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**Mody et al.**

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(54) **PREAMBLE STRUCTURES FOR SINGLE-INPUT, SINGLE-OUTPUT (SISO) AND MULTI-INPUT, MULTI-OUTPUT (MIMO) COMMUNICATION SYSTEMS**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 970 days.

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(51) **Int. Cl.**  
**H04J 11/00** (2006.01)

(52) **U.S. Cl.** ..... **370/210; 370/430; 370/482; 375/144**

(58) **Field of Classification Search** ..... 370/430, 370/480-482, 208, 206, 330, 210, 329, 512, 370/513; 342/375, 383; 375/146, 260, 355, 375/267, 144, 148

See application file for complete search history.

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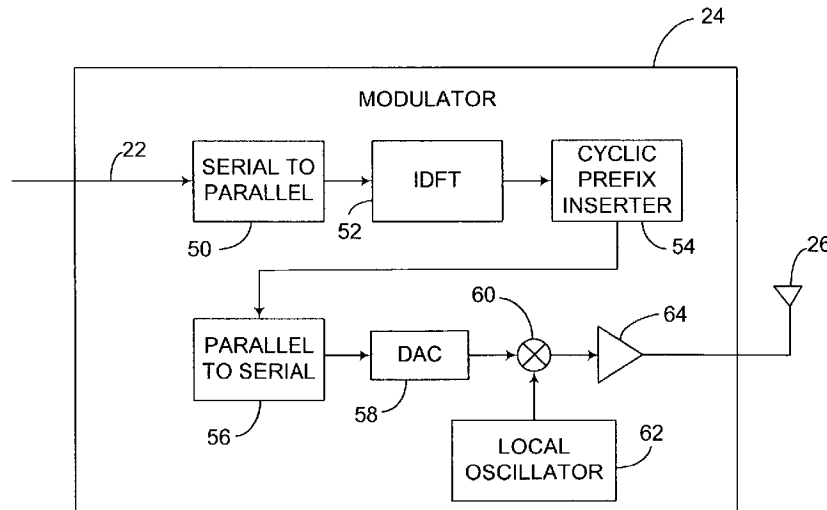
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(57) **ABSTRACT**

A communication system is provided herein for transmitting frames across a channel. The frames may be transmitted in single-input, single-output (SISO) and/or multi-input, multi-output (MIMO) communication systems. One such frame includes at least one training symbol, each having a cyclic prefix and a training block. The time length  $N_T$  of the training block is equal to an integer fraction  $I$  of the time length of a data block, i.e.,  $N_T = N/I$ . Furthermore, the time length  $G$  of the cyclic prefix is an integer fraction of the time length  $N_T$ . For example,  $G$  may be equal to  $N_T/4$  or 25% of  $N_T$ . The training symbols provide coarse and fine time synchronization, coarse and fine frequency synchronization, channel estimation, and noise variance estimation.

