DECLARATION UNDER 37 CFR 1.131(a)

Application Serial Number: 17/105,574

Patent Number: 11,381,285

Filing Date: 11/26/2020

Inventor: Steve Shattil

Attorney Docket Number:

I, Steve Shattil, declare as follows:

1. I am the inventor of Patent No. 11,381,285 ('285).

2. This Declaration establishes constructive reduction to practice (and thus, invention) of the subject matter of each rejected claim prior to the effective date (under 35 U.S.C. 102(e)) of references on which the rejection is based.

3. I completed my invention as described and claimed in the subject patent 11,381,285 ('285) as evidenced by the following:

4. The subject matter of each of the claims is disclosed in U.S. Patent Pub. no. **20030147655 ('655), Appl. No. 10/360,346, filed February 7, 2003**.

5. The features of claim 1 (with emphasis) and corresponding support in '655, by way of example, but without limitation, are shown as follows:

Claim 1. A method for communication by a user device in a wireless network, comprising:

6. Written support in '655 includes the following: (emphasis added)

Par. 0153:

"A **network** may be characterized by various types of communication architectures **having two or more users**, or nodes, including point-to-point, point-to-multipoint, broadcast, multipoint-to-multipoint, multipoint-to-point, hierarchical, ad-hoc, peer-to-peer, multi-hop, and **cellular**. The invention is independent of the type of network."

7. A person of ordinary skill in the art (POSITA) would recognize "network… having two or more users" as a wireless network that serves user devices.

encoding a set of data symbols with a set of complex-valued codes, to produce a set of subcarrier values;

8. Written support in '655 includes the following: (emphasis added)

Par. 0149:

"FIG. 9A illustrates a plurality of CI pulse waveforms **901** to **909** orthogonally positioned in time. A plurality N of equally spaced carriers $f_1, f_2, \ldots, f_N$ are combined to generate the pulses **901** to **909**. A set of carrier phases **911**, **912**, . . . , **919** corresponds to each of the pulses **901**, **902**, . . . , **909**, respectively. Each set of carrier phases **911**, **912**, . . . , **919** is an orthogonal **polyphase CI code** (or phase space) applied to the carriers to center a given pulse waveform at a corresponding instant in time."

Par. 0151:

"Complex **carrier weights** corresponding to each of the carriers $f_1, f_2, \ldots, f_N$, represent a sum of the phase spaces **911**, **912**, . . . , **919** multiplied by their corresponding data symbols. In particular, an nth (n=1,2, . . . ,N) carrier's complex weight equals the sum of each complex data symbol in the nth row of each phase space **911**, **912**, . . . , **919** multiplied by the data symbol value (not shown) associated with that phase space **911**, **912**, . . . , **919** (i.e., pulse position **901**, **902**, . . . , **909**)."

Par. 0159:

"Complex sub-carrier weights may be generated from a sum of products of each of a

plurality of phase-shift sets corresponding to a particular phase space with data symbols corresponding to that particular phase space."

9. The POSITA would recognize polyphase CI codes as complex-valued codes. The POSITA would understand that carrier weights are subcarrier values. The POSITA would understand that the sum of each complex data symbol in the nth row of each phase space multiplied by the data symbol value (not shown) associated with that phase space constitutes encoding the data symbols.

modulating the set of subcarrier values onto a set of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers assigned for use by the user device, to produce a plurality of modulated subcarriers; and

10. Written support in '655 includes the following: (emphasis added)

Par. 0143:

"A subcarrier processing module **816** may be adapted to provide phase offsets to the selected carriers, provide polyphase coding to the carriers, **modulate** data (or **coded data**) symbols **onto the carriers**."

Par. 0152:

"FIG. 9B represents a CI waveform of the present invention. A plurality N of subcarriers **921** to **929** (e.g., sinusoids, or tones) are characterized by at least one predetermined set of complex sub-carrier weights **910**. These weights **910** align the sinusoids **921** to **929** to produce a train or sequence of **information-modulated pulses 901** to **909** in the time domain. These pulses **901** to **909** may be generated by **applying the sub-carrier weights 910 to subcarriers** (such as subcarriers **921** to **929**) allocated to at least one user in a network."

Par. 0166:

"A subcarrier allocation source code segment **991** is adapted to generate a plurality of

subcarriers allocated to at least one user or **allocate a plurality of input subcarriers** (not shown) **to a particular user**."

