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Zheng

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[54] DATA TRANSMISSION SYSTEM AND SCHEDULING PROTOCOL FOR CONNECTION-ORIENTED PACKET OR CELL SWITCHING NETWORKS

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[51] Int. Cl.⁶ H04L 12/56

[52] U.S. Cl. 370/60; 370/94.2; 370/95.1

[58] Field of Search 370/60, 60.1, 94.1, 370/61, 110.1, 108, 85.1, 85.15, 95.1-95.3, 79, 81, 111, 118; 340/825.05, 825.5, 825.51

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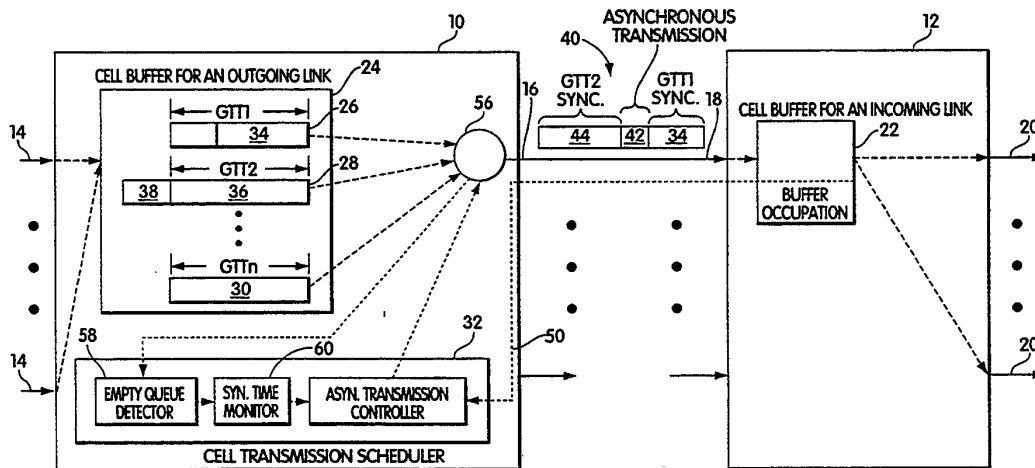
Attorney, Agent, or Firm—Robert K. Tendler

[57] ABSTRACT

In connection-oriented packet or cell switching networks, a data transmission system and scheduling proto-

col utilizes both synchronous transmission and asynchronous transmission in an alternating pattern to provide each user with both a guaranteed transmission bandwidth or capacity to accommodate real-time communications, and bandwidth sharing among users to increase network utilization, while simultaneously eliminating network congestion to avoid data losses. The synchronous time slots provide for the bandwidth guarantees, while the asynchronous time slots are used to transmit data when a part of a previous synchronous time slot is not used. The asynchronous time slots also permit asynchronous data transmission using unallocated time within a given time frame. In one embodiment, time frames for data transmission are provided in which each time frame is composed of synchronous transmission times interspersed with asynchronous transmission times. For a given time frame, alternating synchronous and asynchronous transmission times are specified by a controller which determines the pattern of this alternation. In a preferred embodiment, the pattern is altered using novel timed-round-robin scheduling which transmits cells of data of respective connections over an outgoing link depending upon the synchronous transmission time allocated to each connection. To avoid data losses, asynchronous transmission is permitted only when a downstream switch indicates sufficient buffer space to accommodate asynchronous transmission from an upstream switch.

