EXHIBIT

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United States Patent

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[54] **TERMINAL FOR COMMON CHANNEL SIGNALING SYSTEM**
7 Claims, 2 Drawing Figs.

[52] U.S. Cl. **178/58,**
179/2 DP, 179/15 BS, 179/18 J
[51] Int. Cl. **H04l 7/08**
[50] Field of Search ..... 179/2 DP,
15 BY, 15 BS, 15 AE, 18 J; 178/23

[56] **References Cited**
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ABSTRACT: A common channel signaling system has a duplex signaling channel equipped with terminals that are adapted to maintain a constant data rate by inserting idle words when there are no data words to be transmitted and by inserting an additional synchronizing word when the error control information obtained by analyzing a block of data from a remote terminal is not completed within a predetermined interval before the arrival of the word position which is normally intended to contain such error control information.

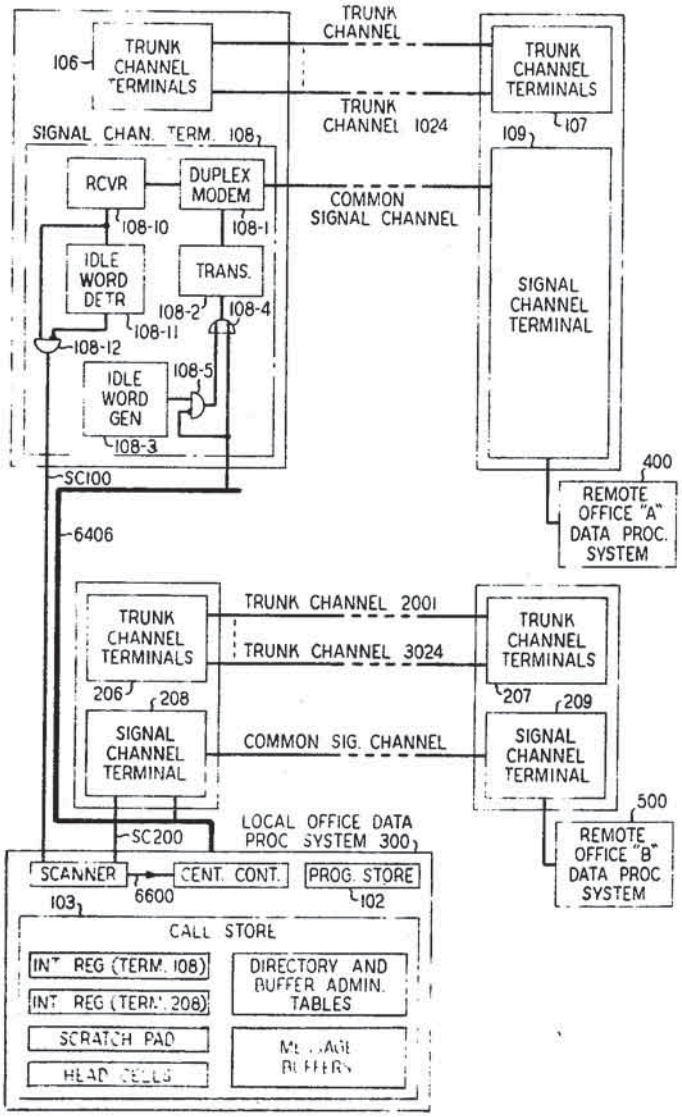
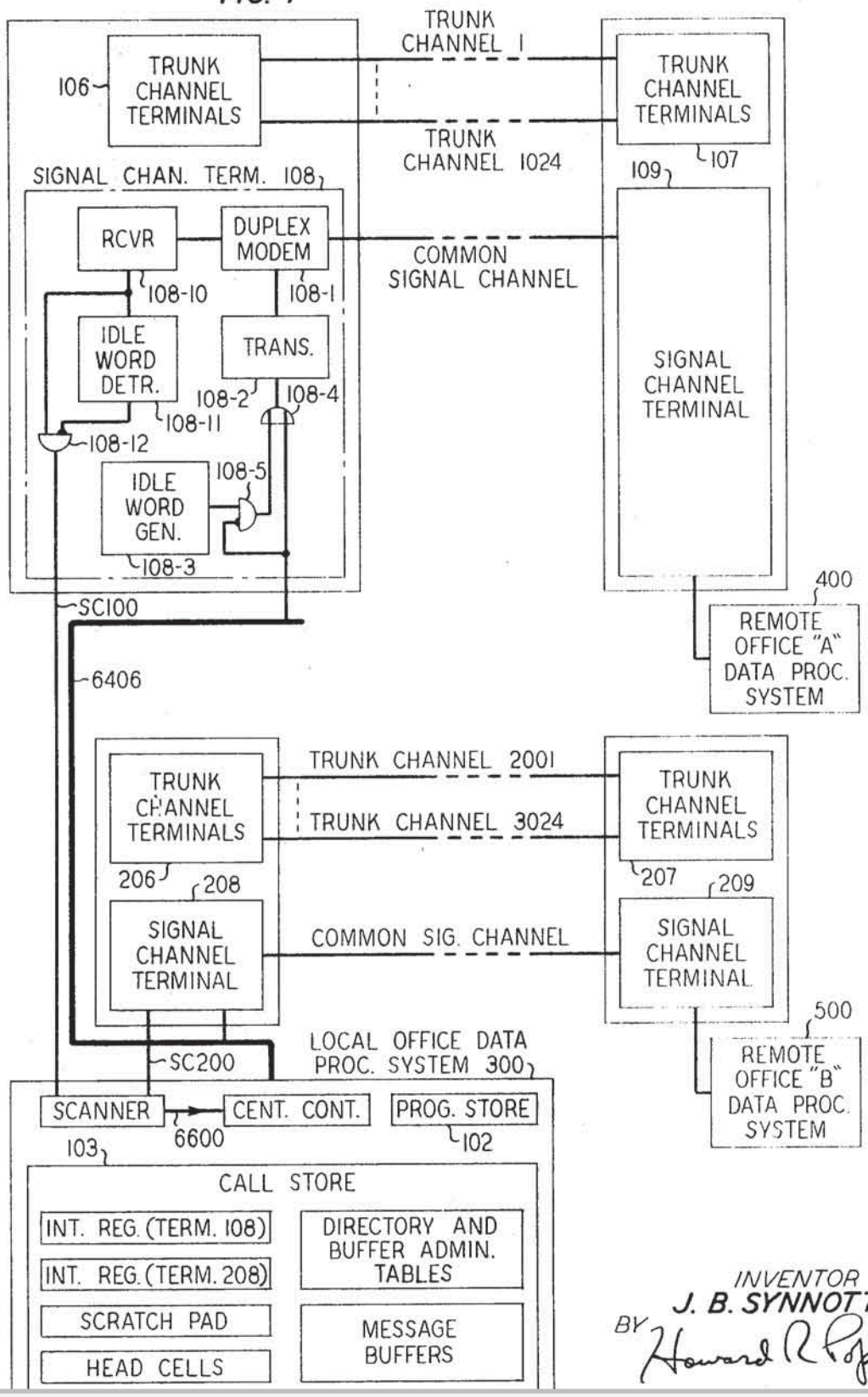


