BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

D E C I S I O N
of 29 June 2006

Case Number: T 1362/05 - 3.5.03

Application Number: 93913976.2

Publication Number: 0689738

IPC: H04B 3/56

Language of the proceedings: EN

Title of invention:
Power line coupler modem device for communication over electrical lines

Applicant:
Videocom

Opponent:
-

Headword:
Power line coupler/VIDEOCOM

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1362/05 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 29 June 2006

Appellant: Videocom
804 Cheswold Court
Wayne, PA 19087 (US)

Representative: Ahmad, Sheikh Shakeel
David Keltie Associates
Fleet Place House
2 Fleet Place
London EC4M 7ET (GB)

Decision under appeal: **Decision of the examining division of the European Patent Office posted 3 May 2005 refusing European application No. 93913976.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. S. Clelland
Members: F. van der Voort
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division to refuse European patent application 93 913 976.2, published as international application WO 93/23928 A pursuant to Article 158(1) EPC. The decision to refuse, dated 3 May 2005, was the second such decision, a previous decision having been rectified.

II. The following documents were referred to in the decision:

D1: WO 90/13950 A; and

D2: John A. C. Bingham, "Multicarrier Modulation for Data Transmission: An Idea Whose Time Has Come", IEEE Communications Magazine, May 1990, pages 5 to 8 and 11 to 14.

III. The reason for the refusal was that the subject-matter of claim 1 of both a main request and an auxiliary request did not involve an inventive step having regard to D1 and the background knowledge disclosed in D2 (Article 56 EPC).

IV. With the statement of grounds of appeal the appellant requested that the decision be set aside and a patent be granted on the basis of claims of either a main request or any one of four auxiliary requests, all as filed with the statement of grounds of appeal. Arguments in support were submitted and oral proceedings were conditionally requested. Subsequently,

the appellant filed an affidavit by the inventor in support of the arguments.

V. The appellant was summoned by the board to oral proceedings. In a communication accompanying the summons, the board gave a preliminary opinion on, *inter alia*, the question of inventive step.

VI. In response to the board's communication, the appellant filed a main request and three auxiliary requests, replacing all requests on file, and presented arguments in support of these requests. A second affidavit by the inventor was also filed.

VII. Oral proceedings were held on 29 June 2006. The appellant requested that the decision of the examining division be set aside and a patent granted on the basis of either the main request or any one of the three auxiliary requests as filed in response to the board's communication. At the end of the oral proceedings the board's decision was announced.

VIII. Claim 1 of the main request reads as follows:

"A communication apparatus (10) for transmitting a frequency division multiplex signal over an electric power line (12) comprising:

a transmitting station (10) adapted to be connected to said electric power line said transmitting station being arranged to conduct to said electric power line (12) said frequency division multiplex signal, characterized by further comprising:

(a) a transmitting station input data line (24) arranged to carry a first electrical information signal,

(b) a demulitplexer *[sic]* (26) arranged to distribute the first electrical information signal to a plurality of modulator input data lines,

(c) a plurality of modulators (16), each one associated with one of the modulator input data lines and operating at a different preselected carrier frequency, each of said modulators providing a modulated carrier signal, and

(d) a plurality of phase-shift linear first station dielectric-core couplers (C1, C2... Cn)(18), each coupler being associated with one of the modulators and arranged to be impedance matched with said electric power line at the carrier frequency of its associated modulator, said couplers being arranged to couple said ones of said modulated carrier signals developed by said modulators to said electric power line."

Claim 1 of the first and second auxiliary requests is identical to claim 1 of the main request, except for the insertion of "*the apparatus*" before "*comprising*" in the second line of both requests and of the following wording after "*signal*" at feature (c): "*, said modulators being arranged to modulate by either quadrature phase shift key modulation or octaphase shift key modulation;*" in claim 1 of the first auxiliary request and "*and each of said different preselected carrier frequencies being selected such that they have a value in between the frequencies of the main harmonics of the said electric power line;*" in claim 1 of the second auxiliary request.

Claim 1 of the third auxiliary request reads as follows:

"A communication apparatus for expanding an Ethernet network (54) system for transmitting and receiving first and second frequency division multiplex signals via an electric power line (12), the apparatus comprising:

a transceiver station (26, 28; 16, 20; 18) connected to said electric power line arranged to:

(a) produce said first frequency division multiplex signal;

(b) conduct to said electric power line (12) a first frequency division multiplex signal;

(c) receive from said electric power line (12) a second frequency division multiplex signal; and

(d) process the second frequency division multiplex signal, said transceiver station including:

(i) a plurality of input data lines carrying first electric information signals and arranged in use to be in communication with the Ethernet network system;