8 Claims, 16 Drawing Sheets



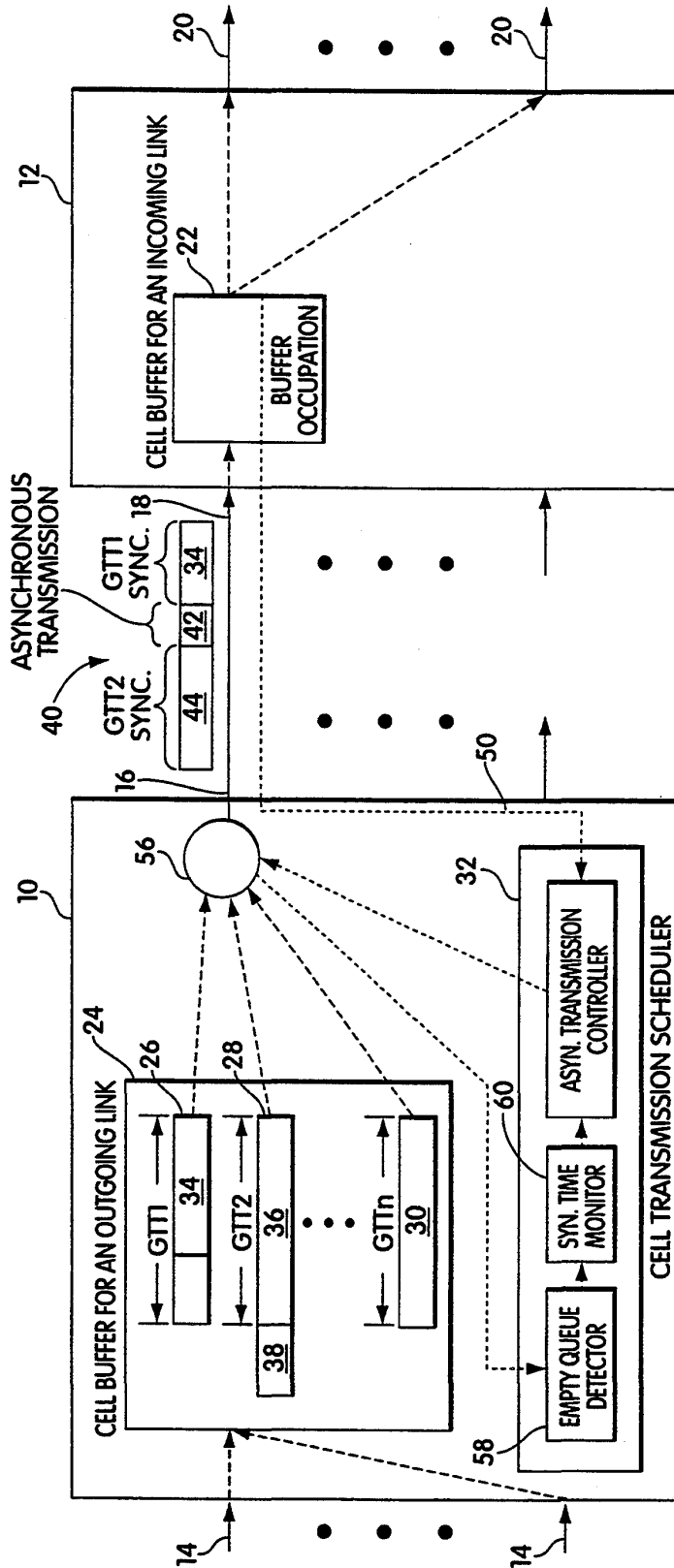


Fig. 1

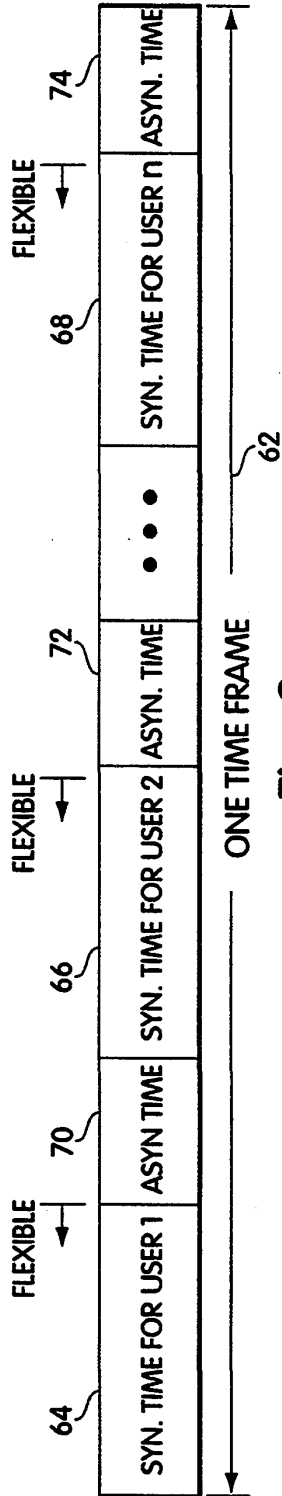


Fig. 2

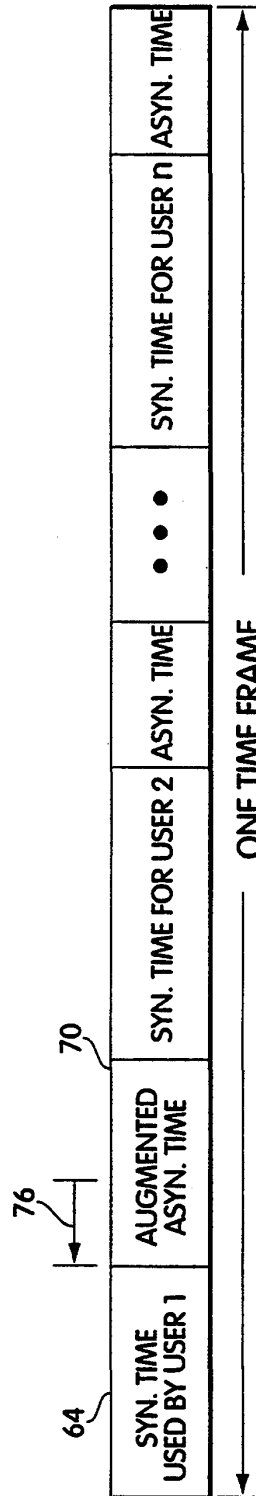


