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Vanzieleghe et al.

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(54) **MULTI-CARRIER TELECOMMUNICATION SYSTEM WITH POWER ADAPTATION MEANS**

0753948 1/1997 (EP) .

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(75) Inventors: **Etienne Vanzieleghe**, Perwez; **Frank Cyriel Michel Defoort**, Kruikebeke-Bazel; **Peter Paul Frans Reusens**, Laarne, all of (BE)

“American Nat’l Std. for Telecommunications–Network and Customer Installation Interfaces– Asymmetric Digital Subscriber Line (ADSL) Metallic Interface” of the American Nat’l Stds. Inst., NY, 1995.

(73) Assignee: **Alcatel**, Paris (FR)

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner—Teskaldet Bocure
(74) *Attorney, Agent, or Firm*—Ware, Fressola, Van Der Sluys & Adolphson LLP

(21) Appl. No.: **09/087,708**

(57) **ABSTRACT**

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Related U.S. Application Data

(60) Provisional application No. 60/052,140, filed on Jul. 10, 1997.

A telecommunication transmitter (TU) for a multi-carrier transmission system of the Digital Subscriber Line [DSL] type and which includes a coding circuit (MMC) able to generate “symbols” derived from carriers (C1–Cn) modulated by incoming data, and a line driver circuit (LDC) to amplify these symbols. When idle data are received, the power dissipated in the transmitter is reduced because the symbols are then merely derived from a few or even a single carrier (the “pilot tone”) instead as from all the available carriers. The power dissipated is even more reduced because the line driver circuit is formed by a parallel connection of a high voltage but low efficiency (LL) and a lower voltage but higher performance (LH) line amplifier. The higher performance, and thus less power consuming, amplifier (LH) is used when idle data are received at the input (IN). In a variant, there is only one line amplifier of which the quiescent current is controlled as a function of the data traffic. In another variant, the number of carriers used by the coding circuit (MMC) is a function of the mean traffic of effective data received.

(30) **Foreign Application Priority Data**

Jun. 2, 1997 (EP) 97401210

(51) **Int. Cl.⁷** **H04L 27/04**

(52) **U.S. Cl.** **375/295; 375/222**

(58) **Field of Search** 375/222, 260, 375/295; 379/93.01; 370/431, 438, 439

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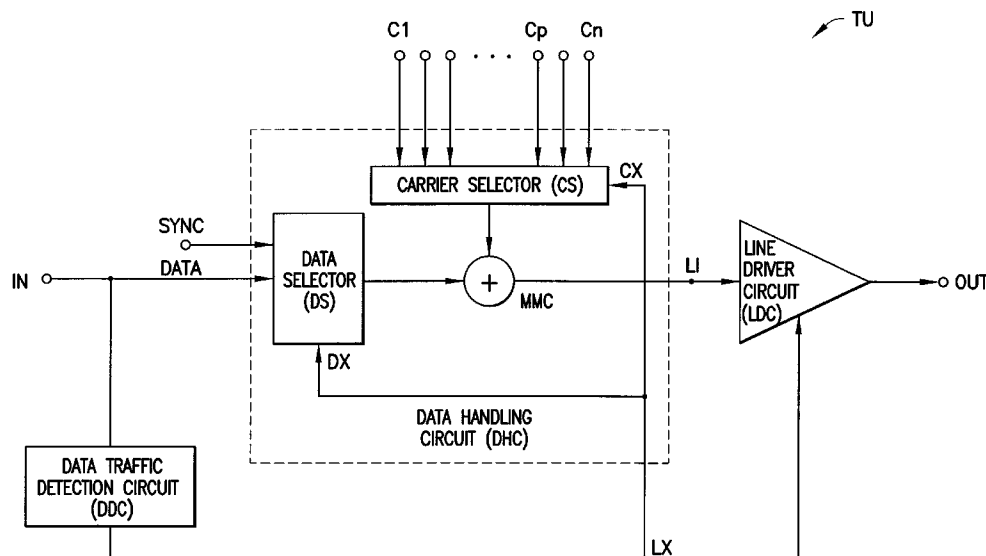
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14 Claims, 3 Drawing Sheets



