



ClearCorrect Operating, LLC
Petitioner,
v.
Align Technology, Inc.
Patent Owner.

Case No. IPR2025-00817
U.S. Patent 10,791,936

Petitioner's Demonstratives

July 31, 2026

The '936 Patent

The '936 patent is directed to a workflow for obtaining a 3D virtual model of dentition using an intraoral scanner

US010791936B2

(12) **United States Patent**
Kopelman

(10) **Patent No.:** US 10,791,936 B2
(45) **Date of Patent:** *Oct. 6, 2020

(54) **METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS**

(71) **Applicant:** Align Technology, Inc., San Jose, CA (US)

(72) **Inventor:** Avi Kopelman, Palo Alto, CA (US)

(73) **Assignee:** Align Technology, Inc., San Jose, CA (US)

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

(21) **Appl. No.:** 16/586,528

(22) **Filed:** Sep. 27, 2019

(65) **Prior Publication Data**
US 2020/0022584 A1 Jan. 23, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued)

(51) **Int. Cl.**
G06T 19/20 (2011.01)
A61C 7/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC A61B 5/0088 (2013.01); A61B 5/0062 (2013.01); A61B 5/4547 (2013.01);
(Continued)

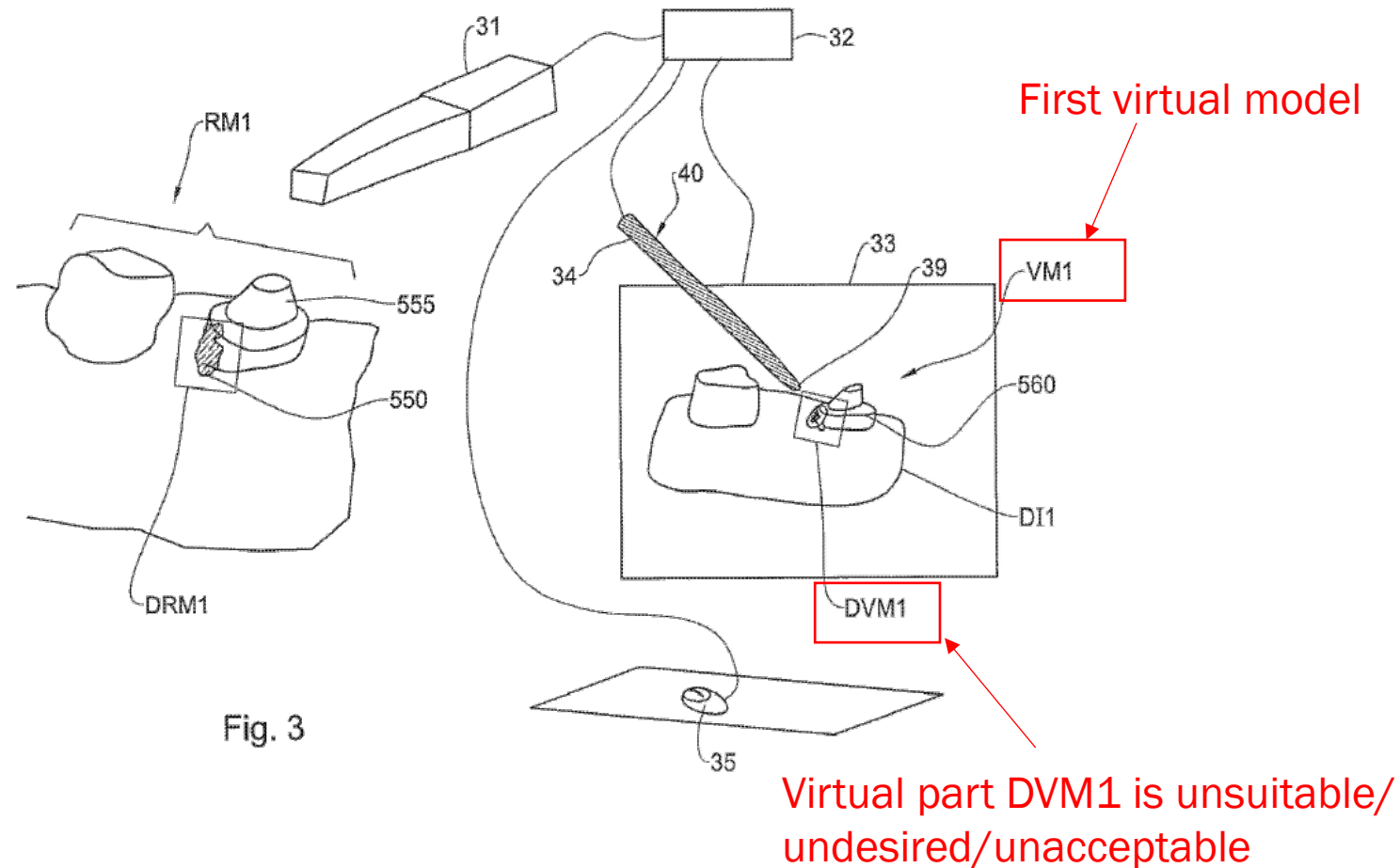
(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
2,467,432 A 4/1949 Kesting
3,407,500 A 10/1968 Kesting
(Continued)
FOREIGN PATENT DOCUMENTS
AU 3011677 A 5/1979
AU 517102 B2 7/1981
(Continued)
OTHER PUBLICATIONS
AADR, American Association for Dental Research, Summary of Activities, Mar. 20-23, 1980, Los Angeles, CA, p. 195.
(Continued)
Primary Examiner — Bijan Mapur
(74) *Attorney, Agent, or Firm* — Wilson Sonsini Goodrich & Rosati

(57) **ABSTRACT**
Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces.

20 Claims, 8 Drawing Sheets

ClearCorrect Exhibit 1001, Page 1 of 30



The '936 Patent



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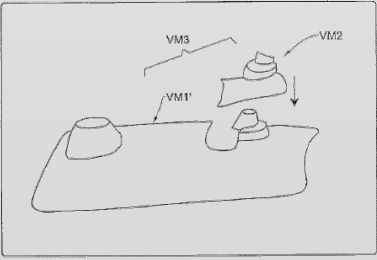
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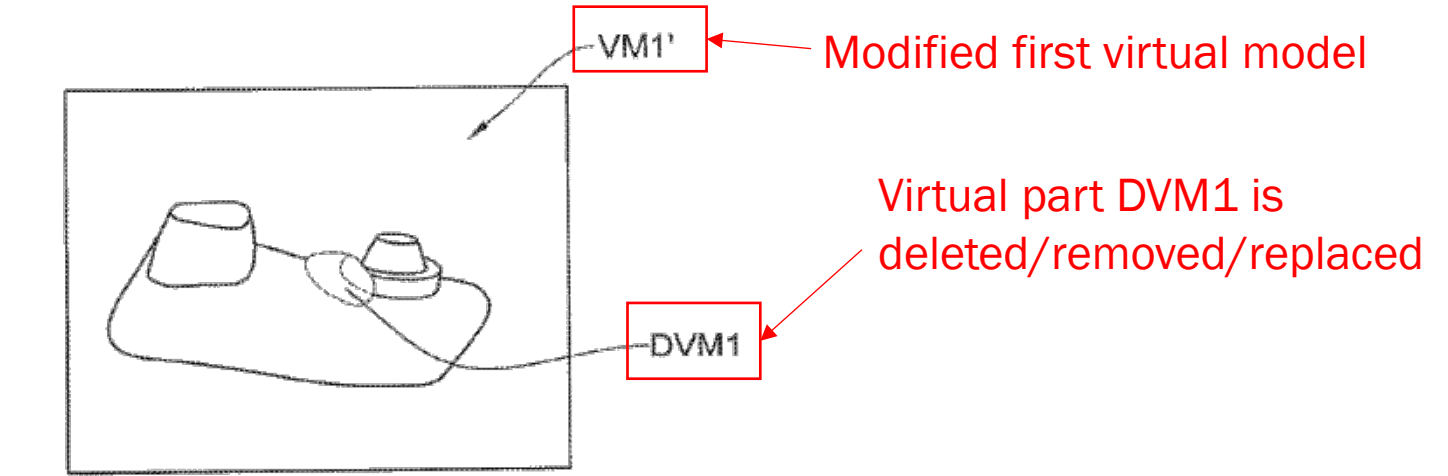


