necessary timing function.

Thus, in the operations wherein the characters or the idle codes are counted, the operating period allowed for each typewriter control code can be determined by selectively regulating the number of the idle codes which are inserted immediately after the typewriter control code as a function of the specific control operation. Similarly, the length of a mark signal may be regulated in accordance with the required control operation specified by the typewriter control code. Thus, in either instance of the use of a long mark or one or more idle codes, a timing interval of selectively controlled duration may be provided to assure proper operation of the typewriter.

In summary, the communication control system of the invention, upon detection of a specific control code for operation of terminal equipment automatically inserts thereafter one or more additional codes having no control effect on the operation of the terminal equipment. Accordingly, the modification of the data to incorporate such idle codes subsequent to each control code, and which has heretofore been accomplished at a central processing unit, now is effected automatically by the communications control system. Accordingly, the software for the central processing unit is considerably simplified. Furthermore, interference to the terminal equipment by codes produced by the central processing unit is eliminated and accurate data transmission is assured.

Numerous modifications and adaptations of the system of the invention will be apparent to those skilled in the art and thus it is intended by the dependent claims to cover all such modifications and adaptations as fall within the true spirit and scope of the invention.

What is claimed is:

1. For use in a data processing system having a central processing unit for supplying codes for controlling operation of terminal equipment, and wherein certain of the codes are control codes as to which the corresponding operation of the terminal equipment exceeds a standard time interval of operation as required for operation in response to others of the codes, a communication control system for receiving and processing the codes from the central processing unit comprising:

means for receiving and temporarily storing each code received by the control system;

means for identifying each said stored control code in said storing means for which the corresponding operation of said terminal equipment exceeds the standard time interval;

means responsive to each identified control code for determining the corresponding predetermined interval of terminal operation of said identified control code;

means for generating an idle code having no control effect on said terminal equipment; and

means responsive to identification of a control code by said identifying means for selectively applying to said terminal equipment the idle code from said generating means in response to each such identified control code, for a time interval corresponding to said predetermined interval of terminal operation according to said identified control code to afford a sufficient time for operation of said terminal equipment.

2. A communications control system as recited in claim **1** wherein said identifying means includes a memory storing a character classification table corresponding to each of the control codes.

3. A communications control system as recited in claim **2** wherein said identifying means further includes decoding means responsive to the code received and stored by said code storing means for collating each such received code with the character classification table of said memory.

4. A communications control system as recited in claim **3** wherein said identifying means further comprises:

a register for storing the control code identification derived from said memory.

5. A communications control system as recited in claim **1** wherein there is further provided:

an assembly buffer;

a gate for supplying said timing code from said timing code generating means to said assembly buffer, and

said gate is normally disabled and is enabled by said inserting means for the time interval established thereby.

6. A communications control system as recited in claim **5** wherein said idle code generating means generates a succession of idle codes.

7. A communications control system as recited in claim **1** wherein:

said timing code generating means generates a succession of idle codes, and

said applying means includes means for counting the number of idle codes inserted subsequent to the control code to establish a timing code of the required time interval.

8. A communications control system as recited in claim **1** wherein:

said idle code generating means generates an idle code of relatively long duration, and

said applying means responsive to the identification of the control code for inserting the long duration idle code subsequent to each control code for the required time interval corresponding to the identified control code.

9. A communications control system as recited in claim **1** wherein there is further provided:

means for generating a character request signal to be transmitted to the central processing unit for requesting transmission of each successive code to the communication control system,

first gating means normally enabled to pass the character request signal for transmission and disabled

by said inserting means for the duration of each timing code,

output means for supply of codes from said communication control system to said terminal equipment, and

second gating means normally enabled to transmit the received code from said temporary storage means to said output means, and disabled by said applying means for the duration of the idle code produced thereby.

10. In a data processing system having a central processing unit for supplying codes for controlling operation of terminal equipment, and wherein certain of the codes are control codes as to which the corresponding interval of operation of the terminal equipment exceeds a standard time interval of operation as required for operation in response to others of the codes, a method of operation for receiving and processing the codes from the central processing unit comprising:

receiving and temporarily storing each code received by the control system;

identifying each said control code for which the corresponding operation of said terminal equipment exceeds the standard time interval and its corresponding interval of operation;

generating a timing code having no control effect on said terminal equipment; and

selectively inserting the timing code subsequent to each control code in accordance with the interval of operation of the corresponding identified control code to afford a sufficient time for operation of said terminal equipment.

11. A method of operation as recited in claim **10** wherein the identifcation of each control code comprises:

storing in a memory a character classification table corresponding to each of the control codes,

decoding each said received and stored code, and

collating each such received code with the character classification table stored in the memory for deriving therefrom an identification of the control code.

12. A method of operation as recited in claim **10,** wherein:

the step of generating includes providing a succession of idle codes as the timing code, and

the step of selectively inserting includes the insertion of a number of idle codes subsequent to each said control code to establish a timing code of the required time interval.

13. A method of operation as recited in claim **10,** wherein:

the step of generating includes providing a long duration signal as the timing code, and

the step of selectively inserting includes the insertion of a single long duration signal subsequent to the insertion of each control code for the required time interval of operation corresponding to the identified idle code.

14. A method of operation as recited in claim **10** further comprising:

generating a character request signal to be transmitted to the central processing unit for requesting transmission of each successive code to the communication control system,

transmitting a successive character request signal upon receipt of each code requiring a standard time interval of operation of the terminal equipment, and

for each received control code requiring an operation of said terminal equipment exceeding the standard time interval, transmitting a successive character request signal upon termination of the timing code inserted subsequent to each said control code.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,781,856 Dated December 25, 1973

Inventor(s) TETSUYA AIZAWA ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The Assignees of the above-identified patent shall read:

Nippon Telegraph & Telephone Public Corporation, Tokyo;

Fujitsu Limited, Kawasaki, Japan

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents