UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING LLC,

Petitioners

v.

ALIGN TECHNOLOGY INC.,
Patent Owner.

IPR2025-00814
U.S. Patent No. 10,456,217

Declaration of Dr. Paul C. Clark
in Support of Petition for *Inter Partes* Review of U.S. Patent No. 10,456,217

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I. Introduction

1. I, Paul C. Clark, submit this declaration to state my opinions on the matters described below.

2. I have been retained on behalf of Petitioner ClearCorrect Operating LLC as an independent expert for *inter partes* review proceedings involving U.S. Patent Nos. 10,456,217 ("'217 patent"), 10,524,879 ("'879 patent"), and 11,369,456 ("'456 patent") (collectively, "the Align Patents"). Although I am being compensated for my time in connection with these IPRs at my standard hourly consulting rate of $590 per hour, and reimbursed for reasonable out-of-pocket expenses, no part of my compensation depends on the outcome of this proceeding, and I have no other interest in this proceeding.

3. I have been asked to provide my technical review, analysis, insights, and opinions regarding issues related to the patents at issue and certain prior art references.

II. Qualifications

4. In forming my opinions, I have relied on my education and experience as described below and in my curriculum vitae. Ex-1030.

5. In 1986, I received a Bachelor of Science degree in Mathematics from the University of California, Irvine. In 1988, I received a Master of Science degree in Electrical Engineering and Computer Science from the University of Southern

California. In 1994, I received a Doctor of Science degree in Computer Science from George Washington University specializing in computer security, graphics, and intellectual property law.

6. From 1985 to 1989, I worked as a Systems Engineer at Ultrasystems Defense and Space. As more fully set forth in my curriculum vitae, at Ultrasystems, I designed and implemented large-scale simulation and network-based systems for the United States Department of Defense (DOD). A high-speed database server I designed and implemented was used for real-time intelligence collection by the National Security Agency (NSA).

7. From 1989 to September 1990, as more fully set forth in my curriculum vitae, I worked as a Technical Lead at GTE Government Systems. While at GTE, I designed and implemented network and load generators for OS/2 LAN Manager to measure network performance load metrics for the Central Intelligence Agency (CIA). I also developed X Windows interfaces for a large-scale event-driven network system for the NSA.

8. From 1990 to 1995, as more fully set forth in my curriculum vitae, I worked as a Senior Security Engineer at Trusted Information Systems. While at Trusted Information Systems, I designed and implemented high-assurance security systems, including cryptographic systems and applications for the NSA and the Defense Advanced Research Projects Agency (DARPA). My work at Trusted

Information Systems involved cryptography, operating systems, smartcards, and other security technology developments and high-speed scalable implementations.

9. From 1995 to 1999, as more fully set forth in my curriculum vitae, I worked as Chief Scientist at DynCorp Network Solutions, where I served as senior internal security consultant for a variety of projects. For example, I was architect and Technical Director of the IRS Secure Submission and Retrieval System that allowed the digitally signed and encrypted submission of tax data over the Internet. The successful deployment of this system resulted in three Al Gore Hammer Awards, an award presented to federal employees who made significant improvements to government operation. I also created a suite of security products for providing secure wide-area user access to clustered servers and high-availability computing that was marketed and sold to the DOD and other parts of the federal government.

10. From 1999 to the present, I have served as President and Chief Technology Officer of SecureMethods, Inc. and Paul C. Clark LLC. SecureMethods specializes in the design, implementation, and deployment of advanced secure network applications for commercial and government clients, including the DOD. SecureMethods provides a comprehensive scalable, Commercial-Off-The-Shelf (COTS) secure architecture, implemented through the use of the SM Gateway. The SM Gateway is a next-generation high-availability security appliance developed by SecureMethods that is available on UNIX-based platforms using commercial,

government, and Type I cryptography, implemented in both hardware and software. In my capacity as President and Chief Technology Officer of SecureMethods, I have technical and operational oversight of all projects and corporate technical operations. I provide guidance to senior technical personnel for design, implementation, and troubleshooting for a wide range of systems both internal and external. My work includes network systems and security, cryptographic applications, certification, key management, authentication, and integrity strategies for network applications. I also provide a wide range of high-end technical and legal consulting services. My firm specializes in development and deployment of complex software and hardware systems for commercial and DOD clients.

11. I was also a member of the Federal Advisory Committee for Key Management Infrastructure (KMI), serving as Chairman of the Interoperability Working Group for Cryptographic Key Recovery. I have also served as an adjunct professor in the Computer Science Department at The George Washington University, where I have taught doctoral-level cryptography, network, and computer security courses. I also appeared before a congressional committee to provide testimony on "Advanced Technology for Border Control."

12. Since 2016, I have also served as the CEO of Clear Guide Medical Inc. (CGM). CGM specializes in AI-assisted medical procedures utilizing image processing. As CGM's chief executive, I am responsible for defining technical and

corporate strategy, intellectual property protection, and employee policy. I also serve as the corporate representative to investors and the board of directors.

13. I have co-authored a number of publications in the computer and security areas. Representative publications are identified in my curriculum vitae. Ex-1030. I am also a named inventor on five United States patents: 5,448,045; 5,892,902; 8,695,066; 9,391,957; and 10,129,214.

III. Materials Considered

14. In forming my opinions, I have reviewed the following documents and any other documents cited in this declaration:

Exhibit No.	Description
	U.S. Patent No. 10,456,217 to Kitching et al. ("'217 patent")
	U.S. Patent No. 10,524,879 to Kitching et al. ("'879 patent")
	U.S. Patent No. 11,369,456 to Kitching et al. ("'456 patent")
	Prosecution History of U.S. Patent No. 10,456,217
	Prosecution History of U.S. Patent No. 10,524,879
	Prosecution History of U.S. Patent No. 11,369,456
Ex-1004	U.S. Patent No. 6,471,511 to Chishti et al. ("Chishti-511")
Ex-1005	U.S. Patent No. 6,729,876 to Chishti et al. ("Chishti-876")
Ex-1006	Adrian Becker, *The Orthodontic Treatment of Impacted Teeth* (Martin Dunitz Ltd. 1998) ("Becker")
Ex-1007	U.S. Patent No. 6,250,918 to Sachdeva et al. ("Sachdeva")

Exhibit No.	**Description**
Ex-1008	*ClearCorrect Operating LLC v. Align, Inc.*, IPR2017-01829, Institution Decision, Paper 10 (PTAB Feb. 5, 2018)
Ex-1009	Speaker Profile of Rohit Sachdeva, retrieved from: https://www.emedevents.com/speaker-profile/rohit-sachdeva
Ex-1010	LinkedIn Profile of Rudger Rubbert, retrieved from: https://www.linkedin.com/in/ruedger-rubbert-6136b119
Ex-1011	LinkedIn Profile of Ian Kitching, retrieved from: https://www.linkedin.com/in/ian-kitching-3961333/
Ex-1012	LinkedIn Profile of Alexander Dmitriev, retrieved from: https://www.linkedin.com/in/alexander-dmitriev-5145991/
Ex-1013	*Align Technology, Inc. v. ClearCorrect Operating, LLC, et al.*, Case No. 6:24-cv-00187-ADA-DTG, Dkt. 142, Joint Claim Construction Statement (W.D. Tex. Jan. 3, 2025)

IV. Relevant Legal Standards

15. In preparing this declaration and forming my opinions, I am relying on certain legal principles that counsel explained to me. My understanding of these concepts is summarized below.

16. I have been advised and understand that prior art includes all analogous art, and that two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed; and (2) if the reference is not within the field of the inventor's endeavor, whether the

reference still is reasonably pertinent to the particular problem with which the inventor is involved.

17. I have been advised and understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can "anticipate" the claim. Second, the prior art can make the claim "obvious" to a person of ordinary skill in the art. I understand that for an invention claimed in a patent to be patentable, it must not be anticipated and must not be obvious based on what was known before the invention was made.

18. I have been advised and understand that a patent claim is unpatentable as anticipated under 35 U.S.C. § 102 if each element of that claim is present either explicitly or inherently in a single prior art reference. I have also been advised and understand that, to be an inherent disclosure, the prior art reference must necessarily disclose the limitation. The fact that the reference might practice or contain a claimed limitation is insufficient to establish that the reference inherently teaches the limitation.

19. I have been advised and understand that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been advised and understand that

the obviousness analysis takes into account factual inquiries, including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

20. I have further been advised and understand that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

21. I have been advised and understand that considerations in this analysis are (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; (3) the level of ordinary skill in the art; and (4) evidence of secondary indicia of nonobviousness. I have been informed that secondary indicia

of nonobviousness include (i) “long-felt need” for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) “copying” of the claimed invention by others.

22. I have further been advised and understand that in connection with identifying a reason or motivation that would have led a person of ordinary skill in the art (POSITA) to combine or modify the relevant teachings in the prior art to obtain the claimed invention, a POSITA must have had a reasonable expectation of success in doing so. The reason to select and combine features, the predictability of the results of doing so, and a reasonable expectation of success may be found in the teachings of the prior art references themselves, in the nature of any need or problem in the field that was addressed by the patent, in the knowledge of a POSITA at the time, as well as in common sense or the level of creativity exhibited by a POSITA.

V. Level of Skill in the Art

23. In rendering the opinions set forth in this declaration, I have been asked to consider the Align Patents and the prior art through the eyes of a person of ordinary skill in the art. I understand that a person of ordinary skill in the art is determined by considering (1) the type of problems encountered in the art, (2) prior art solutions to those problems, (3) the rapidity with which innovations are made, (4) the sophistication of the technology, and (5) the educational level and years of experience level of those working in the pertinent field.

24. I understand that I must evaluate the Align Patents from the perspective of a person of ordinary skill in the art. I further understand that the Align Patents must be evaluated through the eyes of a person of ordinary skill in the art at the time of the alleged invention of this patent as of its earliest priority date—August 30, 2006. In my opinion such a person of ordinary skill in the art as related to the Align Patents would have been part of an interdisciplinary team. In my opinion, the team would have included one or more members with a degree in a technical area related to software, graphics, computers, or a related discipline, as the patents discuss software related to a system for modeling the movement of digital representations of teeth. In my opinion, this interdisciplinary team likely would have also included someone experience in the dental field, since the patents describe certain orthodontic techniques and terms. In my opinion, the team member with a software or computer-related technical degree would have had 1-3 years of software development experience, although more education could substitute for work experience and vice versa.

25. Based on my educational background and experience, I am qualified as at least a person of ordinary skill in the art with respect to the Align Patents. In particular, by August 30, 2006, I had a B.S. in Mathematics, an M.S. in Electrical Engineering and Computer Science, and a Dsc. in Computer Science. By that time, I also had 20 years of experience working as a software engineer. I am also familiar

with working as part of an interdisciplinary team. For example, in my work at CGM, I often work as part of an interdisciplinary team. In that role, I frequently work closely with those in medical fields, including collaborating on product features based on their medical expertise and translating those features into software based on my technical expertise.

26. I have been informed that ClearCorrect previously filed a petition for *inter partes* review against U.S. Patent No. 8,038,444, which is related to the Align Patents. I am aware that ClearCorrect proposed that a person having a doctorate in dental science and three to five years of training and practical experience in orthodontics would qualify as a person having ordinary skill in the art. As I discussed above, I agree that the interdisciplinary team would include a member in the dental field. I also believe that it would likely involve a team member with software development experience.

27. This appears to be confirmed by the prior art. For example, the Sachdeva prior art reference includes two inventors: Rohit Sachdeva and Rudger Rubbert. Ex-1007. The inventors of the Sachdeva prior art reference illustrate the interdisciplinary team I discussed. Rohit Sachdeva appears to be an orthodontist (*see* Ex-1009), and Rudger Rubbert is an engineer with a background in mechanical engineering, with specialties in “3D imaging software” (*see* Ex-1010, 1, 5). Similarly, two inventors of the ’217 patent, Ian Kitching and Alexander Dmitriev,

appear to have backgrounds in computer science or software development. *See* Ex-1011; Ex-1012. This is consistent with my expectation that the team would include a member with a technical area related to software, graphics, computers, or a related discipline.

VI. Claim Construction

28. I have been informed that in an *inter partes* review proceeding, claim terms should be construed under the same standard applied in federal district court cases. Under this standard, I have been informed that claim terms are generally given their ordinary and customary meaning as understood by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent. I understand, however, that claim terms are generally not limited by the embodiments described in the specification.

29. I understand that in addition to the claims, specification, and prosecution history, other evidence may be considered to ascertain the meaning of claim terms, including textbooks, encyclopedias, articles, and dictionaries. I understand that the specification is highly relevant to the claim construction analysis and can be the single best guide to the meaning of a disputed term. I have been informed that the specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication. I have been informed that

this additional evidence is often less significant and less reliable than the claims, specification, and prosecution history.

30. I have been informed that claims should only be construed to the extent necessary to resolve any controversy. For all claim terms, I have considered and applied their plain and ordinary meaning as they would have been understood by one skilled in the art at the time of the alleged invention and consistent with the specification.

31. I have also been informed that in the parallel district court proceeding, the parties agreed to the meanings below for the following terms:

Claim Term	Construction
round[-]tripping / round-trip ’217 patent, cls. 1, 6, 7, 11, 16, 17 ’879 patent, cls. 1, 6, 7, 9, 20	[moving / move] a first tooth out of the path of a second tooth, and once the second tooth has moved sufficiently, [moving / move] the first tooth back to its previous position before proceeding to a desired final position of that first tooth
slowing / slow ’217 patent, cls. 5, 10, 15, 20 ’456 patent, cls. 9, 11	[having / have] one or more teeth scheduled to move at a rate less than the rate of other teeth, or even [stopping / stop] using interim key frames, so that collisions and/or obstructions do not occur
“all-equal pattern” ’456 patent, cl. 3	A pattern where all of a patient’s teeth move in parallel with one another (i.e., all of the patient’s

	teeth that need to move begin moving at the same stage, and finish moving at the same stage)

Ex-1013, 8.

In the related district court litigation, Petitioner also proposed the following constructions for the following claim terms of the ’456 patent. Patent Owner contends that no construction is necessary.

Term	**Proposed Construction**
“V-shaped pattern” ’456 patent, cl. 3	“A pattern where teeth having the same and/or similar positions on the arch will be moved beginning at the same stage, and will move continuously until they reach their final position, and where the most posterior positioned teeth move first (e.g., the molars, or teeth in position 7 and/or 8) then the next anterior-positioned teeth move sequentially until all of the teeth reach their final position, with the next anterior-positioned tooth not scheduled to begin moving until at least approximately the half-way stage of its respective posterior-positioned tooth”
“A-shaped pattern” ’456 patent, cl. 3	“A pattern where teeth having the same and/or similar positions on the arch will be moved beginning at the same stage, and will move continuously until they reach their final position, with the most anterior-positioned teeth (e.g., the incisors, or teeth in positions 1 and/or 2) moving first and then the next posterior-positioned teeth sequentially moving until all of the teeth reach their final position”

"M-shaped pattern" '456 patent, cl. 3	"A pattern where teeth having the same and/or similar positions on the arch will be moved beginning at the same stage, and will move continuously until they reach their final position, with teeth between the anterior teeth and the posterior teeth (e.g., the bicuspids, or teeth in positions 4 and/or 5) and both the adjacent anterior and/or adjacent posterior teeth then sequentially moving until all of the teeth reach their final position"
"mid-line shift pattern" '456 patent, cl. 3	"A pattern where tooth movement begins on one side of the patient's arch to center the teeth with respective to the mid-line of the patient's mouth, with the next tooth/teeth to move not scheduled to begin moving until at least approximately the half way stage of its respective previously scheduled tooth/teeth"

Ex-1013, 2-3.

VII. Overview of the Align Patents

32. The Align Patents describe a system for automating the "staging of teeth, from an initial position to a final, corrected position." '217 patent, 2:10-12.[1] Initially, the system receives an "electronic representation of the patient's teeth in an initial position" as taken by an intra-oral scanner. *Id.*, 5:25-32. The software then generates an electronic representation of a "desired final position" for each of the teeth and "automatically create[s] a route for each tooth to move from its initial

[1] Cites to the '217 patent are used here, but the Align Patents share the same specification.

position to its final position." *Id.*, 5:30-36. A set of aligners are then manufactured for moving the teeth along the route in various stages. *Id.*, 5:36-37.

33. The Align Patents explain that the user can select from a number of patterns that will be used as an input for how the patient's teeth are moved to their final positions. *Id.*, 5:42-53, 6:15-18. The software can then analyze whether "the pattern should be modified to accommodate the teeth movement of the current patient to avoid collision." *Id.*, 6:41-45. The Align Patents also discuss certain types of techniques for avoiding collisions, such as staggering, round-tripping, and slowing. *Id.*, 6:53-57; *see also id.*, 12:63-13:21. This process is generally shown in Figure 2B, reproduced below.

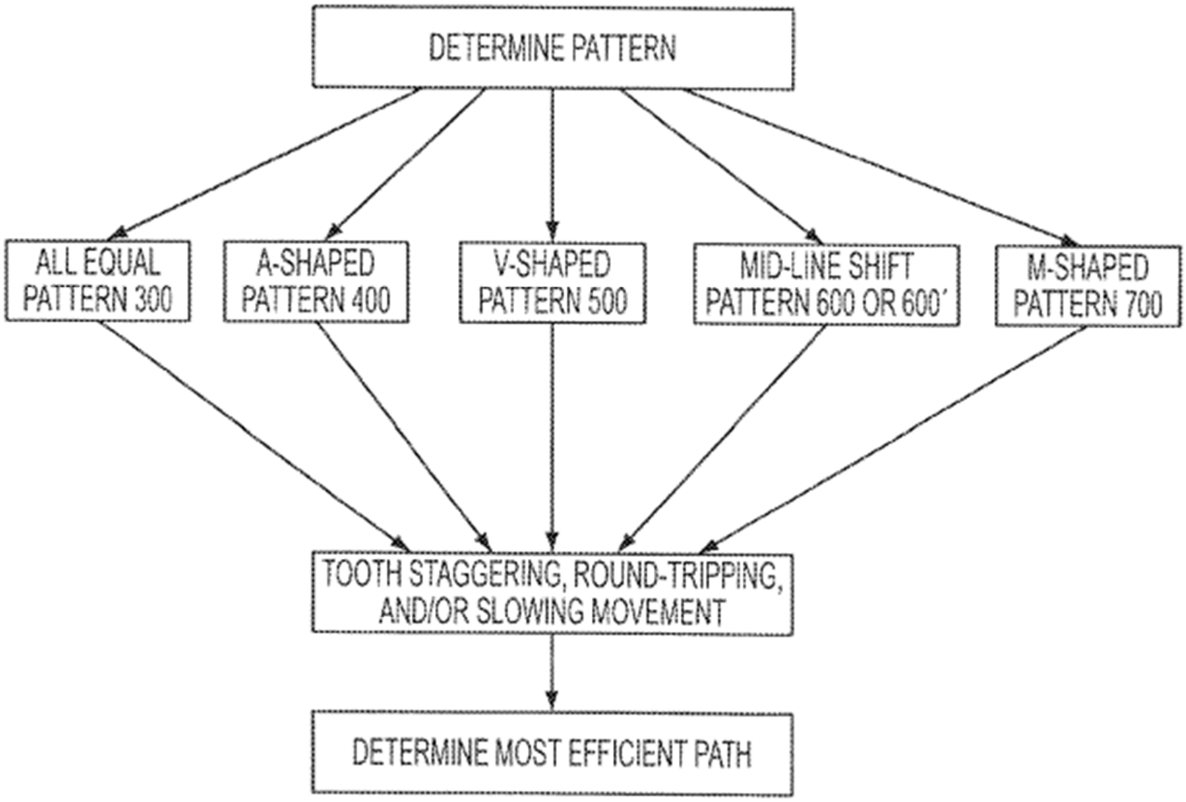


FIG. 2B

Id., Fig. 2B.

34. The Align Patents also illustrate that the electronic representations of the patient's teeth can be represented in software as they move from stage to stage from their initial to their final positions. An example of this is shown in Figure 4, below, which shows the patient's teeth moving in an "A-shaped" pattern that shows that "the patient requires 18 stages of treatment before the patient's teeth reach their final position in stage 19." *Id.*, 8:44-53.

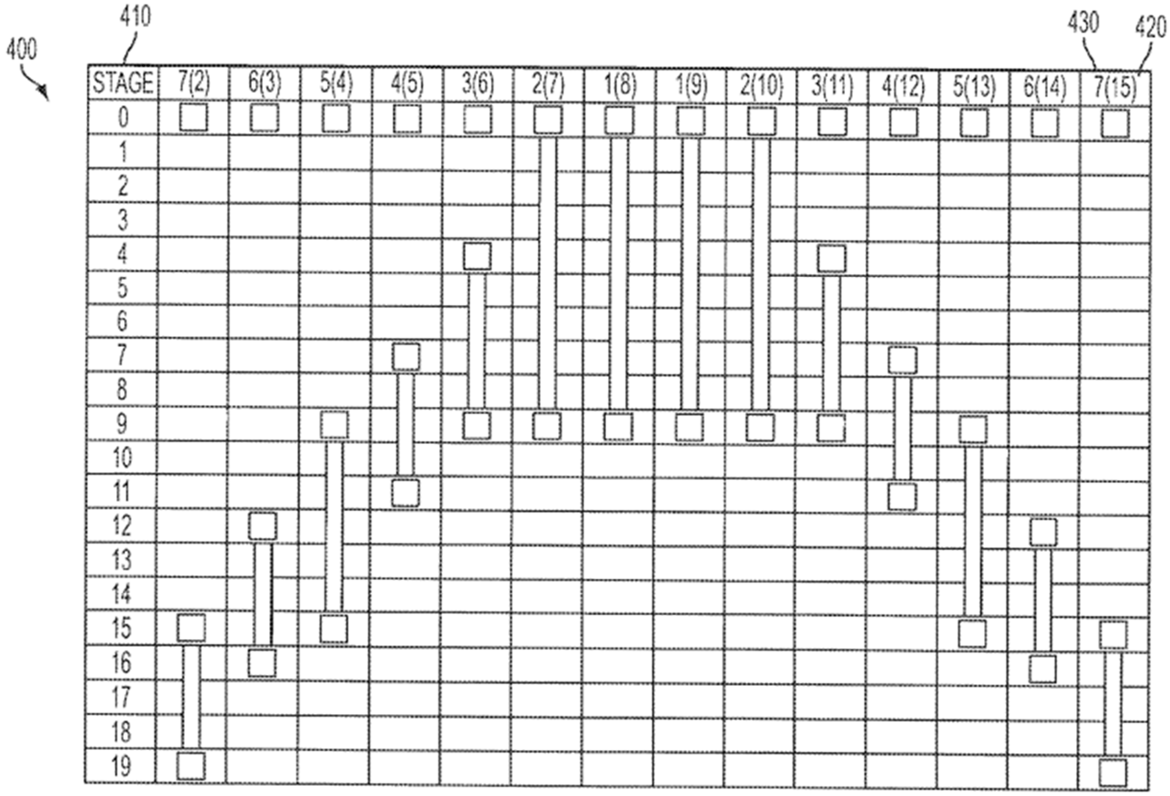


FIG. 4

Id., Fig. 4.