Fig. 4

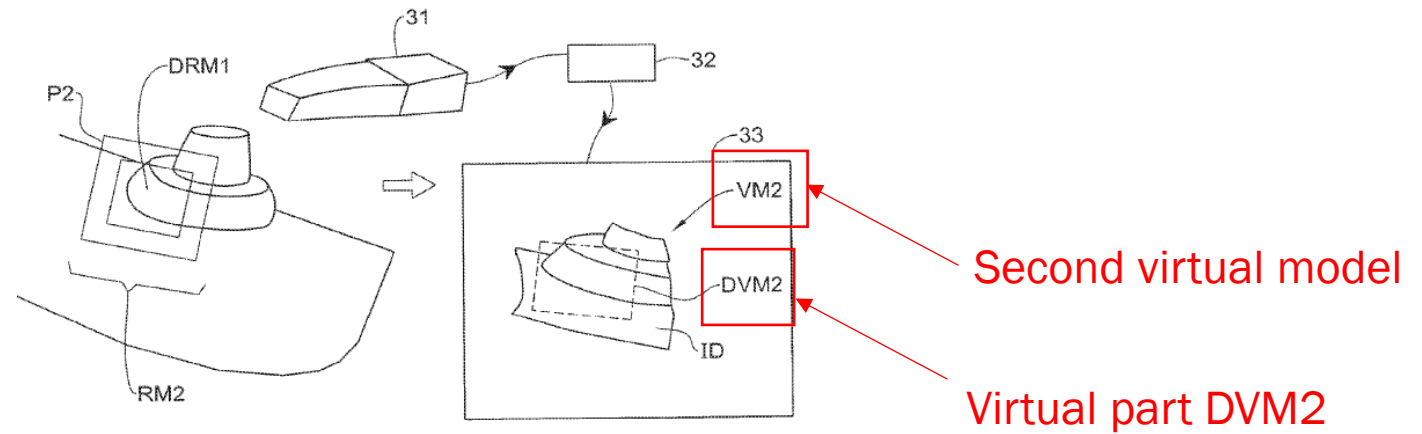


Fig. 5

The '936 Patent



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(54) METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS

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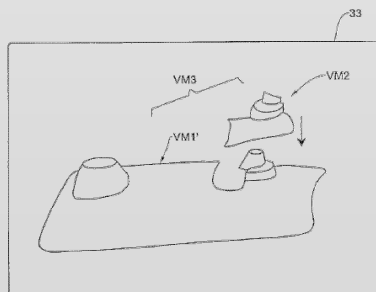
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Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces.
(Continued)

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ClearCorrect Exhibit 1001, Page 1 of 30

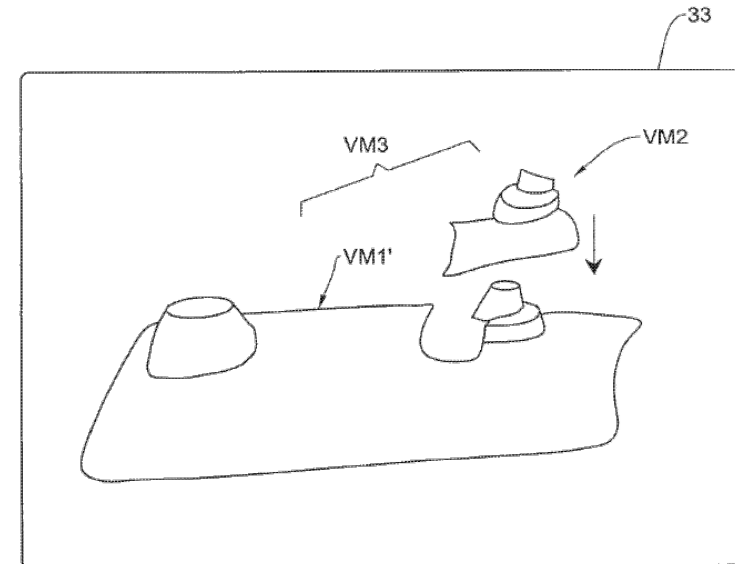
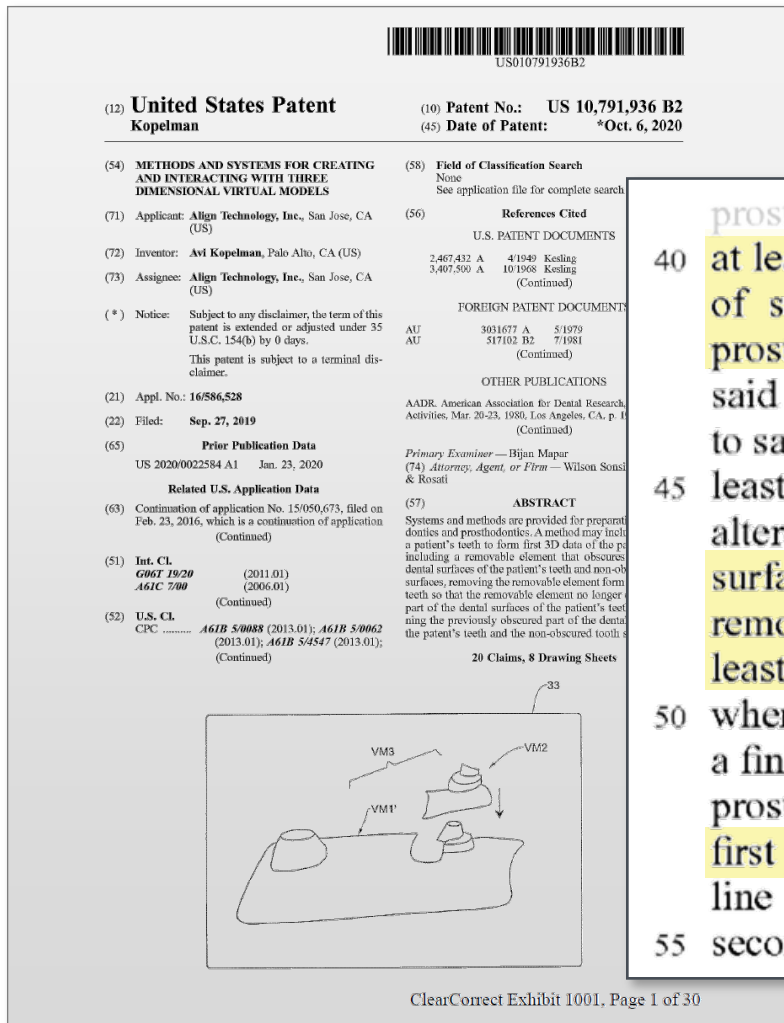


Fig. 6

In step 460, and referring also to FIG. 6, the second 3D virtual model VM2 is spatially registered with respect to the modified first 3D virtual model VM1' to provide a composite third 3D virtual model VM3, wherein the part DVM1 that was previously deleted/removed is at least partially replaced with a corresponding part the second 3D virtual model VM2.