**25 Claims, 7 Drawing Sheets**



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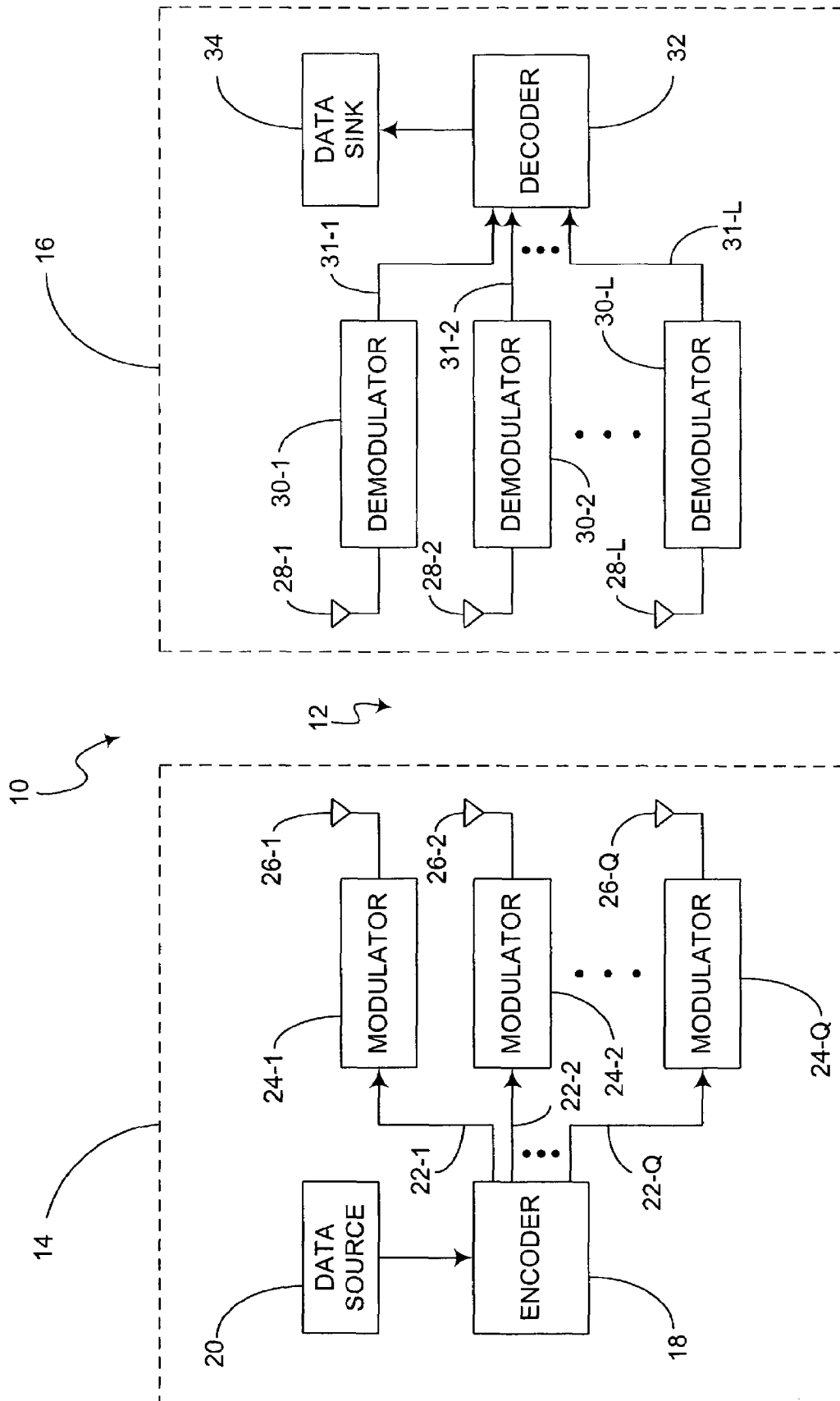
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