VIII. Overview of the Prior Art

A. Chishti-511 (Ex-1004)

35. Chishti-511 is entitled "Defining Tooth-Moving Appliances Computationally" and discloses a software system for repositioning the teeth of a patient. Ex-1004, Title, Abstract. Chishti-511 discloses that its system acquires "a scan of [a] patient's teeth," and using that data, "a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and

other tissues." *Id.*, 3:40-50. Chishti-511 further explains that "data structures that digitally represent individual tooth crowns are produced" as well as "digital models of entire teeth." *Id.*, 3:51-58. The "desired final position of the teeth" is then "received from a clinician" or calculated. *Id.*, 3:59-64.

36. Chishti-511 further teaches that "[h]aving both a beginning position and a final position for each tooth, the process next defines a tooth path for the motion of each tooth," and that "tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping to bring the teeth from their initial positions to their desired final positions." *Id.*, 4:7-12. The "tooth paths are segmented" where "the aggregate of [the] segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth." *Id.*, 4:15-22. Moreover, that "segments are calculated so that each tooth's motion within a segment stays within threshold limits of linear and rotational translation." Ex-1004, 4:15-18. A "general flow" of this process is shown below:

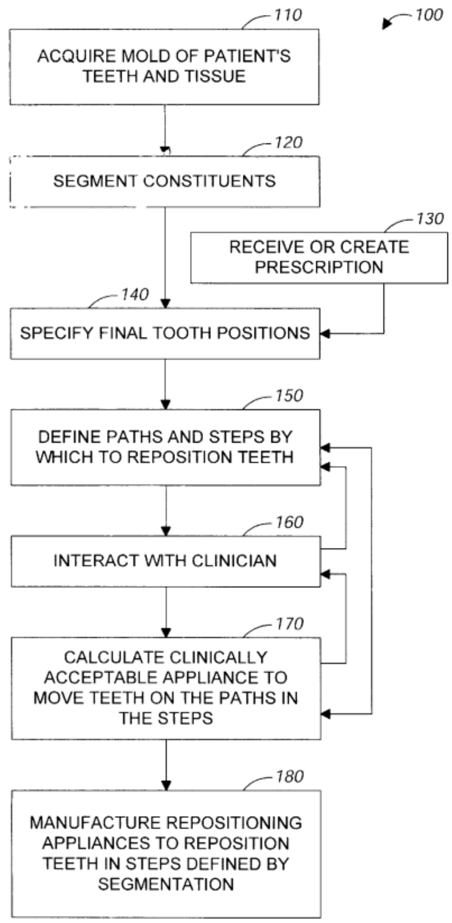


FIG. 1

Id., 3:32-34, Fig. 1. In step 170, the system looks to "calculate clinically acceptable appliance[s] to move teeth on the paths in the steps." *Id.*, Fig. 1. Chishti-511 further explains that the limit values used "can also be updated based on the result of an appliance-calculation (step 170, described later)" and that using "this information, the subprocess defining segmented paths (step 150) can recalculate the paths or the affected subpaths." Ex-1004, 4: 27-35.

37. A more detailed flow of step 170 (Figure 1) is also shown below:

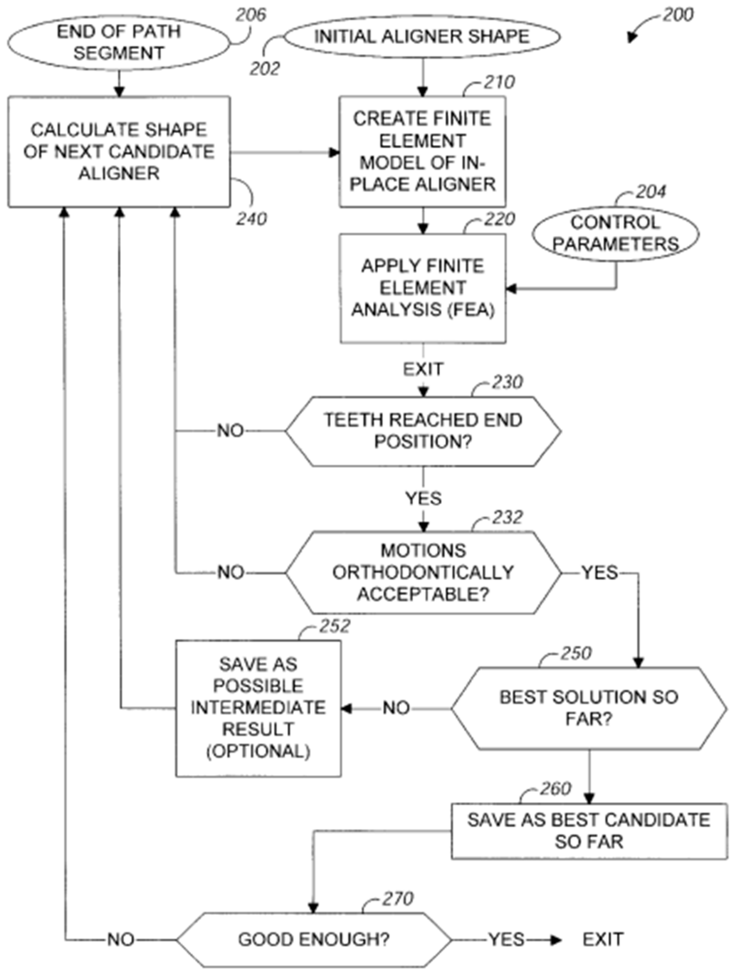


FIG. 2

Id., 5:7-43, Fig. 2. As shown above, Chishti-511 relies on an iterative process for creating acceptable aligners. Indeed, Chishti-511 explains that the "analysis runs until an exit condition is reached, at which time the process evaluates whether the teeth have reached the desired end position for the current path segment, or a position sufficiently close to the desired end position (step 230)." *Id.*, 5:21-25.

38. Chishti-511 further teaches that "[i]f an acceptable end position is not reached by the teeth, the process calculates a new candidate aligner shape

(step 240)." Ex-1004, 5:21-27. Moreover, even where "an acceptable end position is reached, the motions of the teeth calculated by the finite elements analysis are evaluated to determine whether they are orthodontically acceptable (step 232). If they are not, the process also proceeds to calculate a new candidate aligner shape (step 240)." Ex-1004, 5:27-32.

39. Additionally, Chishti-511 explains that "[a]ligners may be unacceptable for a variety of reasons." Ex-1004, 8:42-43. In such situations, Chishti-511 teaches that the process can "transfer[] control to a path definition process (such as step 150, FIG. 1) to redefine those parts of the treatment path having unacceptable aligners (step 630)." Ex-1004, 8:54-58. Chishti-511 further discloses that "[t]his step can include both changing the increments of tooth motion, i.e., changing the segmentation, on the treatment path, changing the path followed by one or more teeth in the treatment path, or both." Ex-1004, 8:58-61. This portion of the process is shown in Figure 6, below.

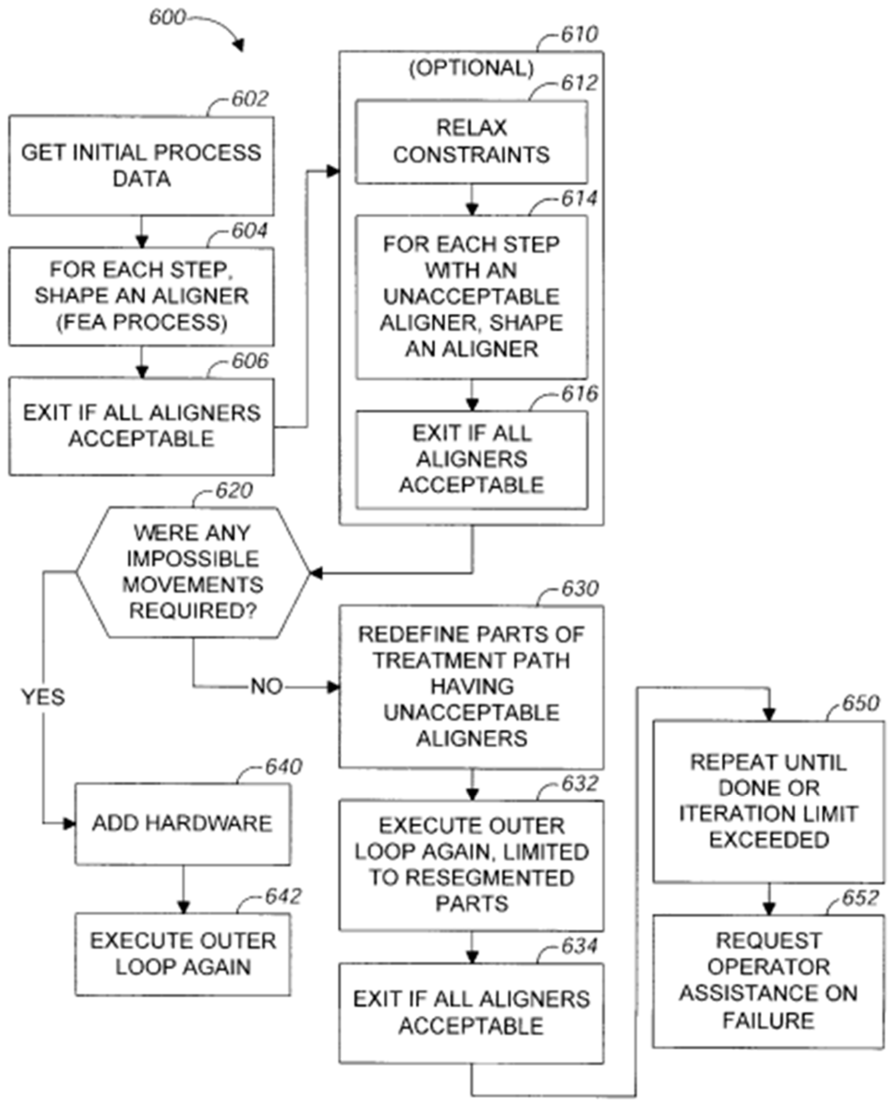


FIG. 6

Id., Fig. 6. Finally, Chishti-511 explains that its steps may be carried out in software executed on a processor. Ex-1004, 2:34-39, 3:31-39, 10:19-51.