The '936 Patent

Various reasons cause the virtual part DVM1 to be “distorted or otherwise defective”



prosthesis to be mounted with respect thereto. For example,
40 at least a part of said surface of interest in said first portion
of said first physical part is inadequate for enabling a
prosthesis to be mounted with respect thereto, and wherein
said second portion of said second physical part corresponds
to said first portion of said first physical part wherein said at
45 least a part of said surface of interest has been physically
altered. For example, where said at least a part of said
surface of interest has been physically altered via a material
removal operation wherein to modify the topology of said at
least a part of said surface of interest. An example of this is
50 where said at least a part of said surface of interest comprises
a finish line of a tooth onto which it is desired to mount the
prosthesis, and said finish line is inadequately defined in said
first portion of said first physical part, but where said finish
line is adequately defined in said second portion of said
55 second physical part.

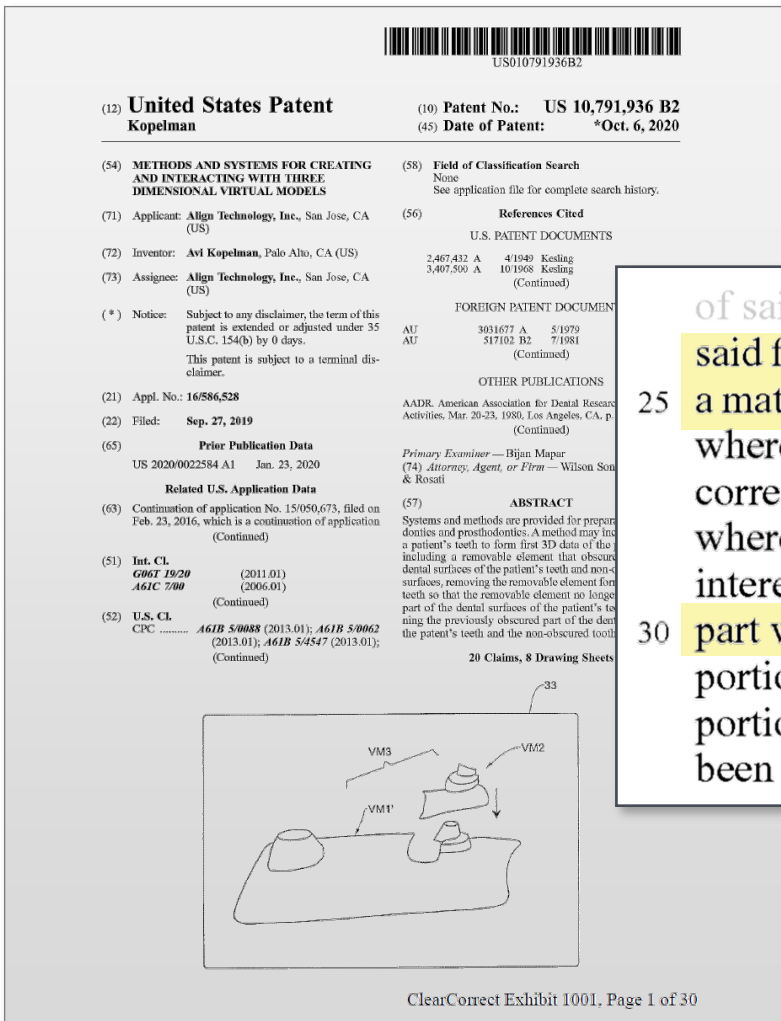
Inadequate Preparation

Physical Alteration

Inadequately Defined
Finish Line

The '936 Patent

Various reasons cause the virtual part DVM1 to be “distorted or otherwise defective”



of said surface of interest is now unobscured. For example, said first portion of said first physical part was obscured with a material including one or more of saliva, debris, blood, and wherein said second portion of said second physical part corresponds to said first portion of said first physical part wherein said material has been removed from said surface of interest. For example, said first portion of said first physical part was obscured with an artifact, and wherein said second portion of said second physical part corresponds to said first portion of said first physical part wherein said artifact has been removed. For example, said artifact comprises an

Obscured by Saliva, Debris, or Blood

Obscured by an Artifact

The '936 Patent: Claim 1



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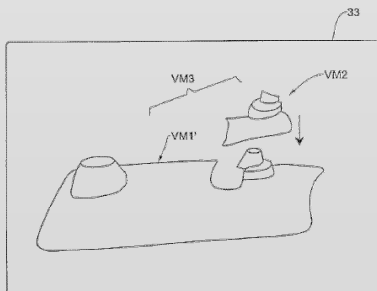
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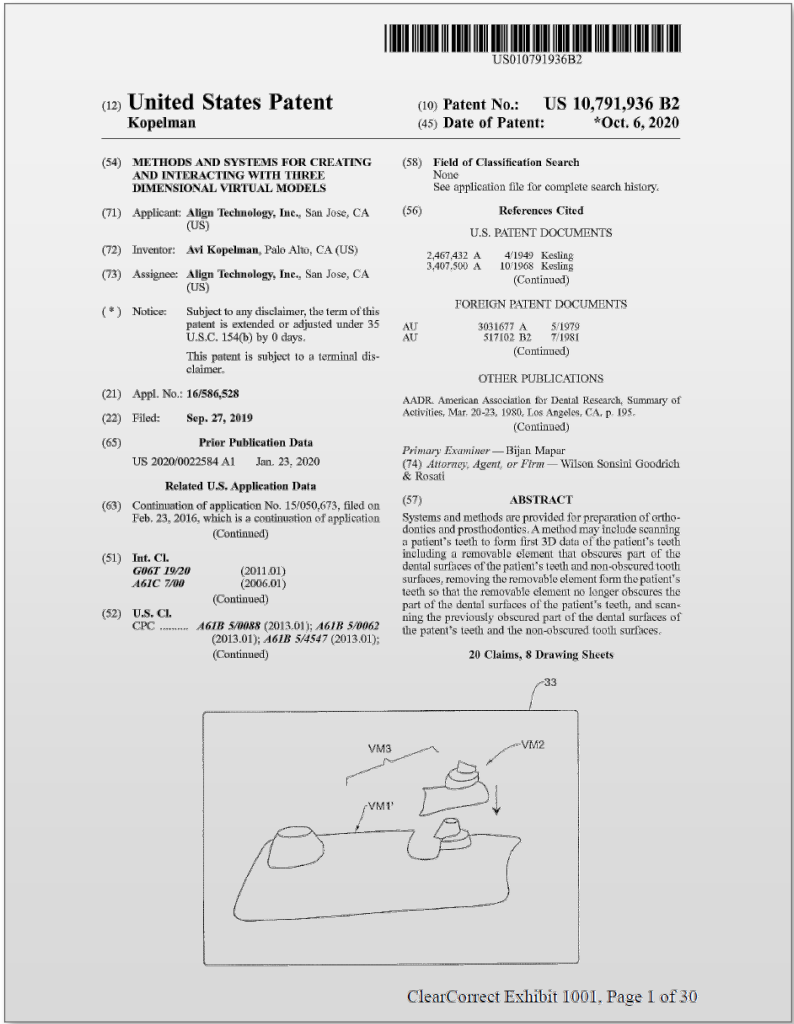
ClearCorrect Exhibit 1001, Page 1 of 30

1. A system for scanning a patient's teeth for a dental procedure, the system comprising:
a hand-held intraoral scanner; and
a computer readable medium including instructions that when executed by a computer system, cause the computer system to:
receive first scan data of the patient's teeth from the hand-held intraoral scanner;
display, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;
receive user input defining a portion of the model to be removed;
remove, from the displayed model, a removed surface portion of the model to be removed according to the user input;
receive second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;
replace at least a portion of the removed surface portion of the model using the received second scan data of the patient's teeth including surface data of a physically changed portion of the patient's intraoral cavity; and
output, to the display, the model of the patient's teeth with the portion of the removed surface portion replaced using the received second scan data.