(ii) a plurality of modulators (16), each one associated with one of said input data lines and operating at a different preselected carrier frequency, arranged to modulate said first electrical information signals received from associated input data lines to develop components of said first frequency division multiplex signal;

(iii) a plurality of demodulators (20), each one operating at a different preselected carrier frequency, arranged to demodulate components of said frequency division multiplex signal received from said electric power line;

(iv) a plurality of output data lines, each one associated with one of said demodulators arranged to carry second electrical information signals, and arranged in use to be in communication with the Ethernet network system; and

(v) a plurality of phase shift linear dielectric core couplers arranged to:

(a) couple said components of said first frequency division multiplex signal developed by said transceiver station modulators to the electric power line;

(b) separate said components of said second frequency division multiplex signal; and

(c) pass said components of said second frequency division multiplex signal in parallel to said demodulators."

Reasons for the Decision

1. *Inventive step - main request*

1.1 Both the examining division and the appellant considered D1, which has the same inventor as the present application, to represent the closest prior art. The board agrees.

1.2 D1 discloses a communication apparatus 10 (Fig. 6) for transmitting a modulated carrier signal over an electric power line 12. A transmitting station has a modem 20 which includes a modulator operating at a preselected carrier frequency (page 12, lines 2 to 6). The modem is connected to a coupler 14. Fig. 7 shows an example of the coupler which includes an LC circuit 32 including a non-linear air coil transformer 44 and resonating at the transmission carrier frequency (page 11, lines 26 to 29, and page 12, lines 36 to 38). The coupler is impedance matched to the electric power line at the carrier frequency of the modulator (page 12, lines 31 to 33, page 16, lines 27 to 30) and couples the modulated carrier signal developed by the modulator to the electric power line 12. A data transmission rate of up to 10 kbaud may be achieved (see page 24, lines 1 to 8). The transformers are non-linear due to the existence of an air gap forming a dielectric core between the primary and secondary windings (page 14, lines 21 to 23, and page 16, lines 6 to 8), whereas the previous power line communication systems included magnetic or ferrite (iron) core linear transformers (page 2, lines 23 to 29).

1.3 In the course of the oral proceedings the appellant accepted that the air gap transformer of D1 was an example of a dielectric-core coupler but argued that according to present claim 1 the couplers were phase-shift linear, whereas the couplers of D1 were non-linear.

The board however interprets "non-linear capacitively coupled air coil transformers" as referred to in D1 as relating to transformers having a frequency response effectively corresponding to that of a high pass filter (cf. page 3, last paragraph, page 7, lines 13 to 20, page 15, lines 20 to 27, and Fig. 5), in contrast to the "magnetic linear transformers" having a generally flat frequency response (cf. Fig. 3 and page 3, lines 26 to 31). The phase response of the air core coupler of D1 is however, in the same sense as in the present application, linear within a relatively wide bandwidth BW around the carrier frequency, thereby facilitating error free and high speed communication using phase shift keying modulation (D1, page 19, line 11, "*BPSK*" and Fig. 5), whereas magnetic linear transformers require the use of filters which pass only a narrow bandwidth (page 3, lines 7 to 10). The dielectric core coupler of the present application achieves these advantages in the same way (see page 3, lines 19 to 25, and page 13, line 24 to page 14, line 1; throughout this decision reference is made to the application as published). This interpretation is also in line with the fact that the coupler of Fig. 9A of D1 is essentially identical to the coupler of Fig. 8 of the present application.

It follows that phase-shift linear first station dielectric core couplers are known from D1.

1.4 The subject-matter of claim 1 differs from the apparatus of D1 in that the claimed apparatus additionally includes a demultiplexer for distributing the electrical information signal to a plurality of modulators, each operating at a different preselected carrier frequency and each being associated with a coupler for coupling the respective modulated carrier signal to the electric power line.

1.5 The signal transmitted over the electric power line is therefore a frequency division multiplex signal, with the effect that a higher data transmission rate can be achieved (see also the application, page 12, last paragraph).

1.6 The technical problem underlying the claimed subject-matter may therefore be seen in improving the apparatus of D1 such that it supports higher data transmission rates. The formulation of this problem does not contribute to an inventive step, since at the priority date local area networks (LANs) capable of operating at speeds higher than 10 kbaud were well-known (see, e.g., the present application (as published), page 4, line 19, to page 5, line 4) and, hence, the problem of an insufficient data transmission rate achievable with the apparatus of D1 would already have been encountered in practice and have motivated the person skilled in the art to solve it.

1.7 Faced with the above technical problem, a person skilled in the art would have considered D2, since it relates to a data transmission system, the performance of which is discussed in terms of maximum achievable bit rate (see the title, page 5, left-hand col., lines 1 to 14, and page 6, left-hand col., last paragraph).