B. Chishti-876 (Ex-1005)

40. Chishti-876 is entitled "Tooth Path Treatment Plan" and discloses a system for "selecting a tooth treatment pattern from a library of predetermined tooth treatment patterns" and "generating the malocclusion treatment plan implementing the selected tooth treatment pattern." Ex-1005, Title, Abstract.

41. Chishti-876 discloses that its path scheduling algorithm is able to "schedule[] treatment paths by drawing upon a database of preferred treatments for exemplary tooth arrangements," and that "[t]his database can be constructed over time by observing various courses of treatment and identifying the treatment plans that prove most successful with each general class of initial tooth arrangements." *Id.*, 14:63-15:1. This allows the system to "create several alternative paths and present each path graphically to the user." *Id.*, 15:1-3; *see also id.*, 17:65-67 (noting that the movement pattern is "specified by the user").

42. Chishti-876 discloses that the treatment plan is broken into stages, where "[e]ach stage represents a single aligner." *Id.*, 11:34-37. It further explains that "a two-dimensional array is used to track specific movements for each tooth at a specific period of time. One dimension of this array relates to teeth identification, while the second dimension relates to the time periods or stages." *Id.*, 11:38-43.

43. Chishti-876 further describes a process that is used to create new treatment paths if collisions between teeth are detected. It explains that if a collision

is detected, "the program alters the path of at least one tooth in each colliding pair by selecting a new position for one of the intermediate steps." *Id.*, 13:38-42. It further explains that, after "no collisions are detected," the "routine then stores the paths, e.g., by saving the coordinates of each point in the tooth at each position on the path in an electronic storage device, such as a hard disk." *Id.*, 13:42-48.

44. Chishti-876 also provides exemplary representations of its treatment plans using certain movement patterns. Below is a diagram of an A-type movement pattern.

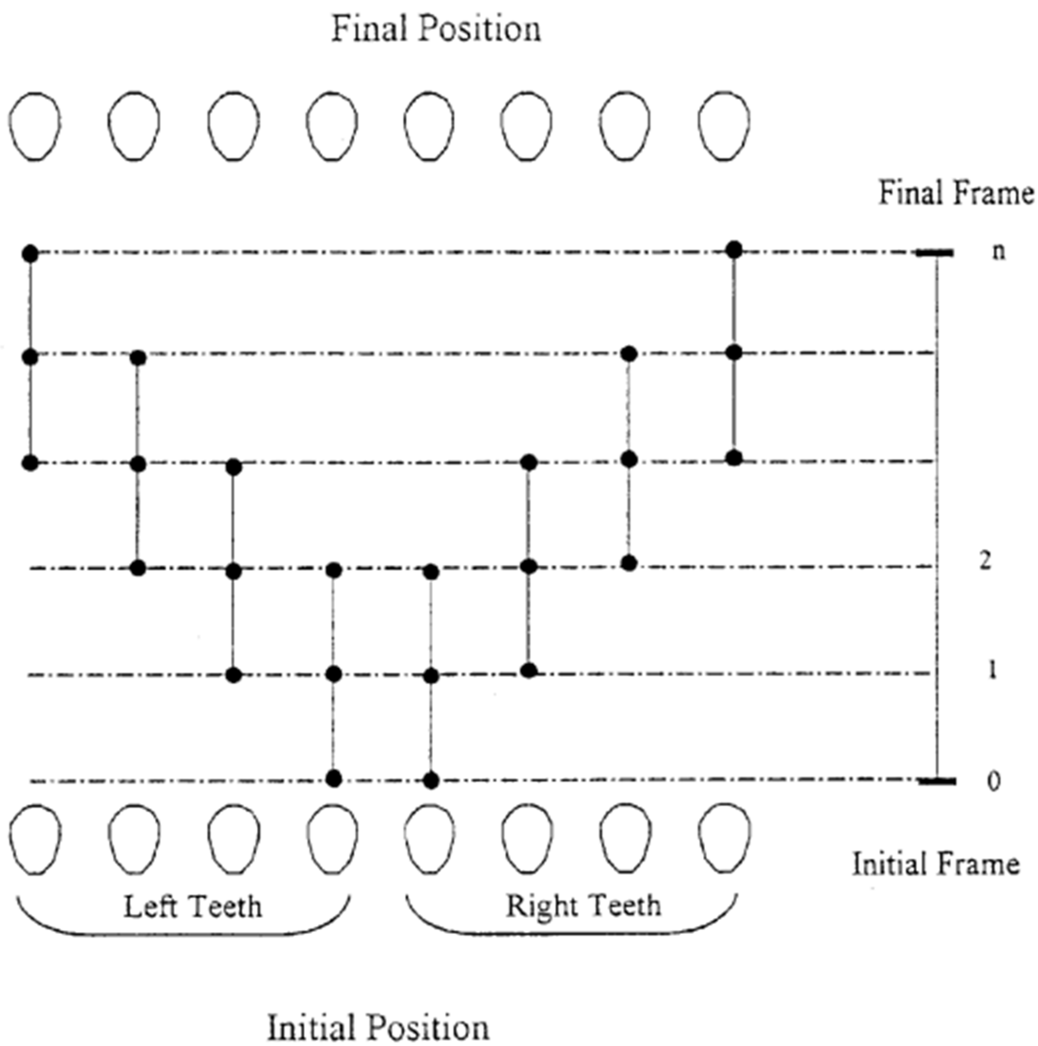


FIG. 11

Id., Fig. 11, 17:1-7.

45. Similarly, below is a treatment plan with an X-type movement pattern, or an "All Equal Movement." *Id.*, 16:57-67.

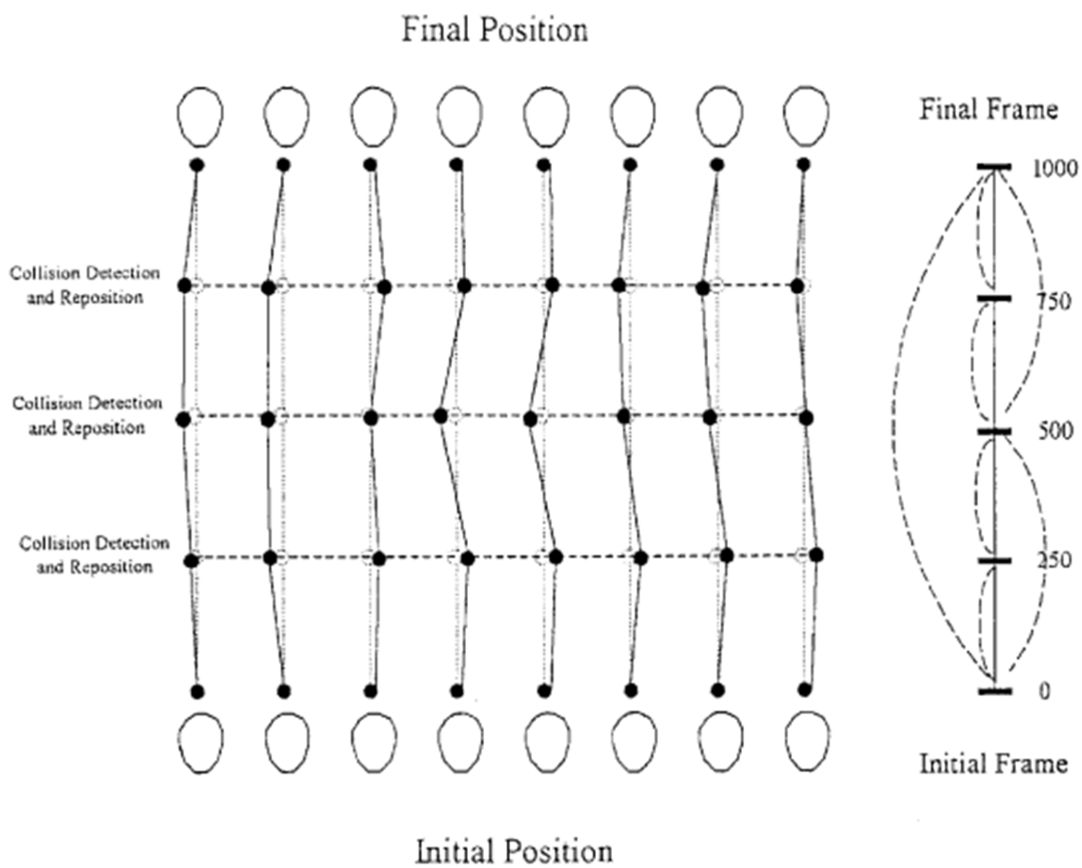


FIG. 10

Id., Fig. 10. As shown, there are instances where the teeth deviate from a straight path where teeth are repositioned due to detection of a collision. *Id.*

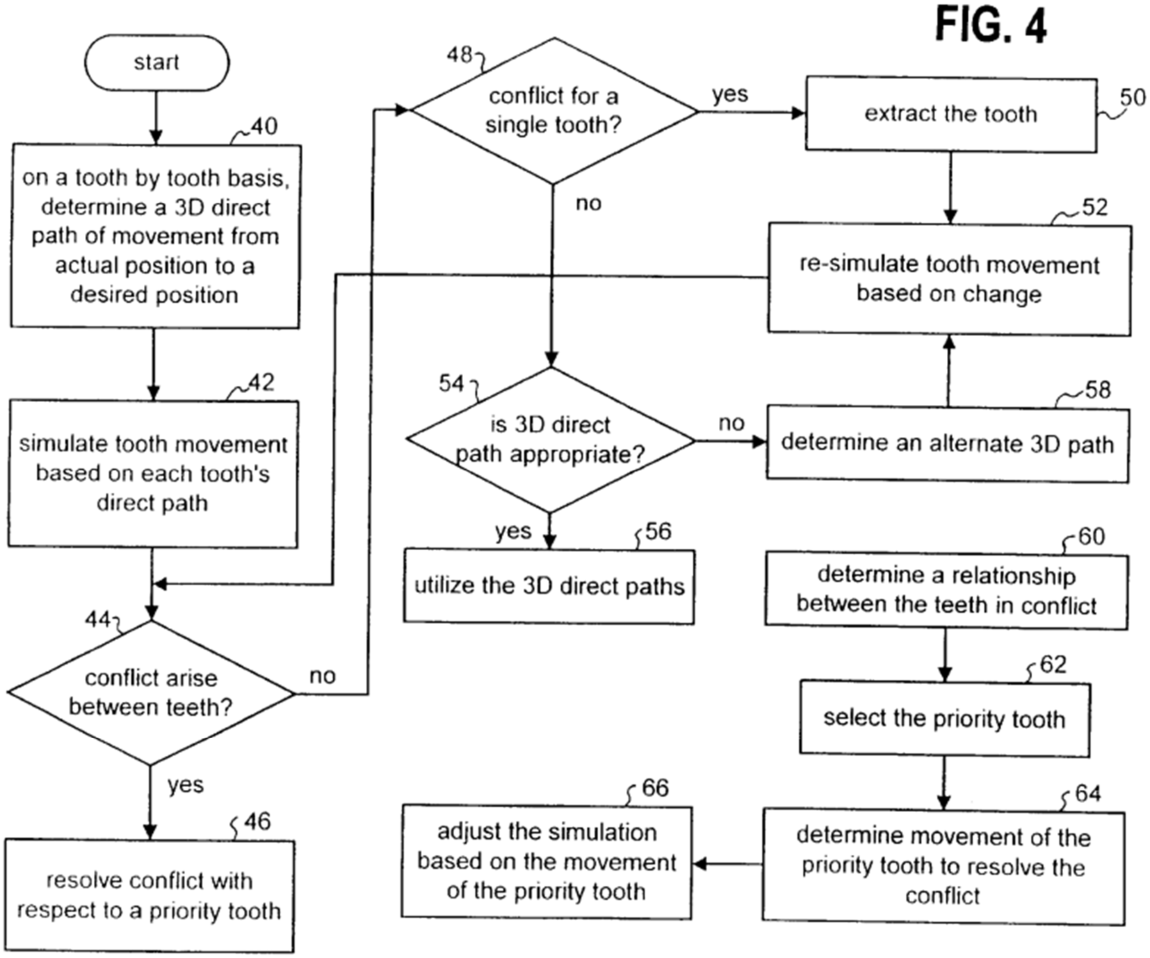
46. Finally, Chishti-876 explains that its various processes may be carried out in software executed on a processor. *Id.*, 23:7-22.