11. The POSITA understands that modulating the (polyphase) coded data onto carriers, or applying sub-carrier weights to subcarriers constitutes modulating the claimed subcarrier values onto OFDM subcarriers. The POSITA understands that the subcarriers are allocated (assigned) to the user device.

producing a time-domain waveform that comprises a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device;

12. Written support in '655 includes the following: (emphasis added)

Par. 0087-0088:

"The real part of each user's OFDM transmission is expressed by

$$s(t) = \sum_{k=1}^{N} \sum_{i=1}^{N} a_k \cos\left(2\pi\left(f_c + if_s\right)t + mi2\pi / N\right)g(t)$$

where a_k is a kth data symbol (preferably a channel-coded data symbol) that is then spread over the N carriers allocated to the user."

Par. 0154:

"„,each pulse **901** to **909** is generated from a **superposition** of predetermined subcarriers **921** to **929**..."

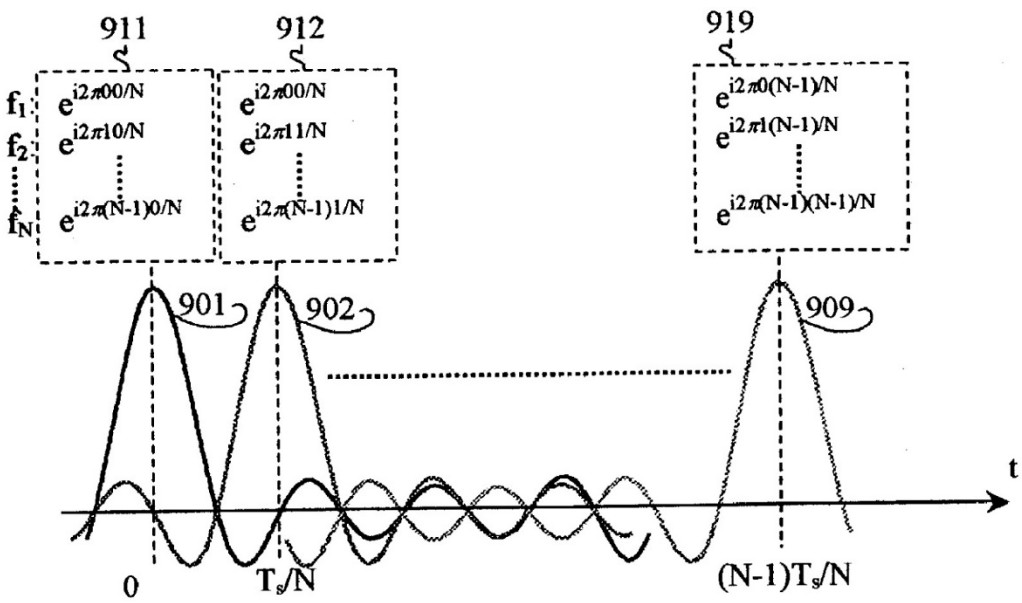


FIG. 9A

13. The POSITA is taught that the periodic time-domain pulses are produced from a superposition of the modulated subcarriers.

wherein the set of subcarrier values comprises a first polyphase code that encodes a first of the set of data symbols and at least a second polyphase code that encodes at least a second of the set of data symbols;

14. Written support in ’655 includes the following: (emphasis added)

Par. 0149:

> “Each set of carrier phases **911**, **912**, . . . , **919** is an orthogonal **polyphase CI code** (or phase space) applied to the carriers to center a given pulse waveform at a corresponding instant in time.”

Par. 0151:

> “Complex carrier weights corresponding to each of the carriers f_1, f_2, . . . , f_N, represent a sum of the phase spaces **911**, **912**, . . . , **919 multiplied by their corresponding data symbols**. In particular, an nth (n=1,2, . . . ,N) carrier's complex weight equals the sum of

each complex data symbol in the nth row of each phase space **911**, **912**, . . . , **919** multiplied by the data symbol value (not shown) associated with that phase space **911**, **912**, . . . , **919** (i.e., pulse position **901**, **902**, . . . , **909**).”