FIG. 1



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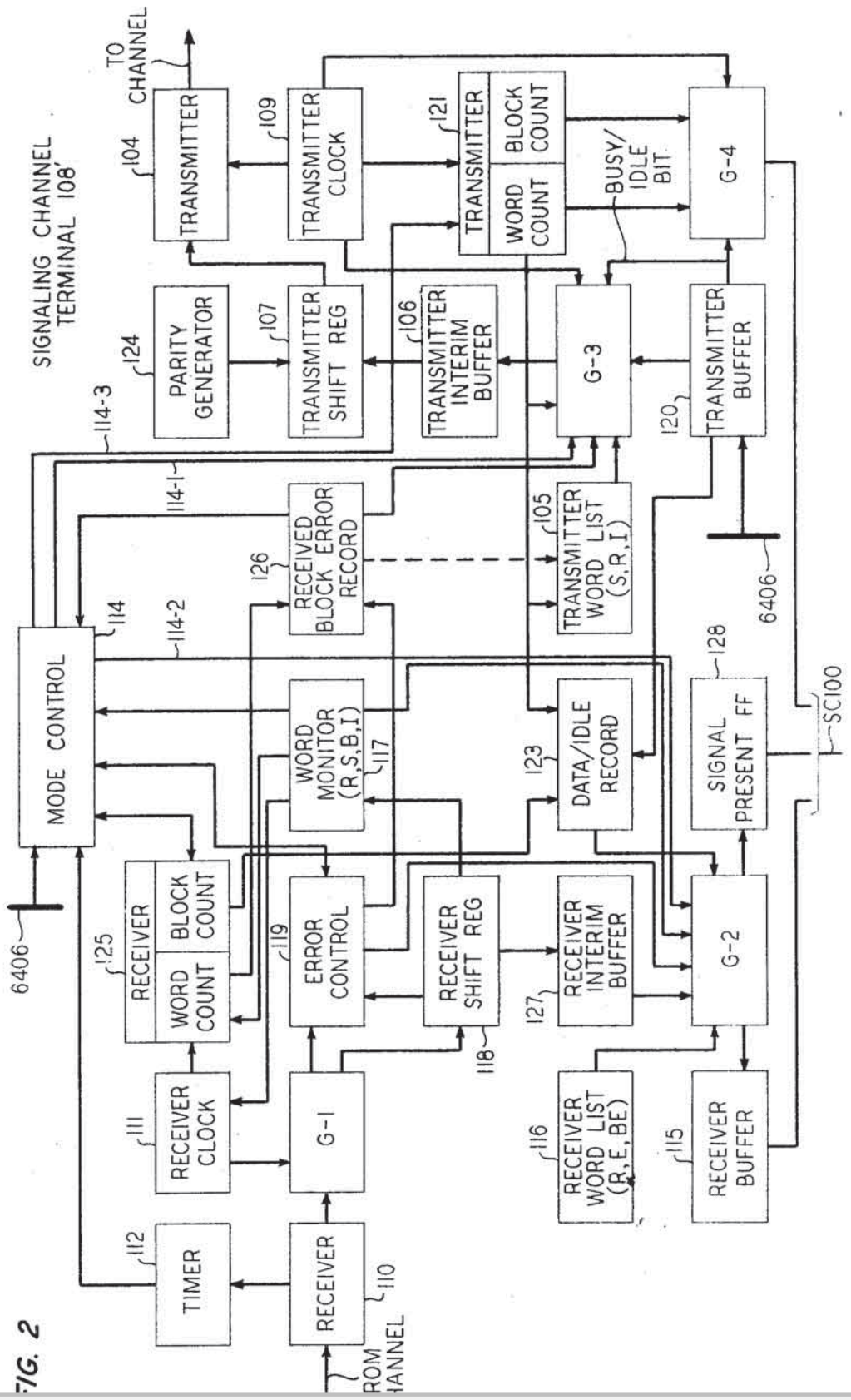

FIG. 2

TERMINAL FOR COMMON CHANNEL SIGNALING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to data transmission systems and more particularly to a common channel signaling system of the type described, for example, in the copending application of W. B. Smith and J. B. Synnott III, Ser. No. 831,006, filed June 6, 1969.

Heretofore data transmission systems have been known in which the signaling channel connecting two terminals is in continuous operation and in which idle words are injected by the terminal whenever there are no data words available to be transmitted. In some applications, this approach is found to be desirable because it avoids the necessity of bringing the transmitting and receiving ends of the signaling channel into synchronization each time the stream of actual data words is interrupted as when there is no data to be sent. Since the system is in continuous operation, delays occasioned by the need to resynchronize may largely be avoided. However, even though the system may continuously be transmitting actual data, the mutilation of a data word or, in some systems, of an idle word, may be so bad as to cause loss of synchronization. Under these circumstances, a resynchronization procedure must be followed. The ability to resynchronize is an inescapable requirement of almost any conceivable signaling system.

In the copending application of W. B. Smith et al. mentioned above, there is described an interoffice common channel signaling system using stored program controlled data processing equipment at each terminal. The program-controlled data processor supervises the loading of the transmitter from the storage unit at the terminal and erases the transmitted words from the storage unit when the distant terminal has forwarded error control information in the form of a BLOCK word which verifies that all of the transmitted words constituting an integral message have been correctly received at that distant terminal. In that application, data messages stored in the storage unit of the processor might be either single word or multiword messages. The multiword messages might on some occasions be distributed over more than one transmitted block. Accordingly, the processor was charged with the task of not releasing a multiword message from storage even though a BLOCK word indicated that some of the words which were contained in a previously transmitted block had been correctly received. Only when all of the words of a message in each of the blocks in which they happen to have been transmitted were identified as correctly received could the words constituting the message be erased from memory.