C. Sachdeva (Ex-1007)

47. Sachdeva is entitled "Method and Apparatus for Simulating Tooth Movement for an Orthodontic Patient." Ex-1007, Title. It describes a system capable

of “determining, on a tooth by tooth basis, a three-dimensional direct path of movement from a three-dimensional digital model of an actual orthodontic structure and a three-dimensional digital model of a desired orthodontic structure.” *Id.*, Abstract.

48. Sachdeva describes that “the actual tooth position 30 is referenced by a three-dimensional axis system that is mapped to the center of the tooth.” *Id.*, 4:12-19. Sachdeva further explains that “a vector may be generated to reposition the tooth from its actual position 30 to the desired position 32.” *Id.*, 4:30-38. Sachdeva explains that its process includes “simulating tooth movement for a plurality of teeth based on each tooth’s corresponding three-dimensional direct path,” “determin[ing] whether a conflict arises between at least two teeth of the plurality of teeth,” and resolving any identified conflicts. *Id.*, 3:41-48. An overview of this process is shown below:



Id., Fig. 4, 4:39-5:65.

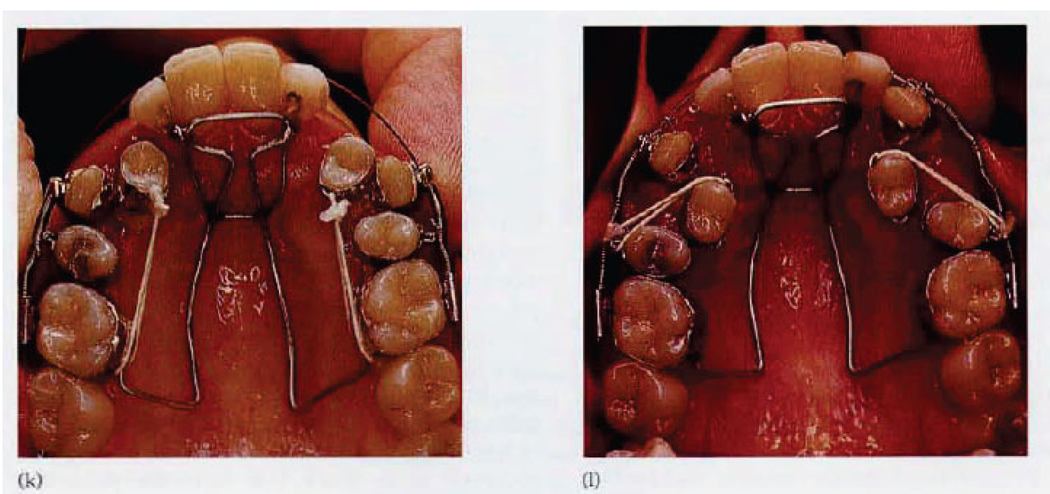
49. Sachdeva discloses a method for resolving conflicts between two teeth that involves moving one tooth before initially moving another tooth. It states, for example, that "[i]f the lower tooth protrudes preventing the upper tooth from moving back, the lower tooth must be moved before the upper tooth can be positioned. Conversely, if the upper tooth is interfering with the lower tooth from being moved out, the upper tooth must first be moved." *Id.*, 5:22-26.

50. As demonstrated in Figure 4 above, Sachdeva's process for treatment planning involves an iterative process whereby the simulation is modified in order to resolve a conflict (steps 52 and 66). *Id.*, 5:27-65.

51. Sachdeva explains that the steps of its method may be performed using software executed on a processor. *Id.*, 4:39-49 (disclosing that Sachdeva's steps may be "implemented as operational instructions, stored in memory, and executed by a processing module").

D. Becker (Ex-1006)

52. Becker is titled *The Orthodontic Treatment of Impacted Teeth* and discloses techniques for repositioning a patient's teeth. Ex-1006, Title, 5. For example, Becker discloses the below technique for repositioning teeth.



Ex-1006, 7 (Figs. 8.6(k), (l)).

53. Becker explains that where a patient's teeth are transposed, there are situations where the preferred "line of treatment" includes "retranspos[ing] [the

teeth] to their ideal positions" rather than "align[ing] the teeth in their transposed positions." *Id.*, 5. Becker explains that, in this situation, a "small section of labial archwire . . . may be used to slide the more buccal of the transposed teeth (usually the canine) in the mesio-distal plane. To allow for that, the more lingual of the transposed teeth must be moved further lingually to allow its partner to pass by. Finally, it must be moved in the opposite mesio-distal direction and back in the line of the arch." *Id.* Becker further shows the teeth in their final positions:

Ex-1006, 8 (Fig. 8.6(m)).

IX. Reasonable Expectation of Success

54. I have been asked to consider whether a POSITA would have had a reasonable expectation of success in combining certain references.

A. Combinations with Sachdeva

55. As discussed above, Sachdeva discloses methods for identifying and avoiding collisions during treatment. *See* Ex-1007, 5:3-5 ("a determination is made as to whether a conflict in movement arose between at least two teeth during the simulation"), 5:5-8 ("A conflict may arise in that the movement of one tooth interferes with the direct path movement of another tooth[,] causing a particular tooth to not be able to obtain its desired position."); *see also id.*, 5:3-32 (discussing resolving conflicts by giving a tooth priority and moving it before another). Chishti-511 likewise recognizes that its process should result in a treatment where teeth do not collide. *See* Ex-1004, 4:18-22 ("[T]he end points of each path segment can constitute a clinically viable repositioning, and the aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth").

56. In my opinion, a POSITA would have had a reasonable expectation of success in modifying Chishti-511 to include Sachdeva's collision detection and avoidance features. Chishti-511's system is readily equipped for such modification as both references disclose similar computer-implemented treatment-planning systems that use digital models of a patient's teeth to determine movement paths and avoid collisions between teeth. Ex-1004, Abstract; *see also* Ex-1004, 10:19-51 (discussing that Chishti-511 may be implemented in software), 3:51-58 (discussing

Chishti-511 using a digital data set and producing "data structures that digitally represent individually tooth crowns . . . digital models of entire teeth are produced"), 4:7-22 (discussing segmented tooth paths that are arranged "so that moving from one point to the next in the sequence does not result in a collision of teeth"); Ex-1007, 4:39-49 (discussing Sachdeva is "implemented as operational instructions, stored in memory, and executed by a processing module"), 3:36-41 (Sachdeva discussing using "a three-dimensional direct path of movement from a three-dimensional digital model of an actual orthodontic structure and a three-dimensional digital model of a desired orthodontic structure"), 5:3-32 (discussing determining whether "a conflict in movement arose between at least two teeth" that would "interfere[] with the direct path of movement" and resolving the conflict). A POSITA would have understood that Sachdeva's collision identification and avoidance techniques also would have been compatible with Chishti-511.

57. Chishti-511 also already discloses that its software process will calculate clinically viable sequences that avoid collisions and that new aligners will be calculated in various circumstances, such as if the system determines that teeth motion is not acceptable or if "an acceptable end position is not reached by the teeth." Ex-1004, 4:15-22 ("the end points of each path segment can constitute a clinically viable repositioning, and the aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the

next in the sequence does not result in a collision of teeth"), 5:27-32 ("**If an acceptable end position is not reached by the teeth, the process calculates a new candidate aligner shape (step 240)** . . . [i]f an acceptable end position is reached, the motions of the teeth calculated by the finite elements analysis are evaluated to determine **whether they are orthodontically acceptable** (step 232). **If they are not, the process also proceeds to calculate a new candidate aligner shape** (step 240).") (emphases added):

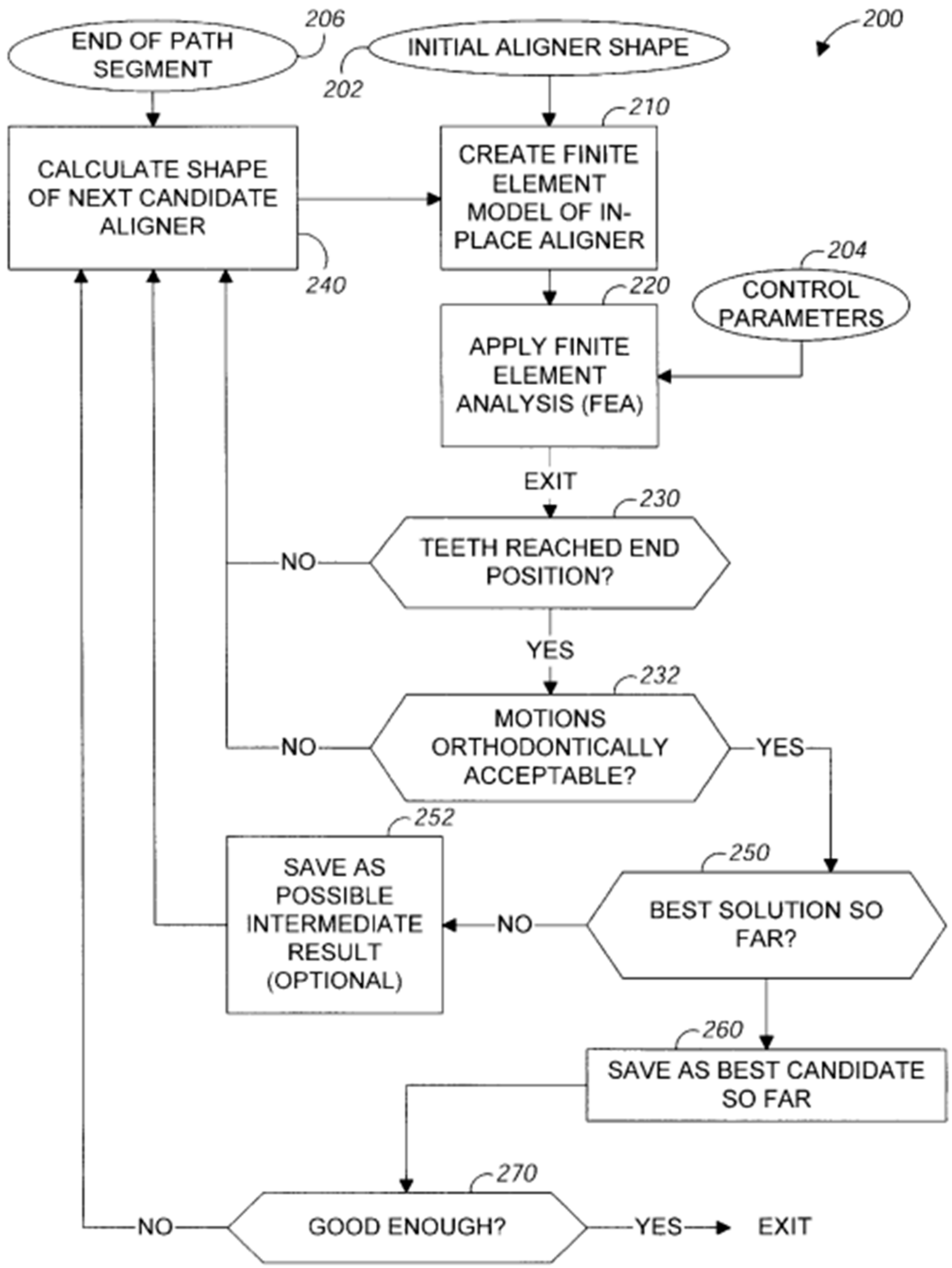


FIG. 2

Id., Fig. 2. Chishti-511 also discloses that "[a]ligners may be unacceptable for a variety of reasons" and that for unacceptable aligners, "the process transfers control to a path definition process (such as step 150, FIG. 1) to redefine those parts of the treatment path having unacceptable aligners (step 630)." *id.* 8:42-58; Ex-1004, 8:54-58. Fig. 6:

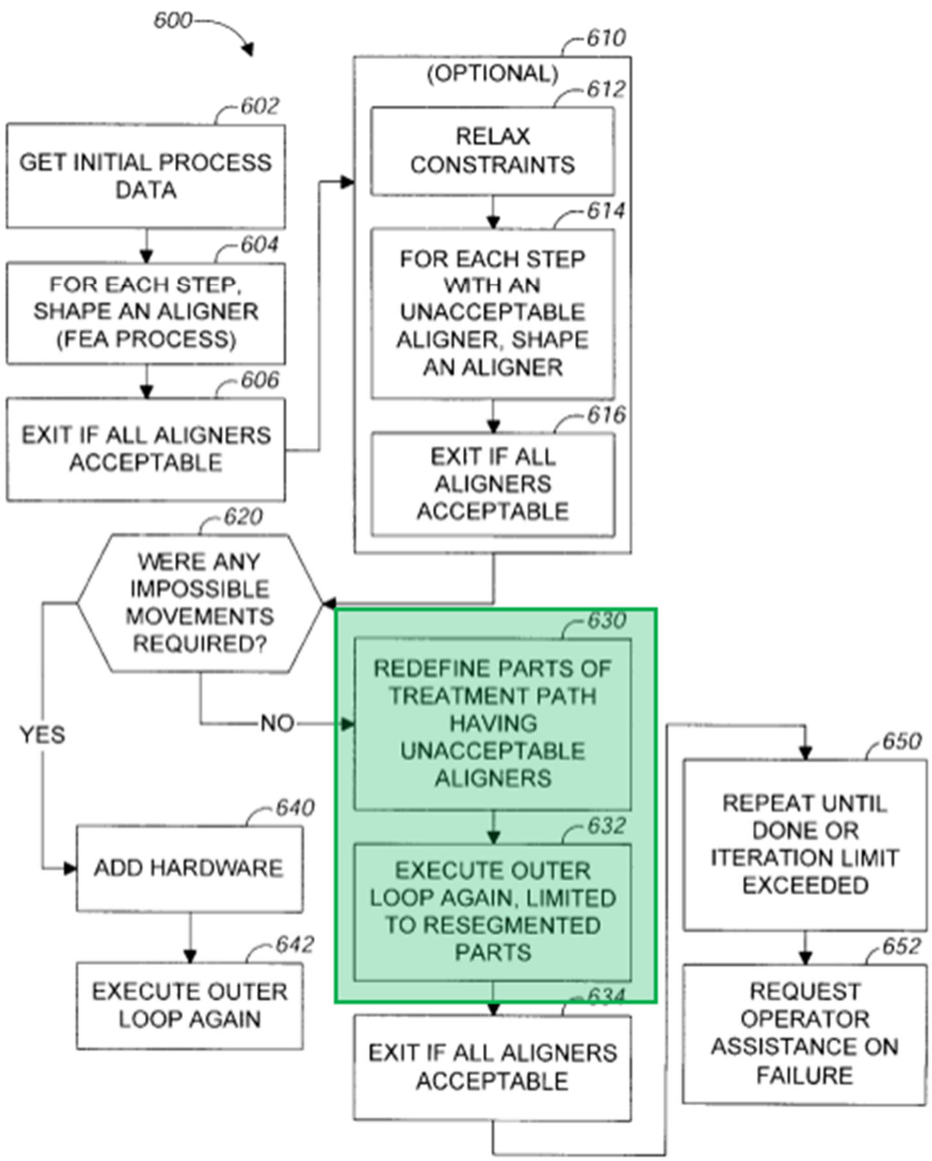


FIG. 6

Ex-1004, Fig. 6 (annotated), 8:42-65.

58. To the extent not already performed by Chishti-511, a POSITA would have understood that Sachdeva's process for identifying collisions may be used as part of the determination of whether a new aligner shape should be calculated. A POSITA would understand that if a collision was detected (as disclosed in Sachdeva), a new aligner calculation may be triggered (as is already performed by Chishti-511). This would have been a mere software modification, and a POSITA would have had a reasonable expectation of success in making this modification.

59. A POSITA also would have had a reasonable expectation of success in integrating Sachdeva's collision detection and avoidance technique in Chishti-511's system. Chishti-511 already explains that changes in teeth motion may be part of the path redefinition process that is performed when a new aligner is calculated. Ex-1004, 8:42-43 ("[a]ligners may be unacceptable for a variety of reasons."), 8:54-58 ("the process transfers control to a path definition process (such as step 150, FIG. 1) to redefine those parts of the treatment path having unacceptable aligners (step 630)"), 8:58-61 ("[t]his step can include both changing the increments of tooth motion, i.e., changing the segmentation, on the treatment path, changing the path followed by one or more teeth in the treatment path, or both."), Fig. 6. A POSITA would understand these changes that are part of the path definition process may include Sachdeva's disclosed collision avoidance process and subsequent path adjustments.

60. Sachdeva further provides clear guidance for how teeth are moved to resolve a conflict if a collision is detected. *See, e.g.*, Ex-1007, 5:18-32 ("For an intra-arch conflict, the actual position of the tooth will dictate whether the upper tooth is priority or the lower tooth is priority. If the lower tooth protrudes preventing the upper tooth from moving back, the lower tooth must be moved before the upper tooth can be positioned. Conversely, if the upper tooth is interfering with the lower tooth from being moved out, the upper tooth must first be moved . . . The process then proceeds to step 66 where the simulation is adjusted based on the movement of the priority tooth."), 5:3-18, Fig. 4.

61. Implementing Sachdeva's collision detection and avoidance technique within Chishti-511's system would have been a mere software modification in which a POSITA would have had a reasonable expectation of success. A POSITA would have understood that integrating Sachdeva's collision avoidance technique would merely involve triggering Chishti-511's "path definition process" upon detecting a collision and modifying the "path definition process," (Ex-1004, 8:54-61), to include Sachdeva's disclosed collision avoidance feature as one of the options for changing tooth motion for an unacceptable aligner. *See* Ex-1004 8:58-61 (Chishti-511 discussing various adjustments that are part of its path redefinition process) With input from an orthodontist or dentist providing guidance on how the teeth would move when using Sachdeva's technique, implementing this combination would

merely involve adjusting the digitally represented teeth locations and path segments that the calculated aligners use to move a patient's teeth such that they reflect the movement technique disclosed in Sachdeva. This would have been well within the skill of a POSITA; thus, a POSITA would have had a reasonable expectation of success in combining these teachings.

B. Combinations with Becker

62. In my opinion, a POSITA would have also had a reasonable expectation of success in modifying Chishti-511 to include Becker's collision avoidance features. For the same reasons that Chishti-511 is well adapted to combine with Sachdeva's teachings, it is also well adapted for similar modifications based on Becker and would have yielded predictable results. *See supra* ¶¶ 55-61. Like Sachdeva's technique, Becker's round-tripping treatment may be integrated into Chishti-511's algorithm for calculating new aligners, such as is already done when teeth motion is not "orthodontically acceptable" or acceptable end positions are not reached. Ex-1004, 5:25-32, 8:42-61, Fig. 6. In the event that a collision was detected, Becker's technique may be one potential treatment used in Chishti-511's path redefinition process, which already incorporates other types of changes to tooth movement. *See* Ex-1004, 8:42-43 ("[a]ligners may be unacceptable for a variety of reasons."), 8:54-58 ("the process transfers control to a path definition process (such as step 150, FIG. 1) to redefine those parts of the treatment path having unacceptable

aligners (step 630)"), 8:58-61 ("[t]his step can include both changing the increments of tooth motion, i.e., changing the segmentation, on the treatment path, changing the path followed by one or more teeth in the treatment path, or both."), Fig. 6. And like implementing Sachdeva's technique, with input from an orthodontist or dentist providing guidance on how the teeth would move in treatment similar to that disclosed in Becker, implementing this combination would involve adjusting the digitally represented teeth locations and path segments that the calculated aligners use to move a patient's teeth such that they reflect the movement technique disclosed in Becker. *See* Section IX.A. This would have been well within the skill of a POSITA, and thus a POSITA would have had a reasonable expectation of success in combining these teachings. Indeed, the Align Patents' discussion of round-tripping includes no implementation details, indicating that the inclusion of such a feature in treatment planning software was well within the skill of a POSITA.

C. Combinations with Chishti-876

1. Selecting from a plurality of movement patterns

63. In my opinion, a POSITA would have also had a reasonable expectation of success in modifying Chishti-511 to include Chishti-876's feature of allowing a user to select one of a plurality of movement patterns, including the patterns disclosed, such as an X-type or all-equal pattern, an A-shaped pattern, or a V-shaped pattern. Ex-1005, 16:57-17:12. Chishti-511 already envisions a software system that

discusses the potential for user input, discussing "user-selectable constraints of good orthodontic practice" and allowing a user to "finely tune" performance through constraints. *See* Ex-1004, 2:45-53. Chishti-876 similarly discloses user involvement in its software system through the selection of treatment patterns. Ex-1005, 15:1-3 (discussing that the system may "create several alternative paths and present each path graphically to the user"); *see also id.*, 17:65-67 (noting that the movement pattern is "specified by the user"). Chishti-876 and Chishti-511 also have common inventors and overlapping details, so a POSITA would have expected that both disclosed systems teach compatible interactive treatment planning tools and software that are readily combinable in a single system to generate plans for incrementally repositioning an orthodontic patient's teeth.