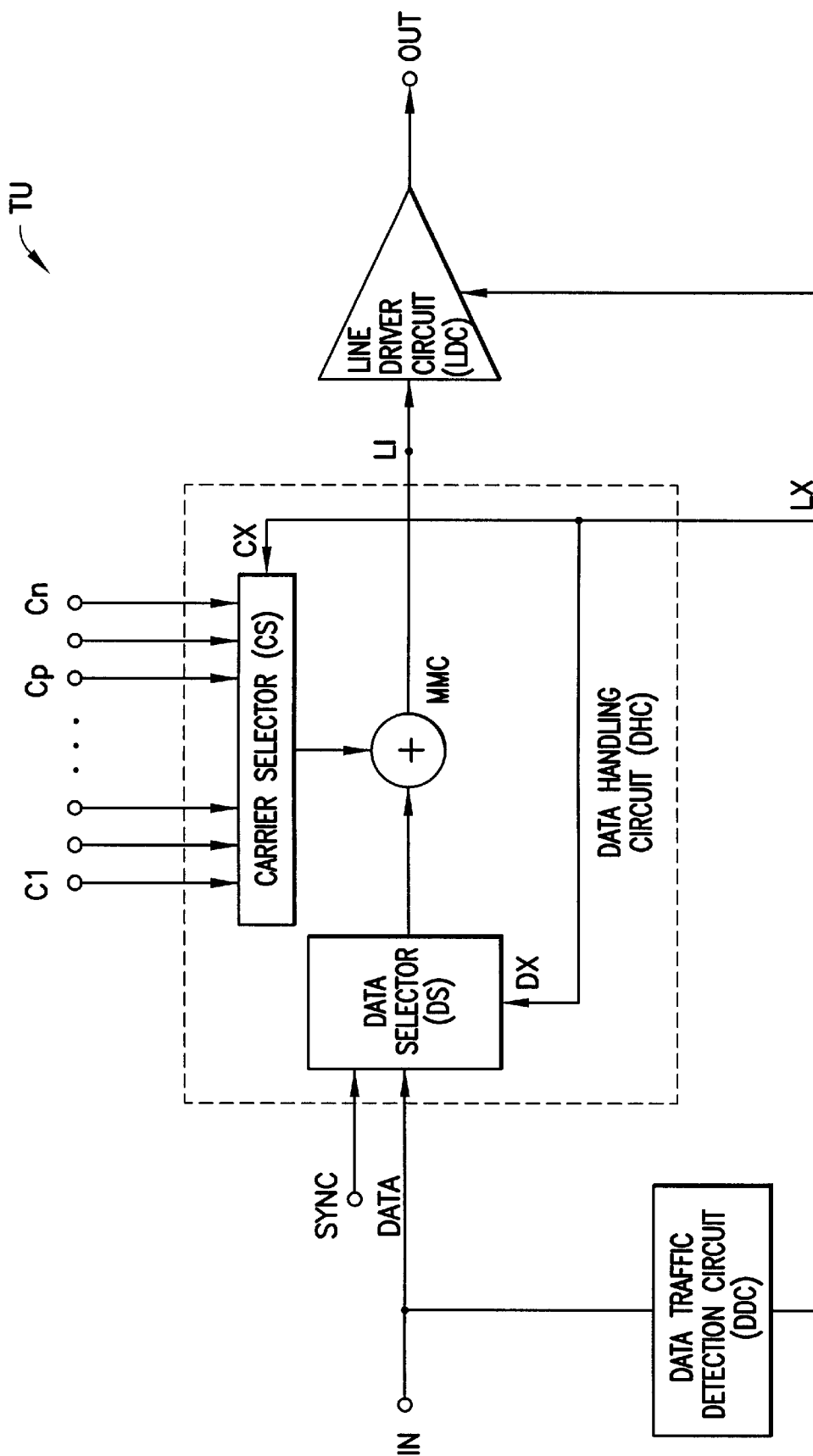


FIG.1

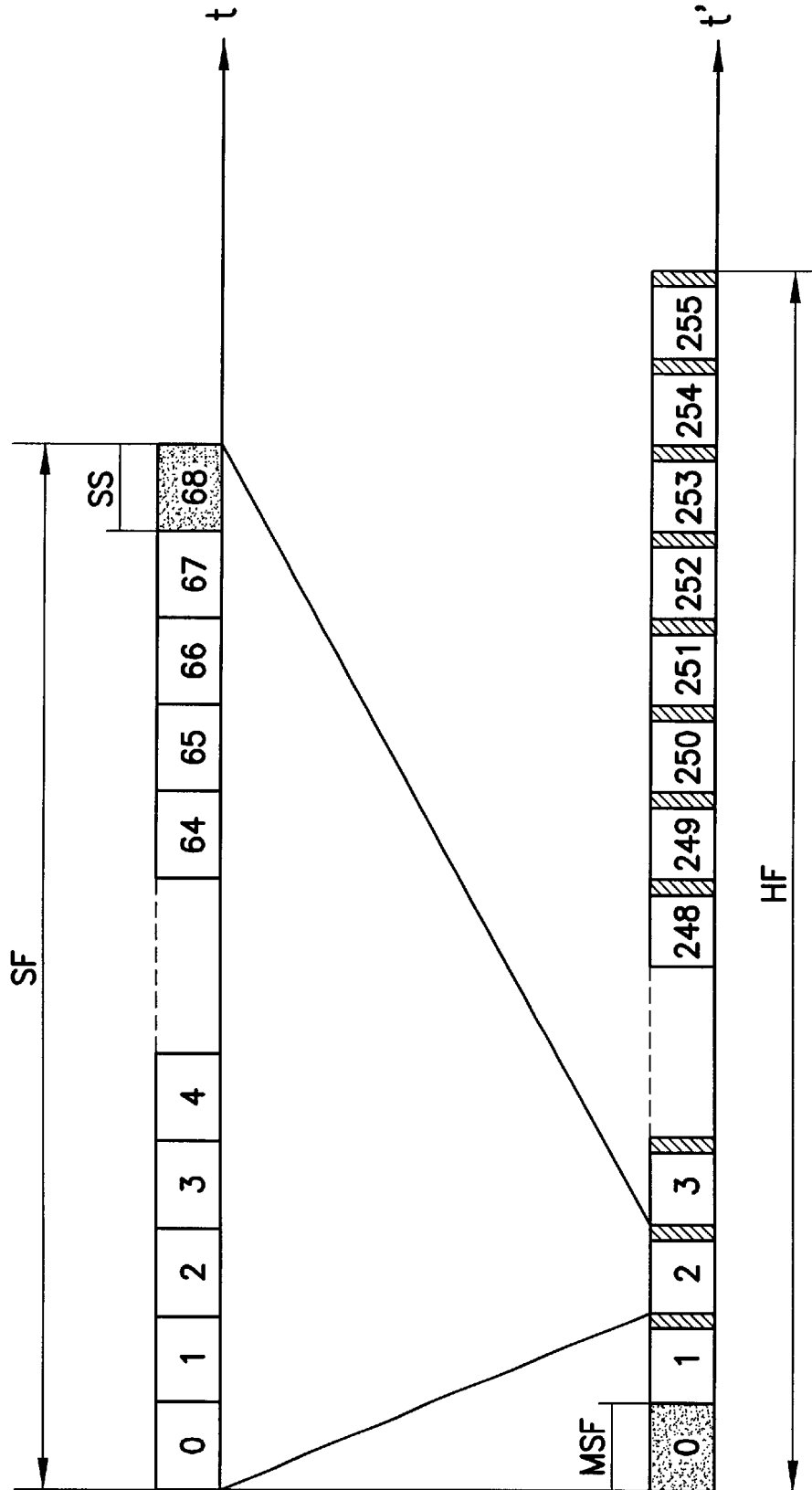


FIG.2

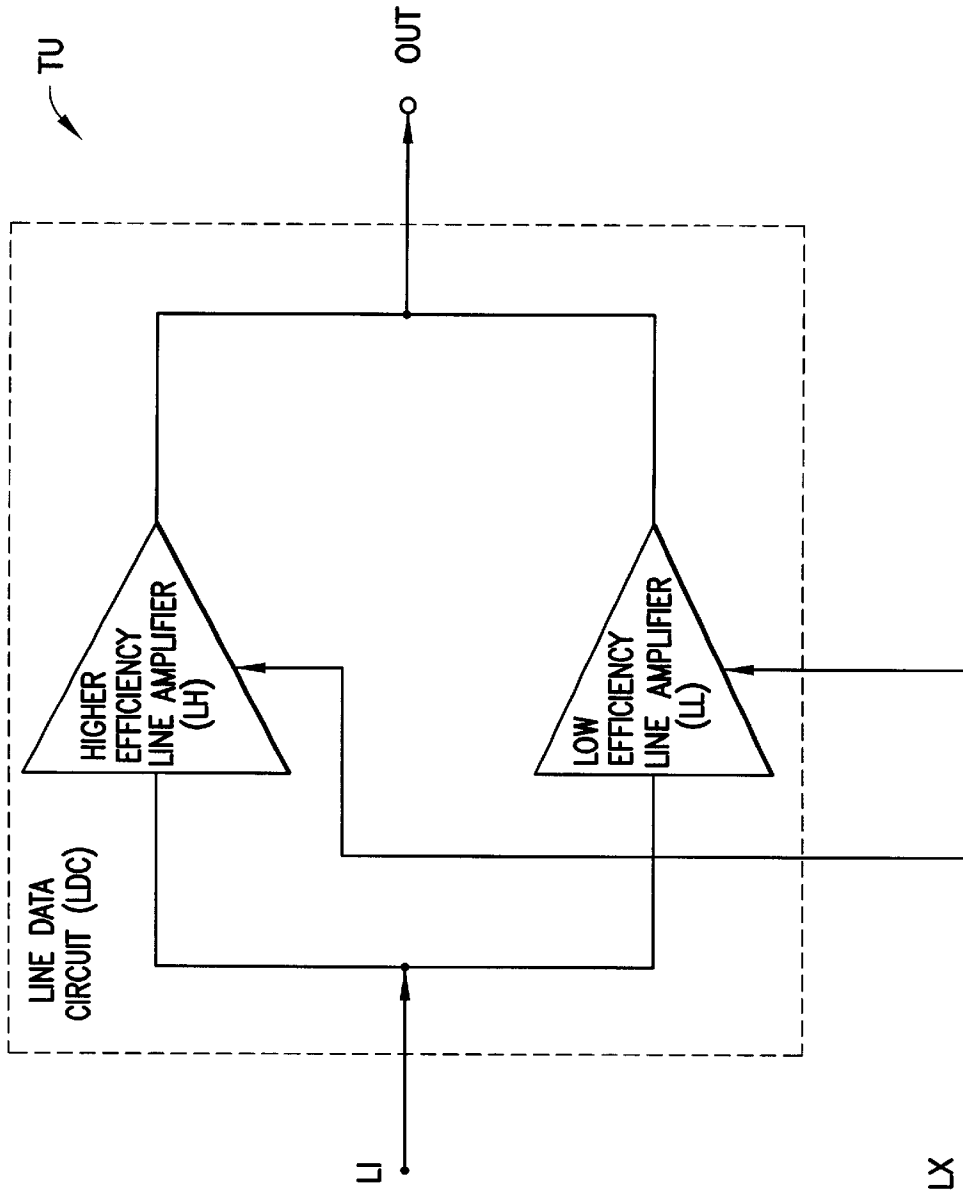


FIG. 3

MULTI-CARRIER TELECOMMUNICATION SYSTEM WITH POWER ADAPTATION MEANS

In addition to claiming priority under 35 USC § 119(a) from EPO application 97401210.6 filed Jun. 2, 1997, this application also claims the benefit under 35 USC § 119(e) of U.S. Provisional Application No. 60/052,140, filed on Jul. 10, 1997.

TECHNICAL FIELD

The present invention relates to a telecommunication transmitter for a multi-carrier transmission system, said transmitter including coding means coupled between a transmitter input and a transmitter output and able to modulate a plurality of carriers with data received at said transmitter input and to derive therefrom symbols which are transmitted towards said transmitter output.