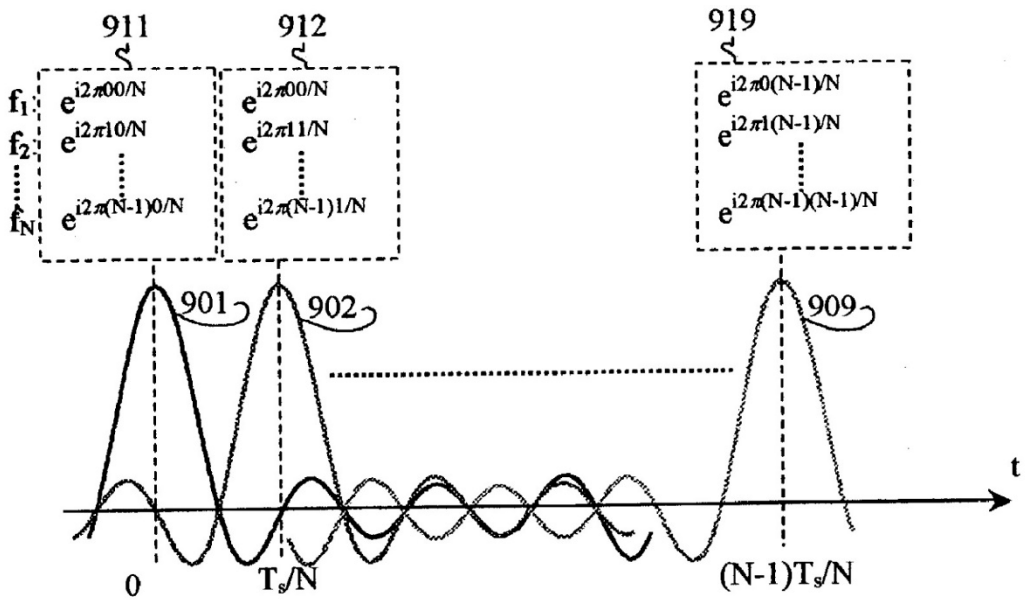


FIG. 9A

15. The POSITA finds explicit teaching of polyphase codes that each encodes (e.g., multiplies) its corresponding data symbol.

wherein the first polyphase code causes constructive and destructive interference between the plurality of modulated subcarriers to produce a first periodic pulse waveform having a peak value that is centered at a first time in an OFDM symbol interval, and the second polyphase code causes constructive and destructive interference between the plurality of modulated subcarriers to produce a second periodic pulse waveform having a peak value that is centered at a second time in the OFDM symbol interval, the second time different from the first time.

16. Written support in ’655 includes the following: (emphasis added)

Par. 0056-0057:

"The phase offsets Δφ typically correspond to any of N orthogonal time offsets corresponding to N orthogonal pulse positions. A kth bit or data symbol a_k in a user's transmission s(t) modulated onto a particular CI pulse, or phase space is expressed as:

$$s_k(t)=e(t-kT_b)$$

where T_b is a time offset corresponding to the particular CI pulse. **Orthogonal pulses are centered at intervals of $T_b=T_s/N$**.

Par. 0107:

"Each pulse's phase space is a set of carrier phases corresponding to the time instant at which the pulse is centered. Thus, **each set of phase offsets maps a data symbol to a pulse centered at a particular instant in time**."

Par. 0122:

"The orthogonality results from **constructive and destructive interference** between the CI carriers. Constructive interference causes narrow time-domain pulses with a repetition rate proportional to the inverse of the carrier-frequency spacing f_s."