Instituted Grounds

Ground	Claims Challenged	35 U.S.C.	Reference(s)/Basis
1	1, 4-6, 8-12, 14-16	§ 103	Boerjes
2	1, 4-6, 8-12, 14-16	§ 103	Boerjes + Geng
3	2-3, 7, 13, 17-20	§ 103	Ground 1 + Babayoff
4	2-3, 7, 13, 17-20	§ 103	Ground 2 + Babayoff

The '936 Patent: Claim 1



1. A system for scanning a patient's teeth for a dental procedure, the system comprising:
a hand-held intraoral scanner; and
a computer readable medium including instructions that when executed by a computer system, cause the computer system to:

receive first scan data of the patient's teeth from the hand-held intraoral scanner;
display, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;

1[e] receive user input defining a portion of the model to be removed;

remove, from the displayed model, a removed surface portion of the model to be removed according to the user input;

receive second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;

1[h] replace at least a portion of the removed surface portion of the model using the received second scan data of the patient's teeth including surface data of a physically changed portion of the patient's intraoral cavity; and

output, to the display, the model of the patient's teeth with the portion of the removed surface portion replaced using the received second scan data.

Disputed

Grounds 1-2: Primary Disputed Issues

- **Ground 1 – Boerjes**
 - Whether Boerjes renders obvious partial replacement of a user-identified portion of a model after physical change
- **Ground 2 – Boerjes in view of Geng**
 - Whether Boerjes and Geng render obvious partial replacement of a user-identified portion of a model after physical change
- **Grounds 1-2: Additionally for Claim 9**
 - Whether Boerjes's identifying a portion to be replaced renders obvious demarcating a portion to be retained

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- **Ground 1 – Boerjes**
 - **Whether Boerjes renders obvious partial replacement of a user-identified portion of a model after physical change**
- Ground 2 – Boerjes in view of Geng
 - Whether Boerjes and Geng render obvious partial replacement of a user-identified portion of a model after physical change
- Grounds 1-2: Additionally for Claim 9
 - Whether Boerjes's identifying a portion to be replaced renders obvious demarcating a portion to be retained

Boerjes Overview

Boerjes discloses a quality control process for obtaining an accurate digital model of dental subject matter

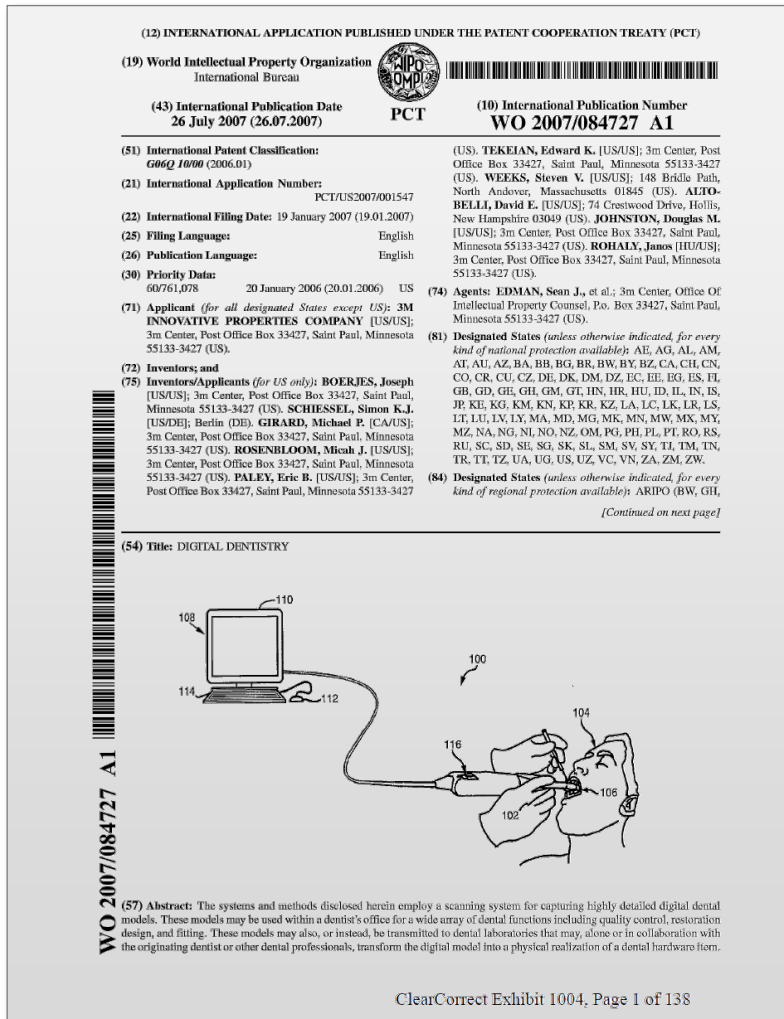


Fig. 4

Boerjes's Quality Control Process Improves Efficiency and Patient Comfort

Real-time quality control reduces or eliminates the need for follow up visits

[00190] In one aspect, quality control may include real time feedback during a scan, or between successive scans. The feedback may be rendered with suitable

a global coordinate system. By providing this information in real time within the context of a single dental visit, treatment may be generally improved by reducing or eliminating a need for follow up scans.

[00198] Any of the quality control steps above may advantageously be performed while a dental patient is still present at a dental office, or while the patient is still in a dental chair, thus reducing or eliminating the need for follow up dental visits for additional scanning.

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(22) International Filing Date: 19 January 2007 (19.01.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/761,078 20 January 2006 (20.01.2006) US

(71) Applicant (for all designated States except US): 3M INNOVATIVE PROPERTIES COMPANY [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(72) Inventors; and
(75) Inventors/Applicants (for US only): BOERJES, Joseph [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); SCHIESSEL, Simon K.J. [US/DE]; Berlin (DE); GIRARD, Michael P. [CA/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); ROSENBLUM, Micah J. [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); PALEY, Eric B. [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(74) Agents: EDMAN, Sean J., et al.; 3m Center, Office Of Intellectual Property Counsel, P.O. Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SG, SK, SL, SM, SV, SY, TL, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: DIGITAL DENTISTRY

(57) Abstract: The systems and methods disclosed herein employ a scanning system for capturing highly detailed digital dental models. These models may be used within a dentist's office for a wide array of dental functions including quality control, restoration design, and fitting. These models may also, or instead, be transmitted to dental laboratories that may, alone or in collaboration with the originating dentist or other dental professionals, transform the digital model into a physical realization of a dental hardware item.