The appellant argued that, since D2 is not specifically concerned with power line communication but rather with telephone networks, the skilled person would not have considered it. The board does not find this argument convincing, since the above-mentioned technical problem is not specifically related to power line communication and since D2 is also concerned with the general principle of multicarrier modulation independently of the type of transmission channel used (see the title, page 5, left-hand col., lines 1 to 5, and Fig. 1). The person skilled in the art would therefore, in the board's view, have considered D2.

1.8 Fig. 1 of D2 shows a basic multicarrier transmitter for the transmission of data, in which the input data is distributed over a plurality of modulators, each operating at a different preselected frequency, by means of a serial-to-parallel converter, i.e. a demultiplexer, and in which the modulated carriers are summed for transmission. Page 14, first paragraph, suggests that multicarrier modulation achieves the highest possible speed on any line.

The skilled person would therefore have sought to apply the teaching of D2 to the apparatus of D1 by replacing the modem/coupler as shown in, e.g., Fig. 22A of D1, by

the multicarrier transmitter of D2, Fig. 1. Since the LC circuit of the coupler of D1 is impedance matched to the power line and resonates at the transmission carrier frequency, it would have been obvious to the skilled person to provide several of these couplers such that each one includes an LC circuit adapted to its respective transmission carrier frequency. The couplers would thereby form the summing means of Fig. 1 of D2.

1.9 The appellant argued that, even if the skilled person were to apply the teaching of D2 to D1, Figs 1 and 7 of D2 would imply or at least suggest the use of a single coupler (Σ in Fig. 1) for coupling the different modulated carrier signals to the power line. Further, referring to D1, page 12, lines 23 to 25 and 28 to 31, since the coupler of D1 could have a bandwidth of 30 kHz, i.e. could accommodate several modulated carrier signals with a bandwidth of 6 kHz each, it would have been suitable for coupling all of the modulated carrier signals together via a single coupler.

The board does not accept this argument. D2 does not give any constructional details about the summing means Σ schematically shown in Fig. 1. At page 5, right-hand col., it is merely stated that "*The modulated carriers are summed for transmission*", whilst Fig. 7 is a block diagram of one modem only and, hence, corresponds to only one of the modulators of Fig. 1. D1 on the other hand describes the coupler in detail, see Figs 4 and 7 and the corresponding text in the description, describing, *inter alia*, that it resonates at the associated carrier frequency. The example of Fig. 22A of D1 concerns the communication between computers in a

LAN via power lines of the facility, i.e. without power line distribution transformers (page 24, lines 1 to 8). In order to achieve a data transmission rate as high as possible, the whole bandwidth of the coupler would have to be made available to the single modulated carrier signal. The modulated carrier signal bandwidth of 6 kHz referred to by the appellant is mentioned only in relation to communication speeds of up to 1200 baud for communication via power line distribution transformers (page 4, lines 30 to 32, page 12, lines 28 to 31, and Figs 22 and 23) and does not concern the example of Fig. 22A. Hence, the skilled person, starting out from the example of Fig. 22A of D1 and seeking to couple, as taught by D2, each of the plurality of modulated carrier signals to the power line, would have found it obvious to provide further couplers of the same type as described in D1, in which each coupler is made to resonate at the frequency of its respective transmission carrier signal.

1.10 It follows that, without the exercise of any inventive skill, the skilled person would have arrived at a communication apparatus including all the features of claim 1 of the main request.

1.11 For these reasons, the subject-matter of claim 1 of the main request does not involve an inventive step (Articles 52(1) and 56 EPC).

2. *Inventive step - first auxiliary request*

2.1 The additional feature as defined in claim 1 of the first auxiliary request concerns the use of quadrature

phase shift key modulation (QPSK) or octaphase shift key (OPSK) modulation (see point VIII above).

2.2 D1 mentions binary phase shift keying (BPSK) in relation to communication via power lines, see page 19, lines 5 to 15. The effect of using a higher level modulation scheme, e.g. QPSK or OPSK, is a further increase in the data transmission rate. Hence, the technical problem underlying the claimed subject-matter remains that of improving the apparatus of D1 such that it supports higher data transmission rates.

2.3 QPSK and OPSK are well-known examples of m-ary modulation schemes. Further, the board notes that D2 also discloses m-ary modulation schemes, namely m-ary quadrature amplitude shift keying (QASK), with m = 2 to 8 (see page 5, right-hand col., lines 1 to 3, footnote 1 and Fig. 6).

The appellant argued that it was well-known that higher level modulation schemes provided higher transmission rates than BPSK did, but, in return, required a higher channel quality for achieving the same bit error rate. Since it was well-known that power lines constituted communication channels of bad quality due to, e.g., impedance mismatches, strong 60 (or 50) Hz harmonics, impulse noise due to sparking or arcing and noise caused by appliances connected to the power line, the skilled person would not have considered applying a higher level modulation scheme to the power line communication apparatus disclosed in D1.