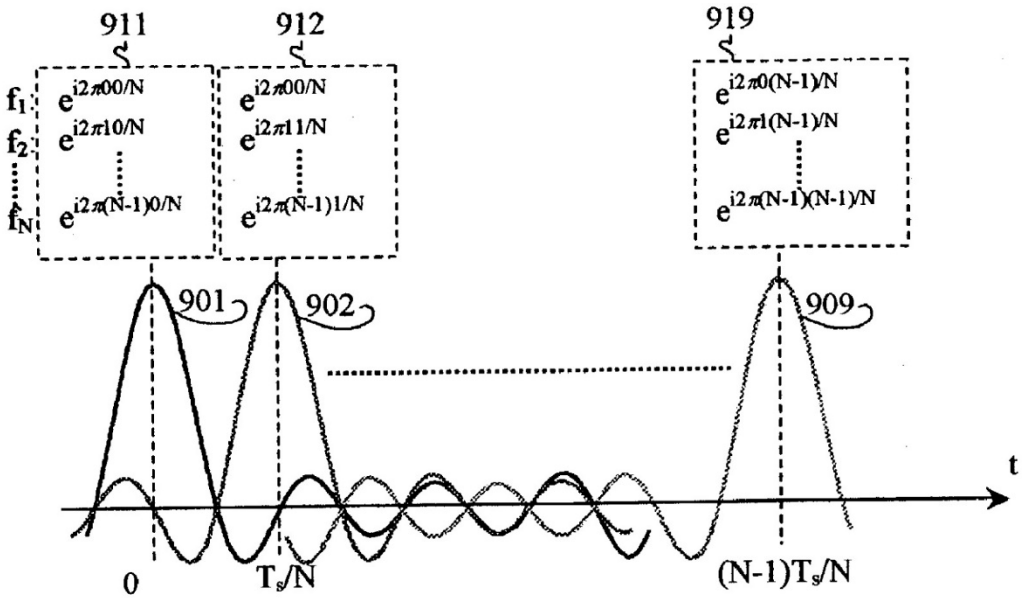


FIG. 9A

17. FIG. 9A depicts periodic pulse waveforms centered at different times. The POSITA finds

written description that teaches that each pulse waveform is a superposition of subcarriers, and the polyphase coding causes constructive and destructive interference of the subcarriers to shape and thus center the pulse waveforms at different times.

Claim 2 (and claims 12, 22). The method of claim 1, wherein an mth one of the plurality of polyphase codes comprises a set of N code chips, wherein each code chip is expressed by $e^{j2\pi nm/N}$, where i is the square root of −1, π is Pi, and n is an integer that varies to provide incremental phase offsets to the set of N code chips.

18. The phase spaces **911**, **912**, . . . , **919** shown in FIG. 9A, which are referred to as polyphase CI codes, are depicted in FIG. 9A:

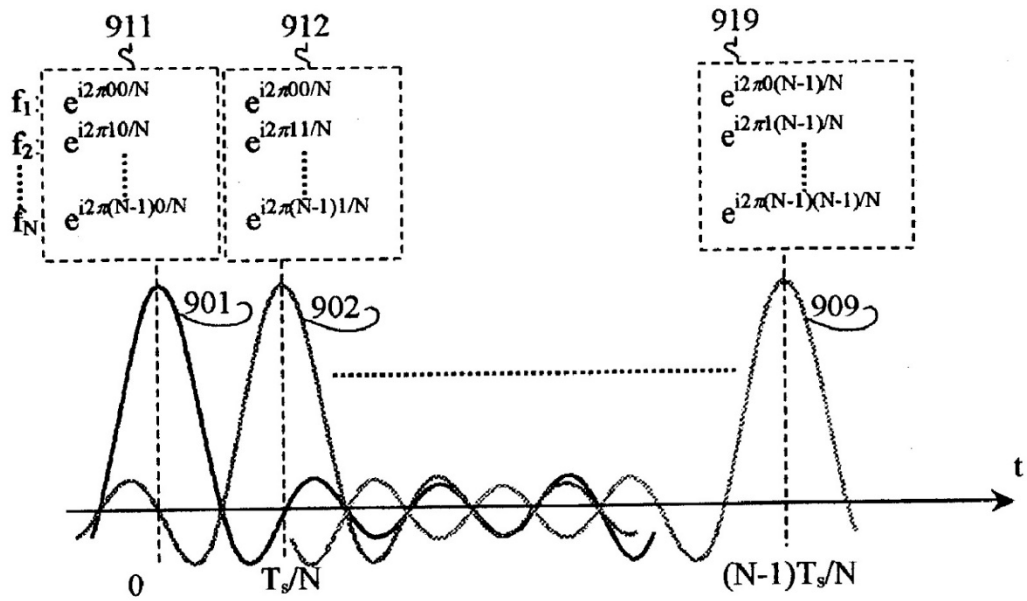


FIG. 9A

Par. 0149:

> "Each set of carrier phases **911**, **912**, . . . , **919** is an orthogonal **polyphase CI code** (or phase space) applied to the carriers to center a given pulse waveform at a corresponding instant in time."

19. The POSITA finds support in FIG. 9A and the written description for the above claim

features.