ClearCorrect Exhibit 1004, Page 1 of 138

Boerjes's Quality Control Process Applies to Regions of the Digital Model

Users identify regions of a digital model with a variety of scan *and/or* surface preparation deficiencies

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(25) (26) (30) (71) (72) (75) (54)

[00195] Quality control, whether automated or manual, and whether local or remote, may include a variety of different dental evaluations. For example, a prepared tooth in an arch that will receive a restoration may be evaluated to determine whether there is adequate space for cement to bond the restoration to the prepared tooth surface. As another example, a dentist may visually confirm accuracy of a scan by inspection for gross errors or omissions such as holes, gaps, distortions, twists, and the like. The dentist may also visually inspect margin lines on surface preparations, and may annotate margins for identification by a dental laboratory or other fabrication

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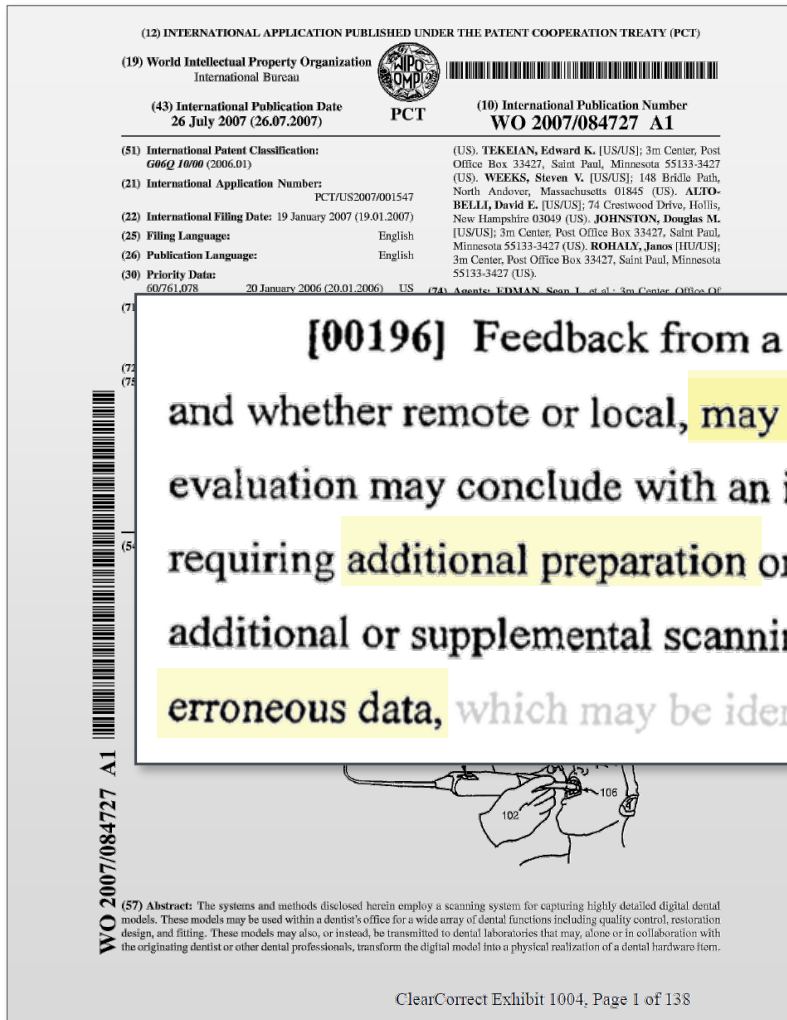
Adequate Spacing

Scan Errors

Margin Lines on Surface Preparations

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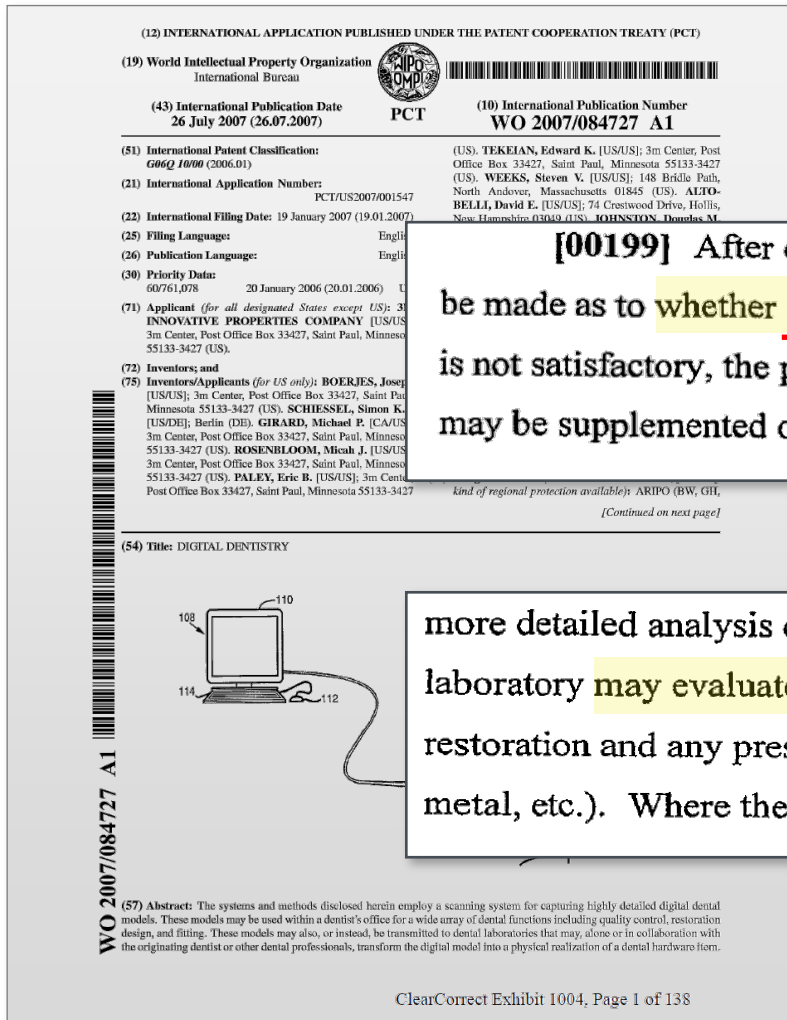


Additional Surface Preparation

Scan Errors

Boerjes's Quality Control Process Applies to Regions of the Digital Model

Users identify regions of a digital model with a variety of scan *and/or* surface preparation deficiencies



[00199] After one or more quality control steps 406-410, a determination may be made as to whether a scan and/or surface preparations are satisfactory. If the data is not satisfactory, the process 400 may proceed to step 414 where the digital model may be supplemented or replaced with new scan data. This may include, for example,

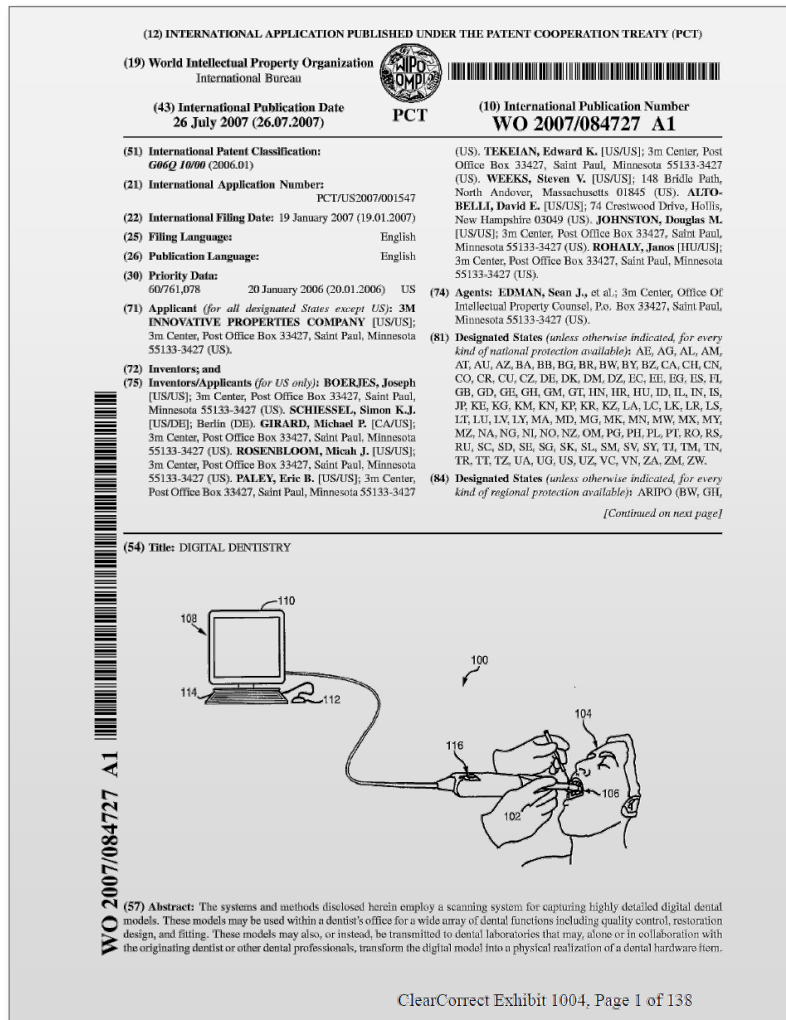
Scan and/or
Surface Preparations

more detailed analysis of the scan data by the recipient. Thus, for example, a dental laboratory may evaluate suitability of the scan and/or surface preparation for a type of restoration and any prescribed components (e.g., full ceramic, porcelain-fused-to-metal, etc.). Where the dental laboratory can quickly generate an accurate or rough