The board does not accept this argument. D2 explicitly takes into account the effects of various channel

impairments, in particular linear and non-linear distortion, 60 Hz phase jitter, impulse noise and single-frequency interference (see page 8 ff. ("*Correcting for the Effects of Channel Impairments*"), page 5, left-col., lines 24 to 32, and Figs 3, 5 and 6), which in the board's view are also relevant to power lines. At the same time, D2 proposes m-ary QASK, with m = 2 to 8, for the multicarrier modulation. Hence, the reader is taught that a higher level modulation scheme may be sufficiently robust despite these channel impairments. A skilled person faced with the above-mentioned technical problem and applying the teaching of D2 to the apparatus of D1 would therefore not have been dissuaded from selecting a higher level modulation scheme for use in the example of Fig. 22A of the power line communication apparatus of D1 for communication between computers via the power lines of the facility. On the contrary, realizing that a higher level modulation scheme provides a higher data transmission rate than BPSK does, the skilled person would rather be led, with a reasonable expectation of success, to try such a modulation scheme.

2.4 In view of the above and the reasons as given in respect of claim 1 of the main request, the board concludes that the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC).

3. *Inventive step - second auxiliary request*

3.1 The additional feature of claim 1 of the second auxiliary request concerns the selection of the carrier frequencies in between the frequencies of the main

harmonics of the power line (see point VIII above). The wording "main harmonics of the said electric power line" is in the context of the present application understood as referring to at least some of the harmonics of a 50 or 60 Hz power line. According to the description, page 16, lines 5 to 7 and 14 to 20, and page 17, lines 2 to 4, multiples of 25 or 30 kHz are strong harmonics.

3.2 It was undisputed that interference from the power line frequency or any of its harmonics must be avoided (see D1, page 2, lines 15 to 17 and page 3, last paragraph). In D1, which concerns a 60 Hz power line system, this is particularly achieved by attenuating the 60 Hz signal and its harmonics (see page 15, lines 21 to 25), whereas previous systems "*attempt[ed] to communicate between the harmonics rather than by reducing the noise significantly through the coupler*" (page 2, lines 15 to 17).

The appellant argued that this showed that communication at frequencies between the harmonics on the one hand and attenuating the harmonics of the power line on the other hand were incompatible teachings. The board disagrees, since each measure would independently contribute to an improved system performance and no reason can be seen why the skilled person would have deliberately selected carrier frequencies which coincide with the known distortion frequencies, here the 60 Hz harmonics of the power line. Nor did the appellant give any reason. Further, D1 does not exclude and does not teach the skilled reader away from a selection of the carrier frequencies in between the main harmonics of the electric power line as a second

measure to avoid interference; at page 17, lines 1 to 10, data communication in a LAN (local area network) via power lines at communication speeds up to 10 kbaud is described, the carrier frequencies being 75 and 111 kHz, which are clearly in between any of the 60 Hz harmonics. Since the example of Fig. 22A of D1 also concerns communication in a LAN between computers through power lines at communication speeds up to 10 kbaud, it would have been obvious to the person skilled in the art to use similar frequency values for, e.g., the modem of workstation 141. For the same reason, it would have been obvious to the skilled person to select the carrier frequencies of each of the further couplers of the multiplexed communication apparatus referred to at section 1.8 above in between the main harmonics of the power line.

3.3 In view of the above and the reasons as given in respect of claim 1 of the main request, the board concludes that the subject-matter of claim 1 of the second auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC).

4. *Inventive step - third auxiliary request*

4.1 Claim 1 of the third auxiliary request differs from claim 1 of the main request essentially in that the transmitting station is replaced by a transceiver station and in that the apparatus is in communication with an Ethernet network system. The board notes that the claim does not define any constructional features of the communication apparatus, which specifically concern the Ethernet network system, other than that the apparatus is for, which the board interprets as

suitable for, expanding the Ethernet network system and is arranged to be in communication with it.

4.2 Local area networks using Ethernet technology were well-known before the priority date of the present application (see also the present application (as published), page 4, lines 19 and 20).

4.3 Since the example of Fig. 22A of D1 illustrates a two-way data communication between computers in a LAN via power lines, it would not have required any inventive skill to apply the same to a LAN based on Ethernet technology.

4.4 In view of the above and the reasons as given in respect of claim 1 of the main request, the board concludes that the subject-matter of claim 1 of the third auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC).

5. Since none of the requests on file can be allowed, it has not proved necessary to consider any of the further objections as set out in the preliminary opinion given by the board in the communication accompanying the summons to oral proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano A. S. Clelland