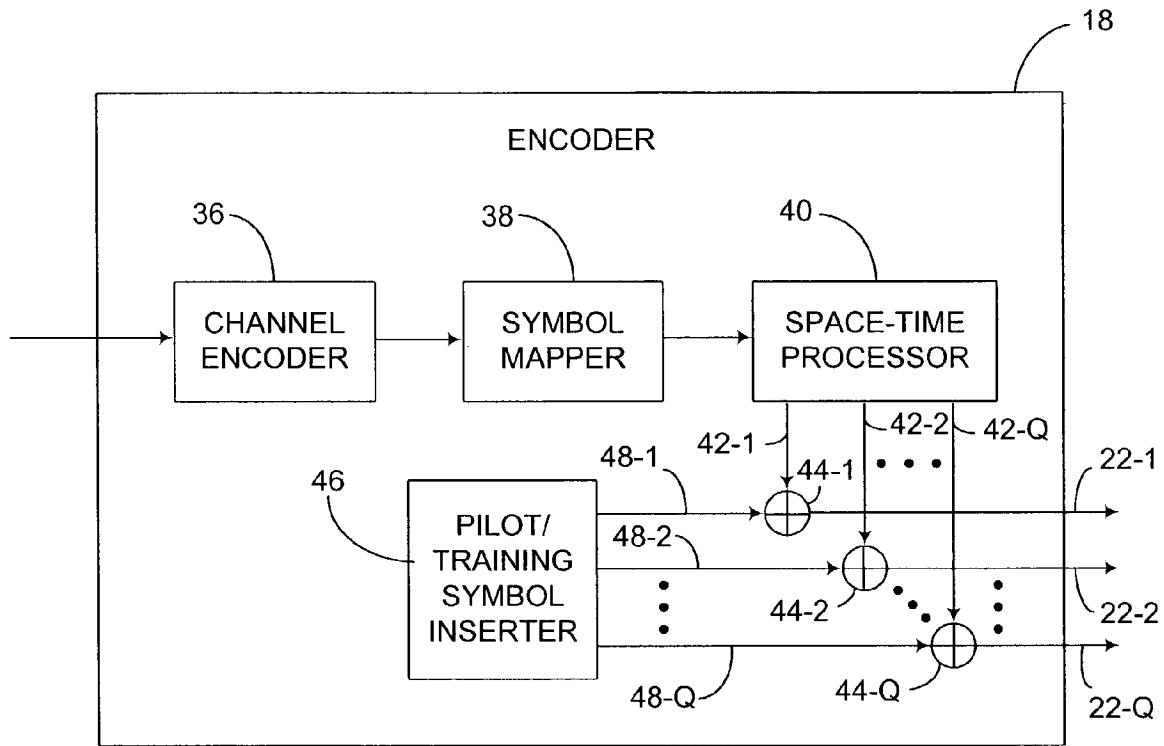
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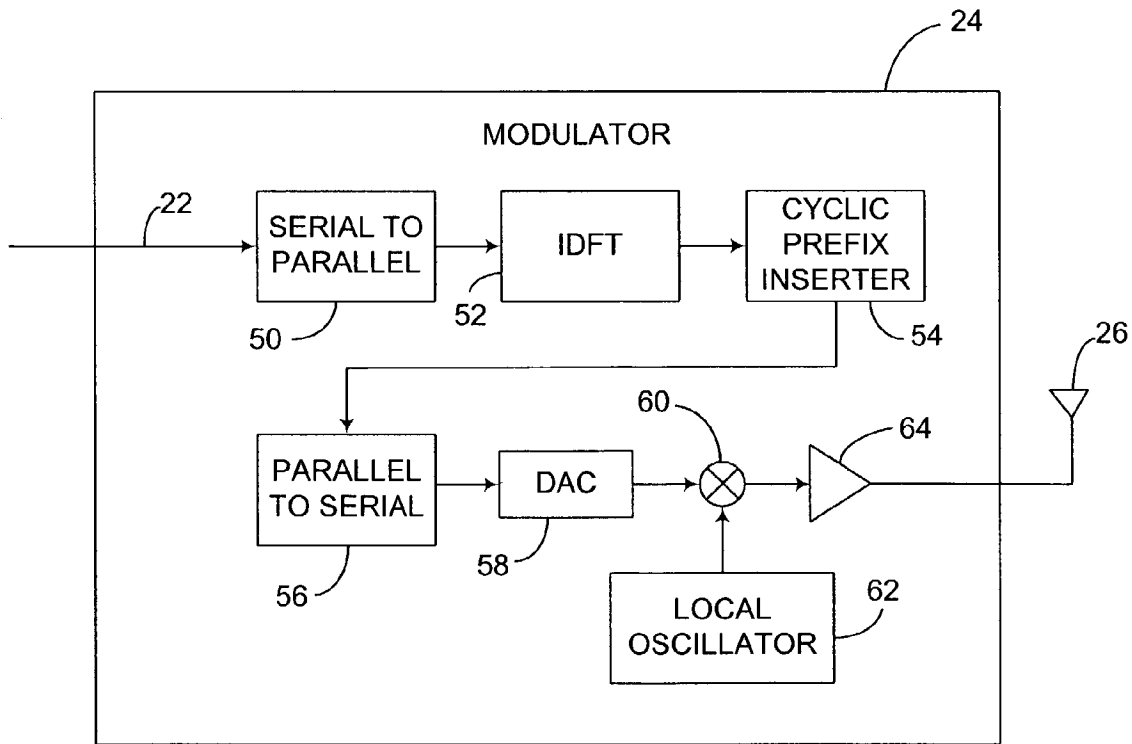
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