Scan and/or
Surface Preparations

Boerjes's Quality Control Process Applies to Regions of the Digital Model

Boerjes's quality control provides feedback for performing various corrective actions targeting the user-identified regions



number of forms. For example, the feedback may include text or audible narrative concerning additional scanning, additional surface preparation, or requests for confirmation. The feedback may be graphical feedback provided by highlighting questionable or erroneous areas of a preparation within a rendered display of scan data. The feedback may identify corrective action on a scan or a surface preparation. The feedback may identify a margin line which may be displayed on a two-dimensional rendering of a three-dimensional representation, and a user interface may permit the margin line to be edited or confirmed. The feedback may include a visual display with regions of inadequate margin highlighted, such as through use of color, texture, or explicit annotations, arrows, callouts, or the like, and any combination of these.

Boerjes's Quality Control Process Applies to Regions of the Digital Model

Trials@uspto.gov
571-272-7822

Paper 16
Entered: October 30, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING, LLC,
Petitioner,

v.

ALIGN TECHNOLOGY INC.,
Patent Owner.

IPR2025-00817
Patent 10,791,936 B2

Before KEVIN F. TURNER, NEIL T. POWELL, and
CYNTHIA M. HARDMAN, *Administrative Patent Judges*.
TURNER, *Administrative Patent Judge*.

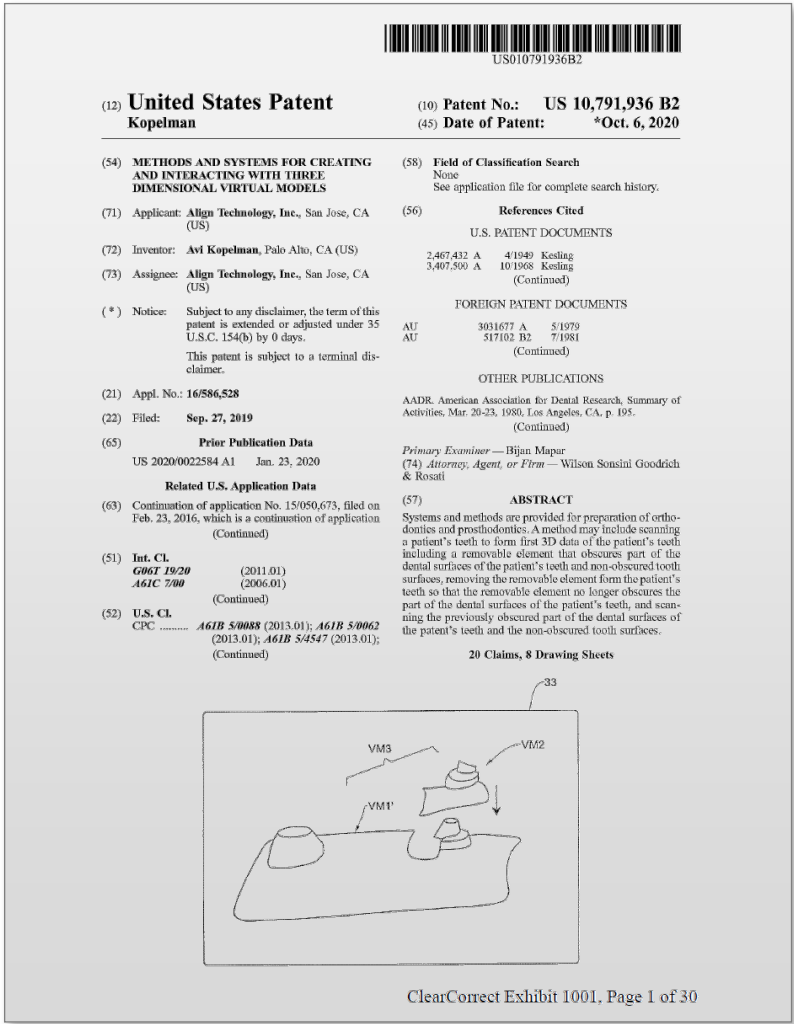
DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

The Board preliminarily made findings supporting that Boerjes discloses Claim 1[e]: “receive user input defining a portion of the model to be removed”

Institution Decision:

Although the Petition is persuasive that Boerjes allows a user to “identify areas that need replacing, such as ‘a margin line’ to be removed, ‘areas of poor margin preparation,’ and ‘holes or areas of incomplete scan[s],’” and that the user can identify regions of a prepared tooth surface requiring additional preparations and “supplemental scanning” (Pet. 32 (citing Ex. 1004 ¶¶ 189, 193, 196)), Boerjes is silent with respect to replacing at least a portion of the removed surface portion of the model using the received second scan data of the patient’s teeth, per claim 1.

The '936 Patent: Claim 1



1. A system for scanning a patient's teeth for a dental procedure, the system comprising:

a hand-held intraoral scanner; and

a computer readable medium including instructions that when executed by a computer system, cause the computer system to:

receive first scan data of the patient's teeth from the hand-held intraoral scanner;

display, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;

1[e] receive user input defining a portion of the model to be removed;

remove, from the displayed model, a removed surface portion of the model to be removed according to the user input;

receive second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;

1[h] replace at least a portion of the removed surface portion of the model using the received second scan data of the patient's teeth including surface data of a physically changed portion of the patient's intraoral cavity; and

output, to the display, the model of the patient's teeth with the portion of the removed surface portion replaced using the received second scan data.