BACKGROUND OF THE INVENTION

A multi-carrier transmission system including such a telecommunication transmitter is already known in the art and is for instance a Digital Subscriber Line [DSL] Transceiver Unit [TU] as defined in international standards such as, for instance, the Asymmetrical Digital Subscriber Line [ADSL] standard. This standard is the "ANSI T1.413—American National Standard for Telecommunications—Network and Customer Installation Interfaces—Asymmetric Digital Subscriber Line (ADSL) Metallic Interface" of the American National Standards Institute [ANSI], New York—1995. The digital data received at the input of such a known transmitter is grouped into frames comprising a predetermined number of bits and wherefore the coding means generates corresponding symbols which are transmitted to a telecommunication line connected to the transmitter output. Since the voltage of each symbol may have different peak values, the signal voltage transmitted on the telecommunication line may vary within a relatively large range. As a consequence, the power dissipated in the telecommunication transmitter is relatively high because it has to support a large value of signal voltage to avoid, or at least minimize, occasional clipping.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a telecommunication transmitter of the above known type but whereof the power dissipation is dramatically reduced.

According to the invention, this object is achieved due to the fact that said telecommunication transmitter further includes carrier selection means adapted to apply said carriers to said coding means, and data traffic detection means adapted to detect if idle data are received at said transmitter input and, if idle data are detected, to control said carrier selection means to apply a predetermined reduced set of said carriers to said coding means.

In this way, when idle data are received at the transmitter input, the symbols generated by the coding means are merely derived from a few carriers instead of from all the carriers as it is the case when effective data are applied to the transmitter input. The power on the line is thereby dramatically reduced, as well as the relatively high power dissipated in the coding means and thus in the telecommunication transmitter.

Since the symbols, which are generated when idle data are received at the transmitter input, contain only a few carriers,

the power dissipated in the transmitter is reduced. In other words, if the number of carriers drops, the dissipated power is reduced accordingly.

Another characteristic feature of the present invention is that said predetermined reduced set of carriers comprises only one carrier that is applied to said coding means.

For frequency synchronization purposes, the only one remaining symbol transmitted on the line can be chosen to be derived from a so-called "pilot tone". The transmission system remains thus efficient in that it allows a fast restart owing to the fact that the synchronization on the telecommunication line is maintained, while the power dissipated is dramatically reduced with respect to that of the known system.

In a preferred embodiment, the present invention is further characterized in that said telecommunication transmitter further includes data selection means adapted to apply said data to said coding means, and in that said data traffic detection means is further adapted, if idle data are detected, to control said data selection means to discard the idle data received at said transmitter input.

As idle data may, in some circumstances, be dummy data, the latter could be used by the coding means to modulate the few or single carrier(s) from which symbols could then be derived and transmitted on the telecommunication line. However, owing to the present invention such dummy data would be discarded and the single carrier will remain un-modulated. As a result, the power dissipation is then minimal.

It should be noted that the switching between symbols derived from effective data and symbols derived from idle data, and vice-versa, can be fast whereby the power savings can be improved.

Preferably, said telecommunication transmitter operates according to a predetermined mapping and modulating protocol defined by a digital subscriber line [DSL] standard such as the Asymmetrical Digital Subscriber Line [ADSL] standard, and said symbols derived from said data are Discrete Multi-Tone [DMT] symbols.

It is obvious for a person skilled in the art that the above multi-carrier transmission technique is not limited to ADSL applications using DMT symbols, but can for instance also be used in High speed Digital Subscriber Line [HDSL] applications, in Very high speed Digital Subscriber Line [VDSL] applications, in Symmetrical Digital Subscriber Line [SDSL] applications as well as in relation with Orthogonal Frequency Division Multiplexing [OFDM] and/or Discrete Wavelet Multi Tone [DWMT] applications. The latter are also multi-carrier transmission techniques differing from ADSL in that, for instance for DWMT, the Fourier and inverse-Fourier transformers used therein are replaced by filterbanks, wavelets transformers and/or Discrete Cosine Transformers [DCT].

Also another characteristic feature of the present invention is that said coding means is adapted to count the number of symbols transmitted towards said transmitter output and to transmit at least one synchronization symbol after each group of N symbols, said synchronization symbol being derived from a frame of synchronization signals received at said data selection means, and that said N symbols and said one synchronization symbol form together a super-frame.

In case of idle data, and as already mentioned, the frequency synchronization between the transmitter and a receiver at the other end of the telecommunication line is maintained owing to the presence of the pilot tone. By sending one synchronization symbol for every N symbols,

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