In the data transmission system disclosed in the above-mentioned Smith-Synnott application, it was desired that starting up delays be avoided and to this end the system was kept in continuous operation. Idle words were sent when there were no available data words to be sent. Accordingly, the previous system exhibited an inherent degree of synchronization between the transmitter at one terminal and the receiver at the other terminal of the transmission channel. Because the transmitters at each terminal would be controlled by individual clocks and these clocks would not operate at exactly the same rate, it was possible for the terminal having the faster transmitter to transmit all or part of a second block of data during the time that the transmitter at the slower terminal was still in the process of transmitting a first block of data. Under these circumstances, the terminal with the slower transmitter would have received more than one block of data from the terminal with the faster transmitter and might have formulated error control words for these blocks. Because its transmitter was operating slowly it would have perhaps two error control words on hand when it was finally able to send a BLOCK word. Under these circumstances, the faster terminal would

plying to the wrong one of these stored blocks of data. Accordingly, a new terminal has been designed which controls the data rate of its transmitter so that it will be unnecessary to store an excessive amount of data because the transmitter at a remote terminal is slower in acknowledging the receipt of messages.

In the aforementioned data transmission system the terminal was adapted to detect idle words that were received over the signaling channel and to prevent the transmission of such idle words to the central processor. This saved central processor operating time inasmuch as there would be no need to require the distant terminal to retransmit an idle word even if it were distorted in transmission. Though idle words were thus individually detected, if all of the words which a terminal happened to receive in a data block were idle words, it would still have to use its associated processor to fabricate a BLOCK word for transmission back to the distant terminal because the distant terminal always expects to receive error control information pertaining to its last transmitted block. The distant terminal, however, was not enabled in the aforementioned disclosure to distinguish BLOCK words relating to idle blocks from BLOCK words acknowledging the transmission of actual data. Accordingly, the central processor at the distant terminal was required to process such "completely idle" BLOCK words resulting in some degradation of central processor operating efficiency. Accordingly, it would be desirable to prevent BLOCK words which merely acknowledge the transmission of blocks containing nothing but idle words from being processed by the central processor.

SUMMARY OF THE INVENTION

The foregoing and other objects of the present invention are achieved in one illustrative embodiment in which the terminal includes a transmitter word list, a receiver word list, and a mode control circuit for selectively transferring words from the transmitter and receiver word lists to the transmitter and receiver buffer circuitry to establish synchronization with the remote terminal and to prevent the difference in transmitting rates of the terminals from causing loss of synchronization.

In accordance with one aspect of the operation of the system of the present invention, the transmitter at the terminal at each end of the signaling channel will transmit a series of RESYNC words until the receiver at that terminal has received a RESYNC word from the remote terminal. At this point the transmitter is instructed to send SYNC words to the remote terminal. Following the correct receipt of a SYNC word, the remote terminal will send two more SYNC words followed by data words from the transmitter buffer. According to this aspect of the operation of the illustrative embodiment, a terminal changes to data transmission whenever it has been simultaneously receiving and sending SYNC words for two consecutive word intervals.

In accordance with another aspect of the operation of the illustrative embodiment, the receiver at a terminal analyzes the data words received from the distant terminal and formulates error control information which is to be passed to the transmitter and transmitted by that transmitter in the form of a BLOCK word to the distant terminal. During the synchronization procedure, if the receiver at the terminal has not yet formulated error control information because of a time delay in the transition from SYNC words to data at the transmitter of the distant terminal, the receiver will notify the terminal control circuitry to cause the transmitter to insert a SYNC word in place of the BLOCK word which would normally be transmitted to the remote terminal. In this manner, the first BLOCK word transmitted corresponds to the first complete block of data received. Synchronization is complete when both terminals have transmitted and received an initial BLOCK word.

Once the terminals at each end of the channel are

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