64. Chishti-876 discloses that its system "schedules treatment paths by drawing upon a database of preferred treatments for exemplary tooth arrangements." *Id.*, 14:63-15:1. It further discloses that "library of treatment patterns includes at least one or more of the following: all equal movement pattern, A-shaped movement pattern, V-shaped movement pattern, M-shaped movement pattern, W-shaped movement pattern, symmetric staircase pattern, asymmetric staircase pattern, and equal equal movement pattern." *Id.*, 2:44-49; *see also id.*, 2:49-62 (describing the all-equal, equal-equal, A-shaped, and V-shaped patterns), 16:53-55 ("FIGS. 10-13 show exemplary movement patterns, namely an X-type movement, an A-type

movement, a V-type movement, and an XX-type movement, among others."), 16:57-67 (describing the X-type, "also known as an 'All Equal Movement'" pattern), 16:57-17:12, Figs. 10-12 (showing X-type, A-type, and V-type movements). A POSITA would have recognized that, when integrated into Chishti-511, Chishti-876's treatment patterns would likewise have allowed the user to select a movement pattern that would affect the schedule of teeth movement.

65. In my opinion, a POSITA would have recognized that such a database described in Chishti-876 would have been equally usable by Chishti-511's software system. Chishti-511's various software processes already allow certain clinician inputs. *See* Ex-1004, 4:43-48 ("The client process is advantageously programmed to allow the clinician to display an animation of the positions and paths and to allow the clinician to reset the final positions of one or more of the teeth and to specify constraints to be applied to the segmented paths."), Figs. 3, 4. The user-selected patterns are a type of constraint applied to the segmented paths that Chishti-511 already envisions. Moreover, Chishti-876 provides flow charts for calculating movement paths based on patterns, such as the known all-equal, A-shape, or V-shape patterns, which a POSITA would have been able to look to when integrating these features, in addition to additional input from an orthodontist or dentist providing guidance on how the teeth would move when using such patterns. *See, e.g.*, Ex-1005, 17:17-18:23, 19:15-38, 20:4-60, Figs. 14, 15, 18, 20A, 20B. Thus, a POSITA would

have recognized that Chishti-876's database of movement patterns, including Chishti-876's guidance of calculating those patterns, may likewise be drawn upon as an input to Chishti-511's treatment planning system, that would have yielded predictable results and that such an integration would require only software modifications that would have been well within the skill of a POSITA at the relevant time and would have yielded predictable results.

2. Determining a respective distance needed to move each dental object from its respective initial position to its respective final position

66. Chishti-876 discloses analyzing a distance needed to move a dental object from its initial position to its final position.

67. For example, Chishti-876 discloses an X-type movement pattern, where "all teeth in a given group are moving at the same time." *Id.*, 16:57:67. It explains that "[t]he tooth path is determined by dividing a starting frame containing the teeth into half frames and recursively determines intermediate paths in each half." *Id.*, 16:60-63. On the first iteration before any recursion, the system determines if the movement from the beginning frame to the mid frame is too large (i.e., the first half of the distance) and determines whether the movement from the mid frame to the end frame is too large (i.e., the second half of the distance). Ex-1005, 16:57-67, 18:1-42, Figs. 15-16. A POSITA would recognize that, together, these values constitute the "respective distance needed to move each of the dental objects from its respective

initial position to its respective final position" which is determined and analyzed by Chishti-876. Moreover, a representation of this movement type is shown in Figure 10, below. *Id.*, 16:57-57.

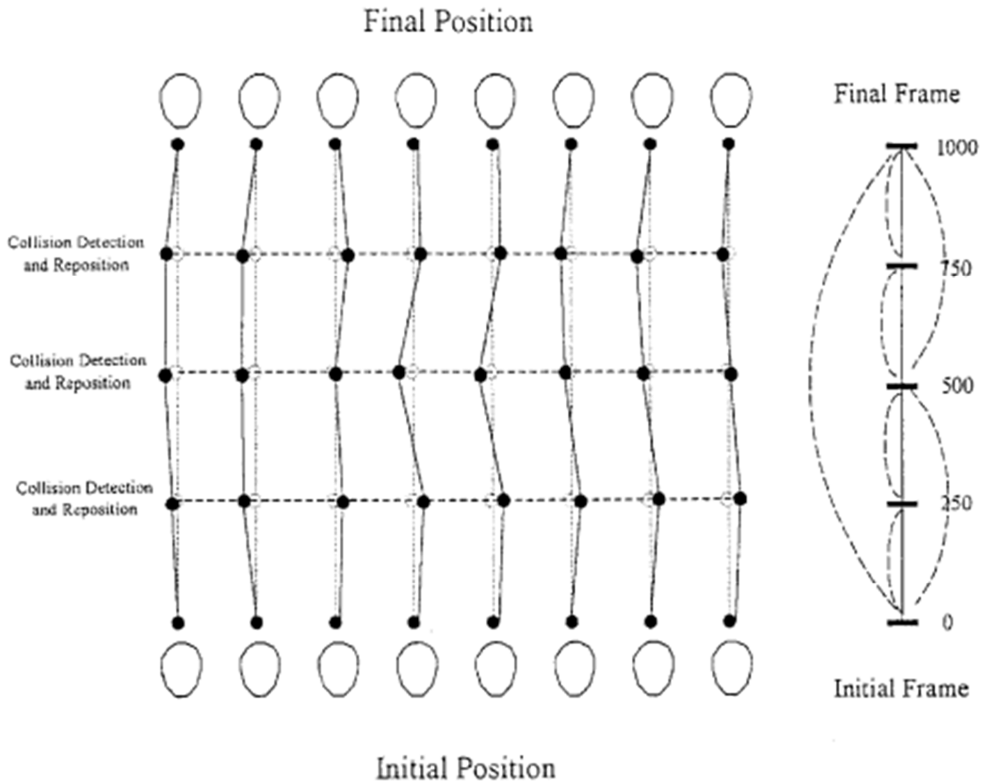


FIG. 10

Id., Fig. 10.

68. Chishti-876 also discusses how this distance is used, explaining that "determining a tooth path comprises finding a collision[-]free shortest path between an initial position and a final position for one or more teeth." *Id.*, claim 3.

69. In my opinion, a POSITA would have also had a reasonable expectation of success in modifying Chishti-511 to include Chishti-876's determining a

respective distance needed to move each of the teeth from its respective initial positions to its respective final positions. Like Chishti-876, Chishti-511 discusses the use of initial positions, final positions, and tooth paths. *See* Ex-1004, 3:40-50 ("[A] mold or a scan of [a] patient's teeth or mouth tissue is acquired . . . . From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues."), 3:59-64 ("The desired final position of the teeth—that is, the desired and intended end result of orthodontic treatment—can be received from a clinician in the form of a prescription, can be calculated from basic orthodontic principles, or can be extrapolated computationally from a clinical prescription . . . ."), 4:7-9 ("Having both a beginning position and a final position for each tooth, the process next defines a tooth path for the motion of each tooth."). Like Chishti-876, Chishti-511 also discloses segmenting paths from their initial to final positions and generating tooth paths. *Id.*, 4:7-22 ("the process next defines a tooth path for the motion of each tooth" and "The tooth paths are segmented."). Integrating Chishti-876's distance determination into Chishti-511 would merely involve using data already present in Chishti-511, such as calculating the distance of each tooth segment, as the teeth move from initial to final positions. A POSITA would recognize that this would be a mere software modification, which would permit choosing a "shortest" path as disclosed in Chishti-876. And such a modification would be well within the skill level of a POSITA, and thus there would been a reasonable expectation of success in making the modification.

3. Slowing movement of a dental object

70. Chishti-876 discloses that it is possible to change the speed of a tooth as it moves along its path. For example, Chishti-876 discloses that "[o]ne component may accelerate along a curve between one pair of stages (e.g., stages 3 and 8 in a treatment plan having that many stages), while another moves linearly between another pair of stages (e.g., stages 1 to 5), and then changes direction suddenly and slows down along a linear path to a later stage (e.g., stage 10)." Ex-1005, 12:22-31.

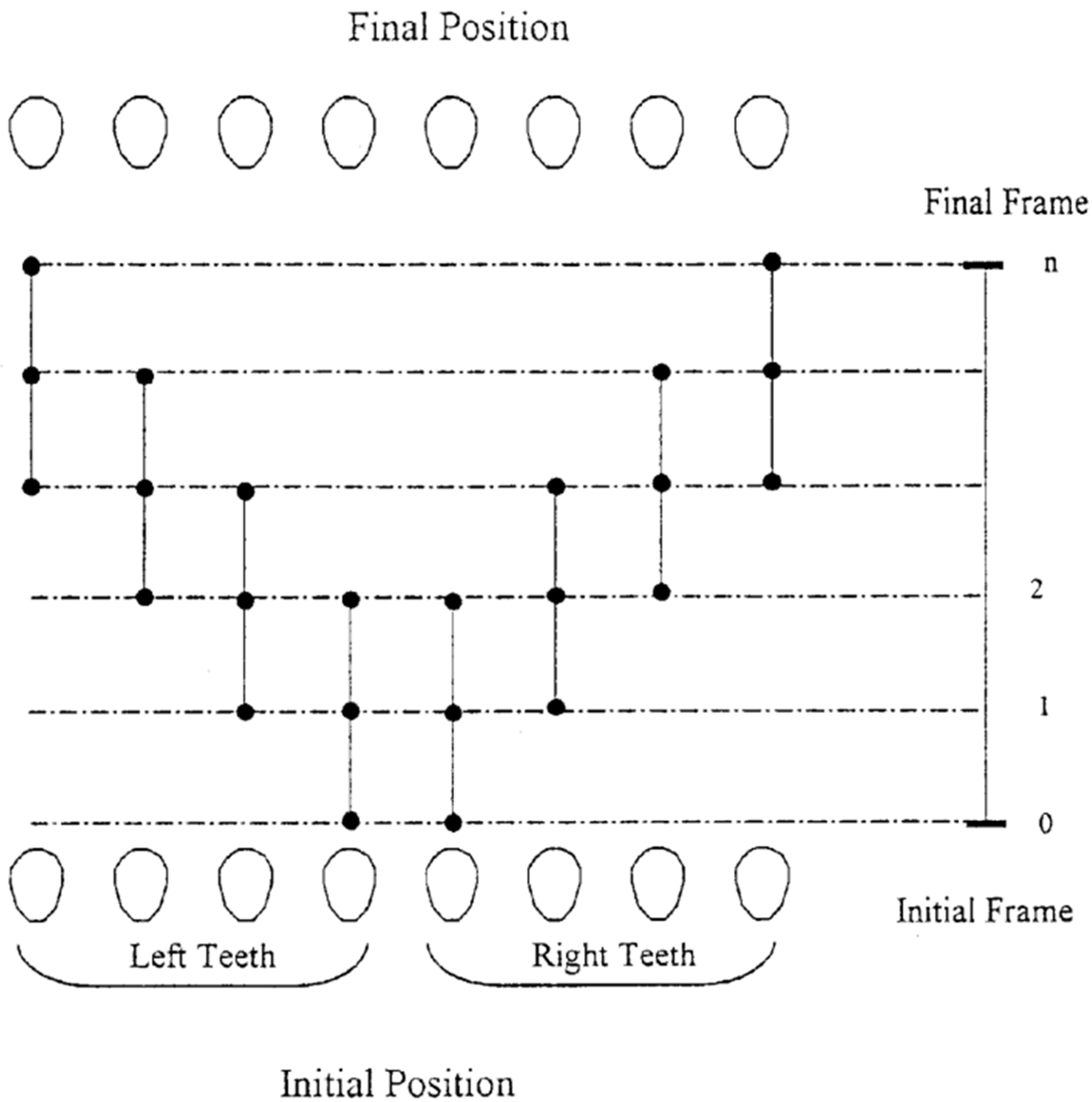
71. As discussed above, I understand that the construction for "slowing" is "[having / have] one or more teeth scheduled to move at a rate less than the rate of other teeth, or even [stopping / stop] using interim key frames, so that collisions and/or obstructions do not occur." Ex-1013, 8. In my opinion, a POSITA would have had a reasonable expectation of success in modifying Chishti-511 to include Chishti-876's changes in tooth speed, such as slowing the movement of a tooth in subsequent stages after previous stages where it moved. As discussed previously, Chishti-511 uses software to determine movement paths, and there is an "end point[]" associated with each path "segment" of the overall tooth path. *See* Ex-1004, 4:15-22. Implementing Chishti-876's system for slowing a tooth relative to other teeth would have been a mere software modification involving changing the "end point[]"