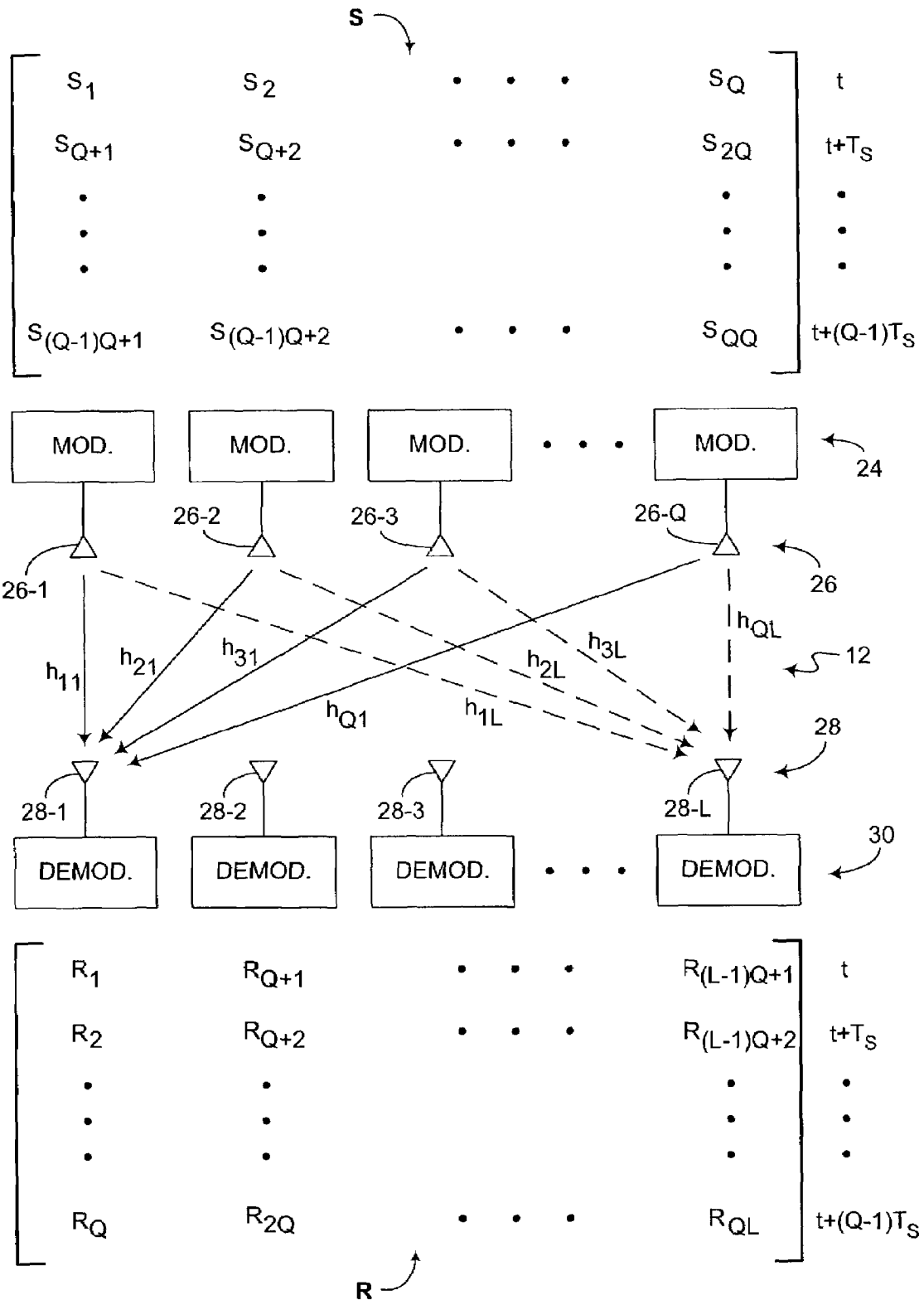
**FIG. 1**



**FIG. 2**



**FIG. 3**



**FIG. 4**

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