Claim 3 (and claims 13, 23). The method of claim 1, wherein the first time and the second time are separated by some integer multiple of T_s/N, where T_s is the OFDM symbol interval and N is the plurality of subcarrier frequencies.

20. Written support in '655 includes the following: (emphasis added)

Par. 0071:

> "The spacing of the pulse positions (i.e., time instants) corresponds to zeroes in the cross-correlation function. **The pulses are centered at equally spaced time instants** k/Nf_s, where $k=0,1, \ldots ,N-1$, N is the number of carriers, and $f_s=1/T_s$ is the frequency separation between the carriers. Thus, **the time instants are defined by 0, T_s/N, . . . , $T_s(N-1)/N$**."

21. The POSITA finds descriptive support for equally spacing N pulse positions in the OFDM symbol interval (i.e., period $T_s = 1/f_s$), which causes the pulse waveforms to be centered at equally spaced time instants that are integer multiples of T_s/N.

Claim 4 (and claims 14, 24). The method of claim 1, wherein the OFDM symbol interval $T_s=L/f_s$, where L is an integer that is greater than zero, and fs is subcarrier frequency spacing of the OFDM signal.

22. Written support in '655 includes the following: (emphasis added)

Par. 0075:

> "The carriers **601**, **602**, and **603** (which represent one set of non-adjacent carrier frequencies allocated to a particular user or data stream) are separated by an integer multiple L of the adjacent carrier frequency separations f_s. The frequency spacing of the set of non-adjacent carriers **601**, **602**, and **603** is $f_s'=Lf_s$. The effective symbol duration T_s' (i.e., effective pulse repetition period) of the non-adjacent carriers is a fraction 1/L of the

symbol period $T_s=1/f_s$. However, in order to provide orthogonality between adjacent carriers (such as illustrated by the overlapping carrier spectra shown in FIG. 6), which may be allocated to other users or data symbols, **the symbol duration is selected to be $T_s=LT_s'$**, which is an integer multiple L of the effective pulse repetition period T_s'."

23. The POSITA finds explicit mathematical and descriptive support for the above-recites OFDM symbol interval.

Claim 5 (and claims 15, 25). The method of claim 1, wherein the periodic pulse waveform shape comprises an in-phase component and a quadrature-phase component.

24. Written support in '655 includes the following: (emphasis added)

Par. 0053:

"A composite signal 130 results from a superposition (i.e., summation) of the carriers 105. The composite signal 130 shows a pulse envelope centered at a predetermined time instant t_1. In the case where there is no amplitude tapering (i.e., a rectangular window) and a plurality N of carriers have a uniform frequency separation f_s, a composite CI signal is:

$$e(t)=\sum_{n=1}^{N} e^{i[(\omega_c+n\omega_s)t+n\Delta\phi]}\text{,,}$$

Par. 0062:

"The function e(t) is also characterized by an **in-phase carrier component $\cos(\omega_c t)$ and a quadrature-phase, component $\sin(\omega_c t)$**."

Par. 0150:

"A complex-valued data symbol (not shown) impressed onto a pulse (such as pulse **901**) may be characterized by an **in-phase** (e.g., real) part modulated onto pulse **901** and a **quadrature-phase** (e.g., imaginary) part modulated onto a pulse waveform (not shown) centered equidistantly between pulses **901** and **902**. Similarly, a first set of N real data symbols may be impressed onto a first set of N orthogonal pulses (such as the pulses **901**

to **909**). A second set of real data symbols may be impressed onto a quadrature-phase set of orthogonal pulses (not shown) centered equidistantly between adjacent pairs of the pulses **901** to **909**."

25. The POSITA finds descriptive support for the recited in-phase and quadrature-phase parts.

Claim 6 (and claims 16, 26). The method of claim 1, wherein the set of subcarrier values comprise a product of a matrix with a vector, wherein the matrix comprises the first polyphase code and the at least second polyphase code and the vector comprises the set of data symbols.

26. Written support in '655 includes the following: (emphasis added)

Par. 0159:

"Complex sub-carrier weights may be generated from a **product of a vector or matrix of data symbols with a vector or matrix of phase space (i.e., CI code) values**."

27. The POSITA finds explicit instructions to make the above claim features.

Claim 7 (and claims 17, 27). The method of claim 1, further comprising adding a cyclic prefix to the time-domain waveform.