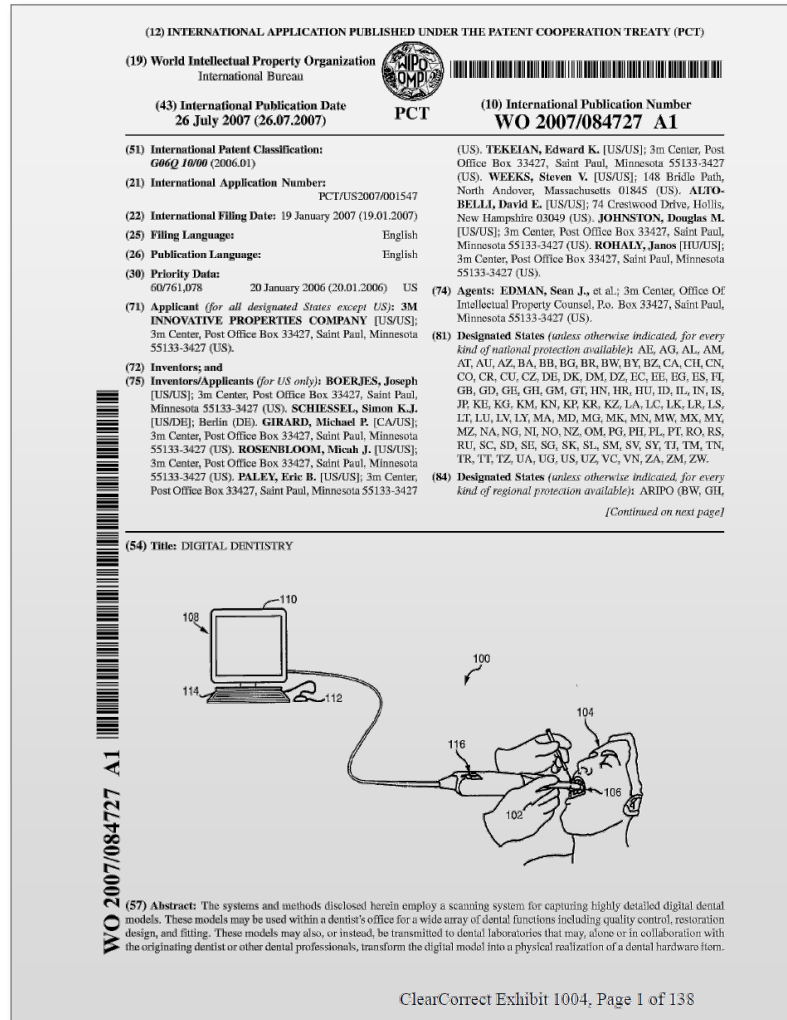
Disputed

Boerjes Teaches Region-Specific Partial Rescans

Boerjes teaches supplemental scans for the regions identified with errors

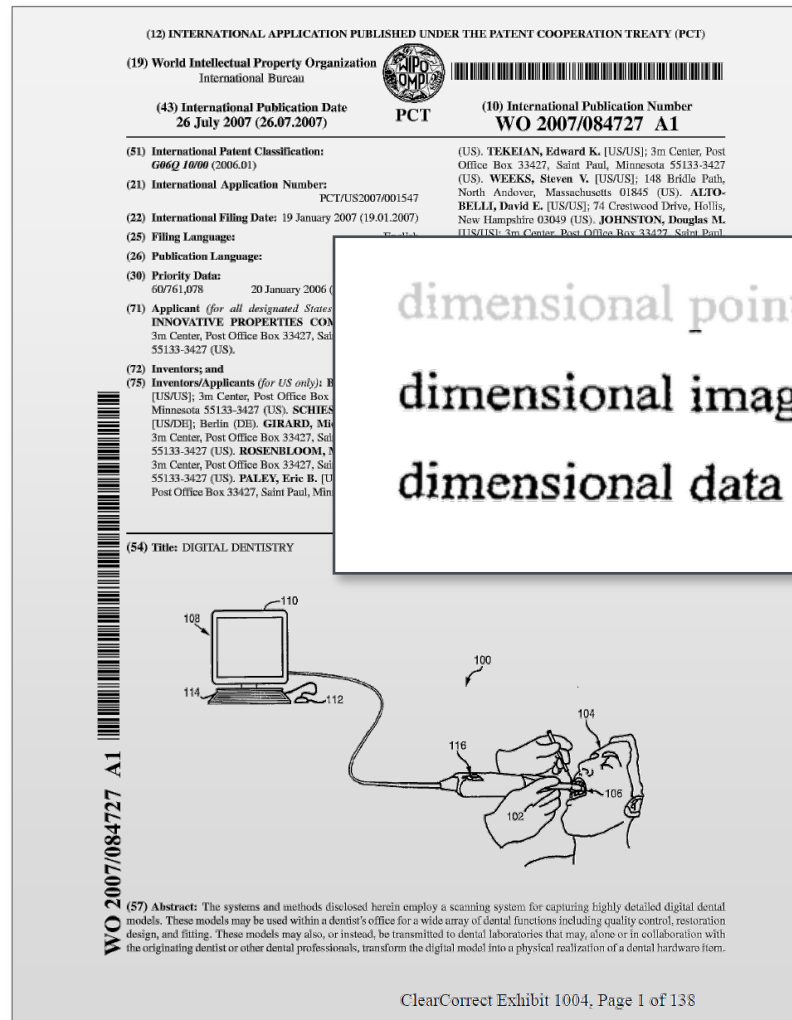
captured intraorally from a dental patient's mouth. A scan may capture a three-dimensional representation of some or all of the dentition according to particular purpose of the scan. Thus the scan may capture a digital model of a tooth, a quadrant of teeth, or a full collection of teeth including two opposing arches, as well as soft tissue or any other relevant intraoral and/or extraoral structures. In other

158. The method of claim 150, wherein the feedback includes a visual display recommending acquiring additional three-dimensional representations of one or more regions of the one or more intraoral structures.



Boerjes Teaches Registering/Stitching New 3D Data to Existing 3D Data

dimensional point clouds. The three-dimensional data for each newly acquired two-dimensional image set may be derived and fitted or “stitched” to existing three-dimensional data using a number of different techniques. Such a system employs



Boerjes Teaches Removing a Portion from the Model

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(71) Applicant (for all designated States except US): 3M INNOVATIVE PROPERTIES COMPANY [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(72) Inventors; and
(75) Inventors/Applicants (for US only): BOERJES, Joseph [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); SCHIESSEL, Simon K.J. [US/DE]; Berlin (DE); GIRARD, Michael P. [CA/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); ROSENBLUM, Micah J. [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US); PALEY, Eric B. [US/US]; 3m Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(74) Agents: EDMAN, Sean J., et al.; 3m Center, Office Of Intellectual Property Counsel, P.O. Box 33427, Saint Paul, Minnesota 55133-3427 (US).

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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, [Continued on next page])

(54) Title: DIGITAL DENTISTRY

(57) Abstract: The systems and methods disclosed herein employ a scanning system for capturing highly detailed digital dental models. These models may be used within a dentist's office for a wide array of dental functions including quality control, restoration design, and fitting. These models may also, or instead, be transmitted to dental laboratories that may, alone or in collaboration with the originating dentist or other dental professionals, transform the digital model into a physical realization of a dental hardware item.

WO 2007/084727 A1

ClearCorrect Exhibit 1004, Page 1 of 138

line. The method may include removing a portion of the three-dimensional representation below the margin line with the second tool. The method may include removing a portion of the three-dimensional representation below the margin line with the second tool to provide a virtual ditched die, and three-dimensionally printing the ditched die.

This may be followed by additional steps such as separate steps of explicitly identifying a margin line with a first tool and then manipulating the digital model “below” the margin line, i.e., away from the tooth surface fitted to a restoration, with a second tool to remove unwanted or unneeded areas from a volume bounded by the digital surface representation. This process may be semi-automated or automated,

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

Boerjes's quality control steps apply to both scan *and/or* surface preparation deficiencies

[00199] After one or more quality control steps 406-410, a determination may be made as to whether a scan and/or surface preparations are satisfactory. If the data is not satisfactory, the process 400 may proceed to step 414 where the digital model may be supplemented or replaced with new scan data. This may include, for example, new scanning to replace apparently erroneous or inadequate scan data, or a new scan of the dental subject matter following, e.g., additional surface preparation consistent with errors identified during quality control. The process 400 may then return to step 404 where a new digital model is obtained.