Fig. 3

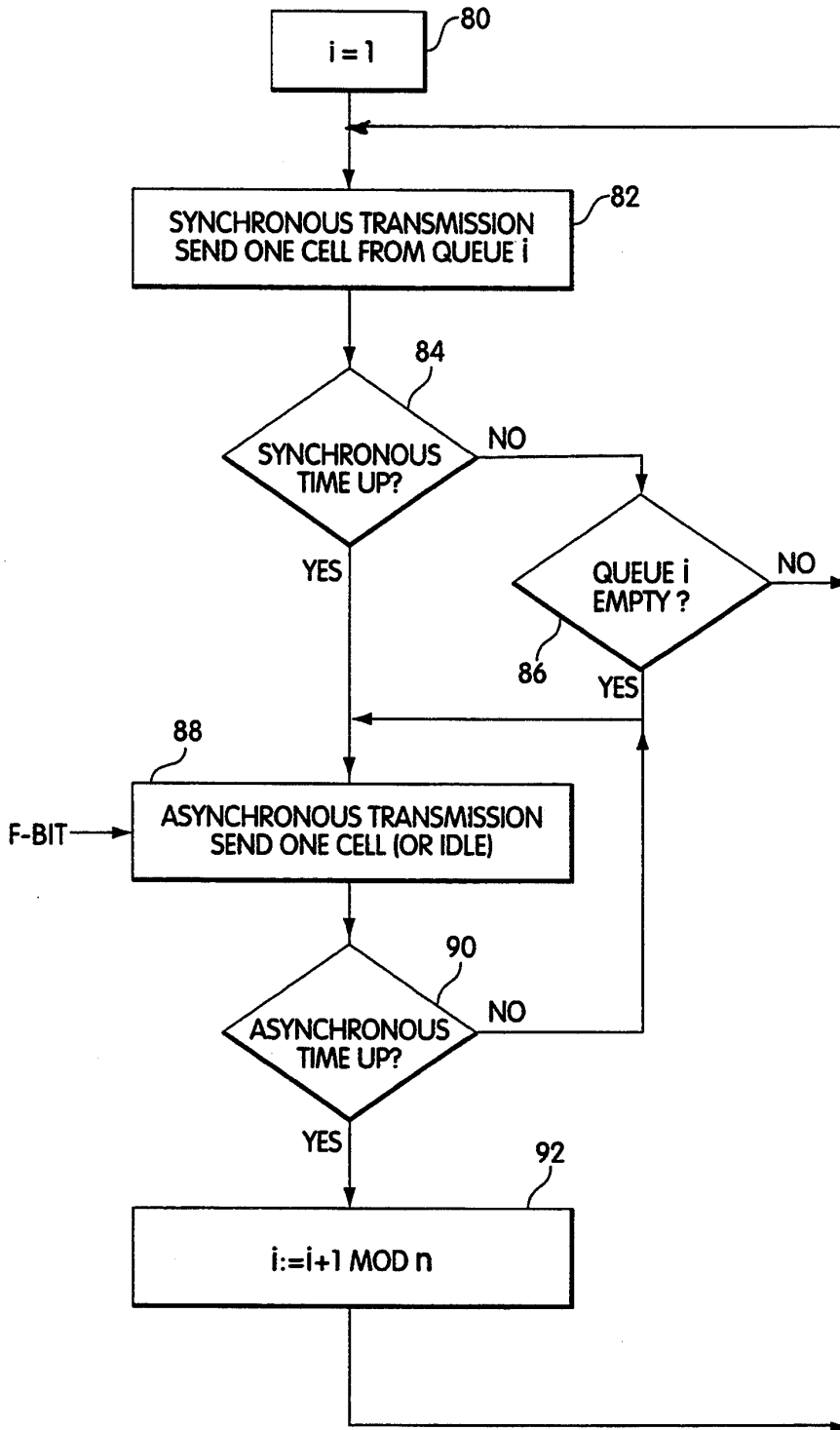


Fig. 4

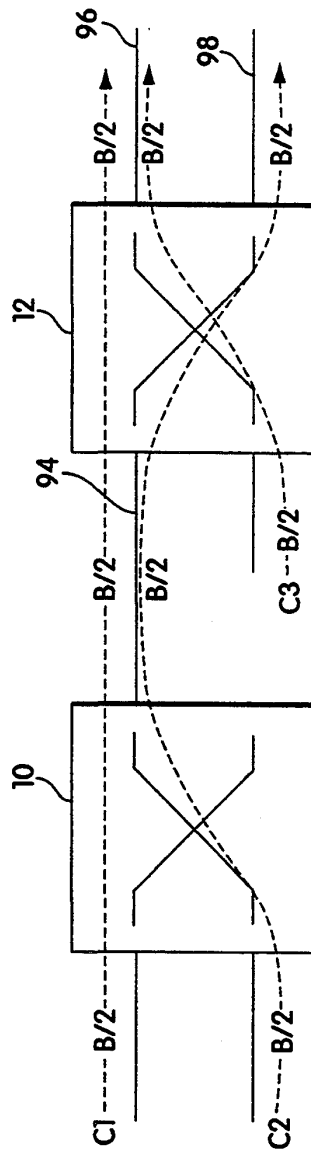


Fig. 5

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