28. Written support in '655 includes the following: (emphasis added)

Par. 0147:

"A cyclic redundancy may be added to the end of a symbol block. A cyclic redundancy may be split between a **cyclic prefix** and a cyclic postfix. Zero values may be provided to the guard intervals."

29. The POSITA finds instructions to add a cyclic prefix.

Claim 8 (and claims 18, 28). The method of claim 1, wherein modulating and producing is performed with an inverse discrete Fourier transform (IDFT), and wherein modulating comprises providing a set of zero and non-zero values to input frequency bins of the IDFT according to OFDM tones assigned for use by the user device.

30. Written support in ’655 includes the following: (emphasis added)

Par. 0102:

> “For example, an IFFT or **IDFT** may be employed with one or more weight vectors applied to the frequency bins of the transform.”

Par. 0132:

> “Each user may be allocated a unique set of carriers, thus providing for **orthogonal frequency division multiple access**.”

Par. 0168:

> “Subcarrier allocation may include generating subcarriers, providing for receiving input subcarriers, retrieving subcarriers or superposition waveforms from memory (e.g., a look-up table), or selecting **non-zero** (or equivalently, **zero**) valued **input bin weights of an invertible transform**, such as a DFT.”

31. The POSITA understands that an IDFT is an invertible transform having input frequency bins, and an IDFT is commonly used for multicarrier modulation. The POSITA understands that when each user is allocated a unique set of carriers for orthogonal frequency division multiple access, it necessitates a combination of zero and non-zero input bin weights of an inverse DFT.

Claim 9 (and claims 19, 29). The method of claim 1, wherein modulating comprises selecting one of a set of subcarrier frequency spacings.

32. Written support in ’655 includes the following: (emphasis added)

Par. 0168:

> "In some applications, subcarrier allocation can include pulse shaping, controlling symbol durations, and/or **selecting subcarrier frequency spacing**. Some frequencies may be selected or avoided relative to channel conditions, bandwidth requirements, and/or interference."

33. The POSITA finds explicit instruction to select subcarrier frequency spacing.

Claim 10 (and claims 20, 30). The method of claim 1, wherein modulating is configured to provide for orthogonal frequency division multiple access.

34. Written support in '655 includes the following: (emphasis added)

Par. 0087:

> "In the **OFDM** implementation of the invention, each user is provided with a unique set of carrier frequencies to eliminate multiple access interference (MAI)."

Par. 0132:

> "Each user may be allocated a unique set of carriers, thus providing for **orthogonal frequency division multiple access**."

35. The POSITA find explicit instruction to use orthogonal frequency division multiple access in which each user is provided with a unique set of carriers.

Claim 11. An apparatus for communication in a wireless communication network, the apparatus comprising:

at least one processor; and

a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for:

36. Written support in ’655 includes the following: (emphasis added)

Par. 0221:

> “It should be appreciated by those skilled in the art that the block diagrams herein represent conceptual views of illustrative circuitry embodying the principles of the invention. Similarly, it should be appreciated that any flow charts, flow diagrams, signal diagrams, system diagrams, codes, and the like represent various processes which may be substantially represented in computer-readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.”

37. The POSITA understands that a signal processor or circuitry can include at least one processor, and can include at least one non-transitory computer-readable memory.

Claim 21. A computer program product for communication in a wireless communication network, the computer program product comprising a non-transitory computer readable storage device having computer readable program code stored therein, said program code containing instructions executable by one or more processors of a computer system for

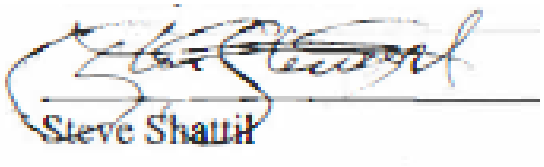
38. Written support in ’655 includes the following: (emphasis added)

Par. 0221:

> “It should be appreciated by those skilled in the art that the block diagrams herein represent conceptual views of illustrative circuitry embodying the principles of the invention. Similarly, it should be appreciated that any flow charts, flow diagrams, signal diagrams, system diagrams, codes, and the like represent various processes which may be substantially represented in computer-readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.”

39. The POSITA understands that a storage medium can include computer-readable memory.

DECLARATION

The declarant acknowledges that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon. The declarant attests that all statements made of the declarant's own knowledge are true and that all statements made on information and belief are believed to be true.

Date: May 9, 2025