associated with the slower teeth. Unlike where Chishti-511 generally attempts to move teeth "in the quickest fashion" (*id.*, 4:9-12), a POSITA would recognize that this modification would involve setting lesser distances (or no distance, if the tooth is stopped) for a slowed tooth. For the slowed segments, slowed teeth would not move as far (or at all, if the tooth is stopped) over those treatment stages relative to other teeth moving a further distance. A POSITA would also be guided by Chishti-876's disclosure that in some situations, movement "will simply show the component an equal linear distance and rotation (specified by a quatemion) closer to the final position," as they would recognize that components may generally move an equal distance, but that distance may be set to a lesser amount to slow the dental object. Ex-1005, 12:6-32. Integrating this feature into the combined system would merely be a software modification that would alter distance parameters to travel a lesser distance for a slowed tooth. With additional input from an orthodontist or dentist providing guidance on expected teeth movement using this technique, this would have been well within the skill of a POSITA at the relevant time, and a POSITA would have a reasonable expectation of success for such a change.

4. Determining number of treatment stages

72. Chishti-876 discloses determining a total number of treatment stages. It explains that its system uses an "initial position of patient teeth and a final corrected position, [and] the system generates in-between stages by finding the stage

positions of each tooth in accordance with a selected movement." *Id.*, 16:48-53. The total number of in-between stages is the total number of treatment stages. *Id.*, *see also* Ex-1001, 8:28-35. Chishti-876 elsewhere discusses the number of stages calculated, for example, discussing a tooth path movement plan of "about fifty discrete stages." Ex-1005, 11:26-40. It further discusses different types of movements, such as an X-type movement, where "the tooth's treatment path has approximately equal lengths between each adjacent pair of treatment steps" (indicating the total number of treatment stages is known). *Id.*, 13:49-55, 16:57-67, Fig. 10. This is also shown with respect to other movement patterns, such as the A-type movement, shown below:



Id., Fig. 11, 17:1-7. Chishti-876 likewise discloses determining the minimum stages for teeth, indicating that it seeks to find "finding a collision[-]free shortest path between an initial position and a final position for one or more teeth" while simultaneously relying on characteristics to optimize movement, such as "the maximum linear or rotational velocity at which a tooth should move" and "the maximum distance over which a tooth should move between treatment steps teeth." *Id*., claim 3, 13:56-14:1.

73. In my opinion, a POSITA would have had a reasonable expectation of success in modifying Chishti-511 to include these features related to number of treatment stages disclosed in Chishti-876. This would merely involve optimizing the paths and segments for each tooth, and calculating the number of segments for each tooth, which would be trivial given that Chishti-511 already calculates tooth segments for each treatment path and likewise seeks to optimize its segments. Ex-1004, 4:15-22 Chishti-511 already discloses that "[t]he tooth paths are segmented" into treatment stages, and thus such calculations based on that existing data would be readily implemented by a POSITA within Chishti-511's system. Ex-1004, 4:7-22.

5. The schedule of movement indicates whether or not each of the dental objects moves during each of the treatment stages

74. Chishti-876 discloses a schedule of movement indicating whether or not each of the dental objects moves during each of the treatment stages. For example, Chishti-876 explains that it will "define or map the movement of selected individual teeth from the initial position to the final position over a series of successive steps." Ex-1005, 9:13-20. And further, it teaches that "a plan is generated for moving teeth" (a schedule of movement), where the system "considers a set of

movement constraints which affect the tooth path movement plan," and that such considerations include, for example: "[s]pace," "[t]eeth moving past each other," "[w]hich teeth are moving when?" and "[w]hich teeth need to be moved before others are moved?" *Id.*, 10:29-34, 11:32-65.

75. Chishti-876 also describes an implementation using "a two-dimensional array" that is "used to track specific movements for each tooth at a specific period of time." *Id.*, 11:38-40. "One dimension of this array relates to teeth identification, while the second dimension relates to the time periods or stages." *Id.*, 11:41-43. Chishti-876 also provides diagrams of certain types of movements. *Id.*, 17:1-7, Figs. 10-13. For example, the A-type movement shown below refers to when "the next tooth starts to move when the current tooth reaches midway to the current tooth's goal position." *Id.*, 17:1-7. The annotated diagram below shows the various treatment stages and indicates when a tooth is moving (green for the leftmost tooth) or not moving (red for the leftmost tooth).

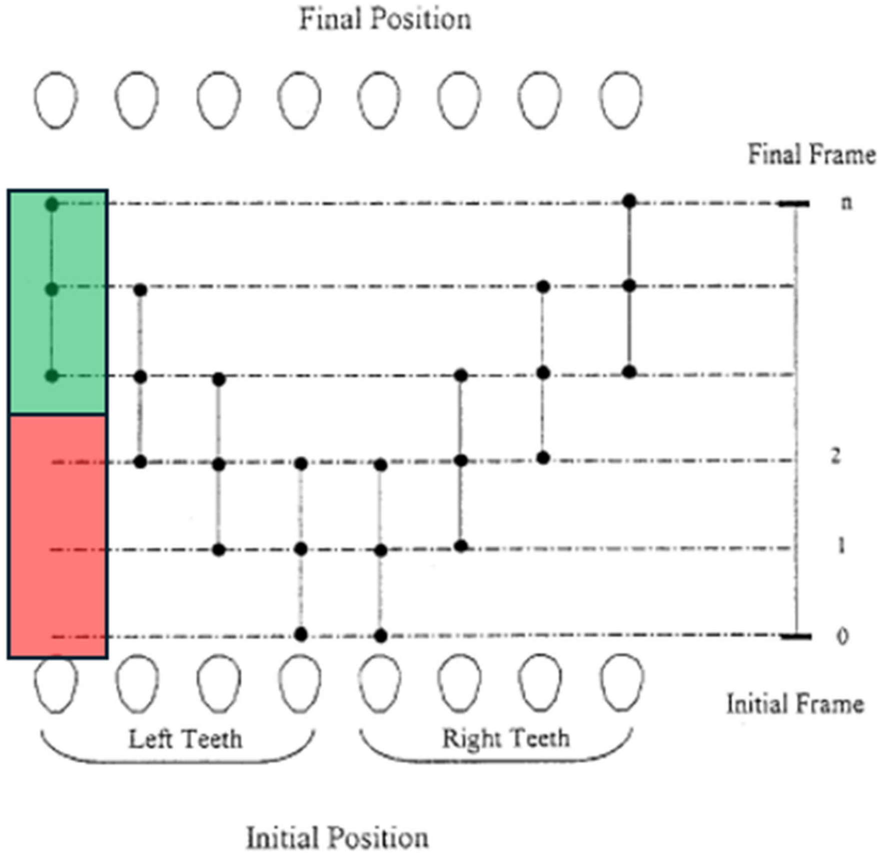


FIG. 11

Ex-1005, Fig. 11 (annotated).

76. To the extent it is argued that Chishti-511 does not already disclose this feature, in my opinion, a POSITA would have had a reasonable expectation of success in combining this aspect of Chishti-876 into Chishti-511's system. Chishti-511 already discloses that "[t]he tooth paths are segmented" and that segmented tooth paths are "used to calculate clinically acceptable appliance configurations." Ex-1004, 4:7-22, 4:51-67. Chishti-511 also discloses that "[e]ach appliance

configuration represents a step along the treatment path," and that the appliance configurations will "move the teeth on the defined treatment path in the steps" toward their respective final positions. *Id.*, 4:51-67. Integrating Chishti-876's disclosed schedule into Chishti-511 would merely involve potentially altering how existing data in Chishti-511 (e.g., data related to segmented paths through which teeth move) is represented in software to show whether a tooth moved during each stage of treatment, and Chishti-876 already provides guidance in its use of a two-dimensional array to represent this data, which a POSITA would recognize is applicable to Chishti-511's system and would allow it to identify a tooth and whether or not it moved during each treatment stage. Ex-1005, 11:38-43. Additionally, a graphical representation of each treatment stage may show whether or not a tooth moved for that stage, such as that illustrated in Figure 11 of Chishti-876. Ex-1005, Fig. 11. In my opinion, this would have been within the skill of a POSITA, and a POSITA would have had a reasonable expectation of success in making any such change.

6. Analyzing the dental objects in their respective initial and respective final positions

77. Chishti-876 discloses analyzing the dental objects in their respective initial and respective final positions. For example, Chishti-876 discloses that its system will reposition a patient's teeth "from their initial tooth arrangement to a final

tooth arrangement by placing a series of incremental position adjustment appliances over the patient's teeth." Ex-1005, 7:13-19; *see also id.*, 9:13-20 (explaining that "it is necessary to define or map the movement of selected individual teeth from the initial position to the final position over a series of successive steps"). It further discloses that in determining how to reposition a patient's teeth, it will "take[] into consideration the following: 1. Initial Position: a detailed description of the initial maloclussion[] [sic] [and] 2. Final Position: a detailed description of treatment goals for the patient." Ex-1005, 9:34-67. It also explains that the "program receives as input the initial and final positions of the patient's teeth and uses this information to select intermediate positions for each tooth to be moved." *Id.*, 13:23-48.

78. To the extent that it is argued that Chishti-511 does not already disclose analyzing the dental objects in their respective initial and respective final positions, a POSITA would have had a reasonable expectation of success in implementing Chishti-876's initial and final position analysis within Chishti-511. Chishti-511 already discloses the use of initial and final teeth positions. *See* Ex-1004, 3:40-4:1 (discussing "a digital data set . . . that represents the initial (that is, pretreatment) arrangement of the patient's teeth" and "a specification of the desired final positions of the teeth"). Chishti-511 further explains that by "[h]aving both a beginning position and a final position for each tooth, the process [implemented by a computer processor] defines a tooth path for the motion of each tooth." *Id.*, 4:7-22. Thus,

Chishti-511 already has access to the variables involved (e.g., initial and final positions, tooth paths, segments) (Ex-1004, 4:7-22), and such a feature would merely involve analyzing existing data in software when determining segments to ensure that they travel from those initial to final positions.

D. Features Combined with Chishti-511

79. For the various features of Sachdeva, Becker, and Chishti-876 discussed above, it is my opinion that those features would not have interfered with one another when incorporated into Chishti-511, and a POSITA would have had a reasonable expectation of success in combining the teachings of those references with Chishti-511 for the reasons discussed above.

80. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: April 4, 2025 By: ____________________________

Paul C. Clark, DSc.