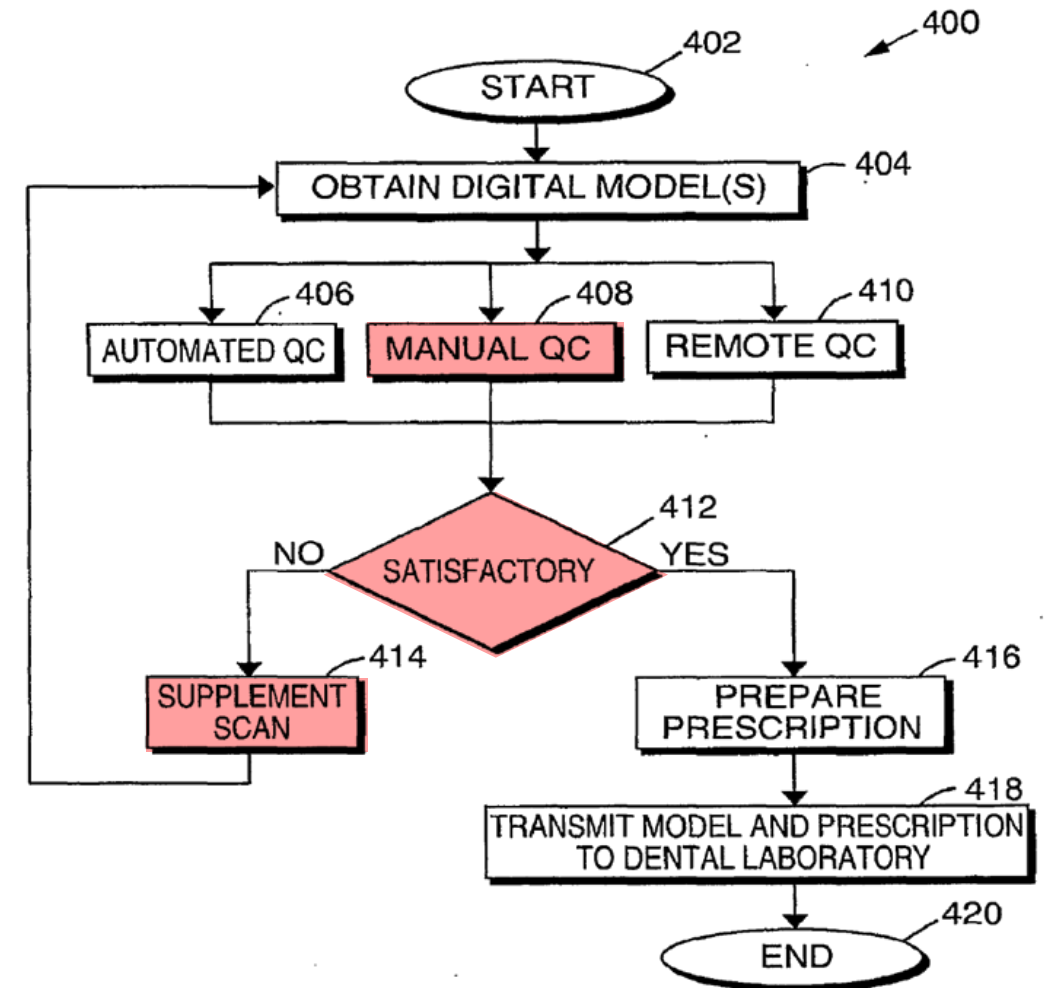


Fig. 4

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

Boerjes's supplemental scanning step 414 applies to both scan *and/or* surface preparation deficiencies

[00199] After one or more quality control steps 406-410, a determination may be made as to whether a scan and/or surface preparations are satisfactory. If the data is not satisfactory, the process 400 may proceed to step 414 where the digital model may be supplemented or replaced with new scan data. This may include, for example, new scanning to replace apparently erroneous or inadequate scan data, or a new scan of the dental subject matter following, e.g., additional surface preparation consistent with errors identified during quality control. The process 400 may then return to step 404 where a new digital model is obtained.

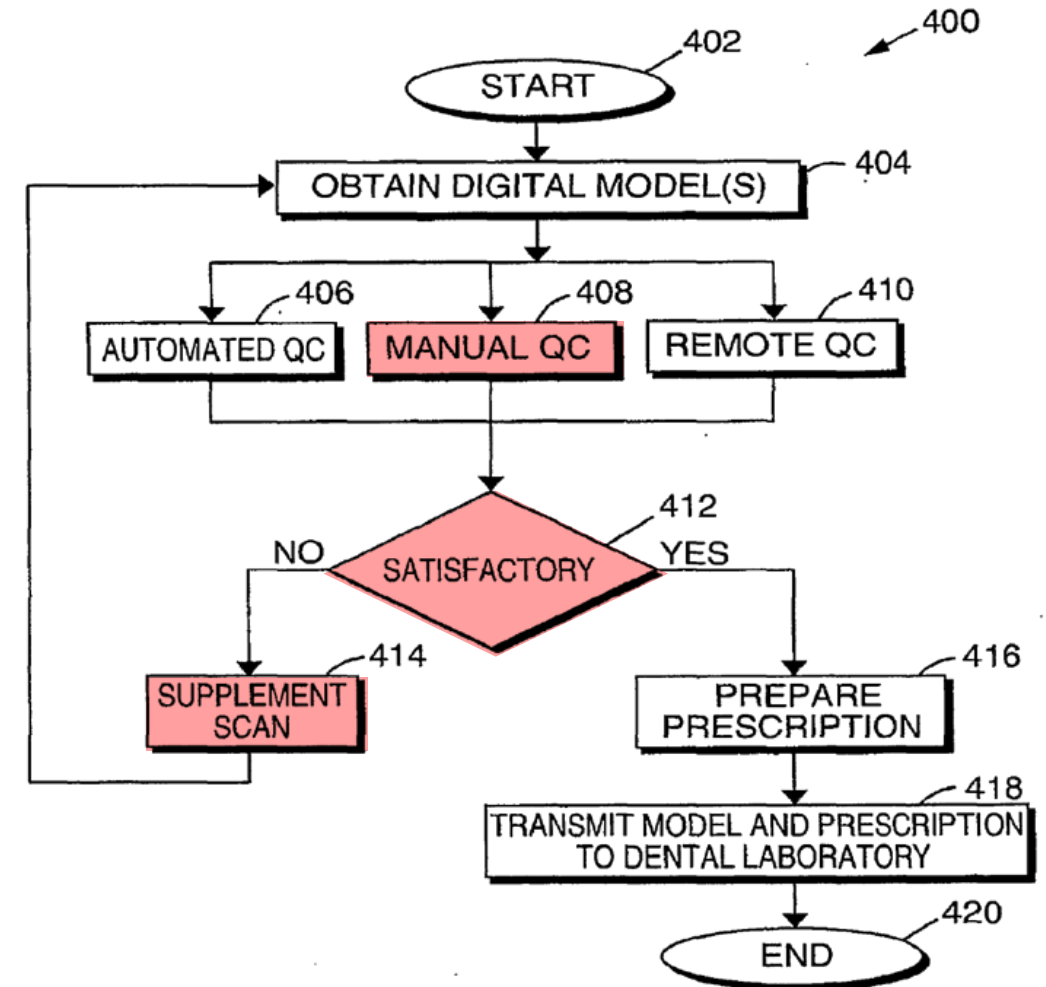


Fig. 4

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

Boerjes's teaches non-exclusive examples of supplemental scanning

[00199] After one or more quality control steps 406-410, a determination may be made as to whether a scan and/or surface preparations are satisfactory. If the data is not satisfactory, the process 400 may proceed to step 414 where the digital model may be supplemented or replaced with new scan data. This may include, for example, new scanning to replace apparently erroneous or inadequate scan data, or a new scan of the dental subject matter following, e.g., additional surface preparation consistent with errors identified during quality control. The process 400 may then return to step 404 where a new digital model is obtained.

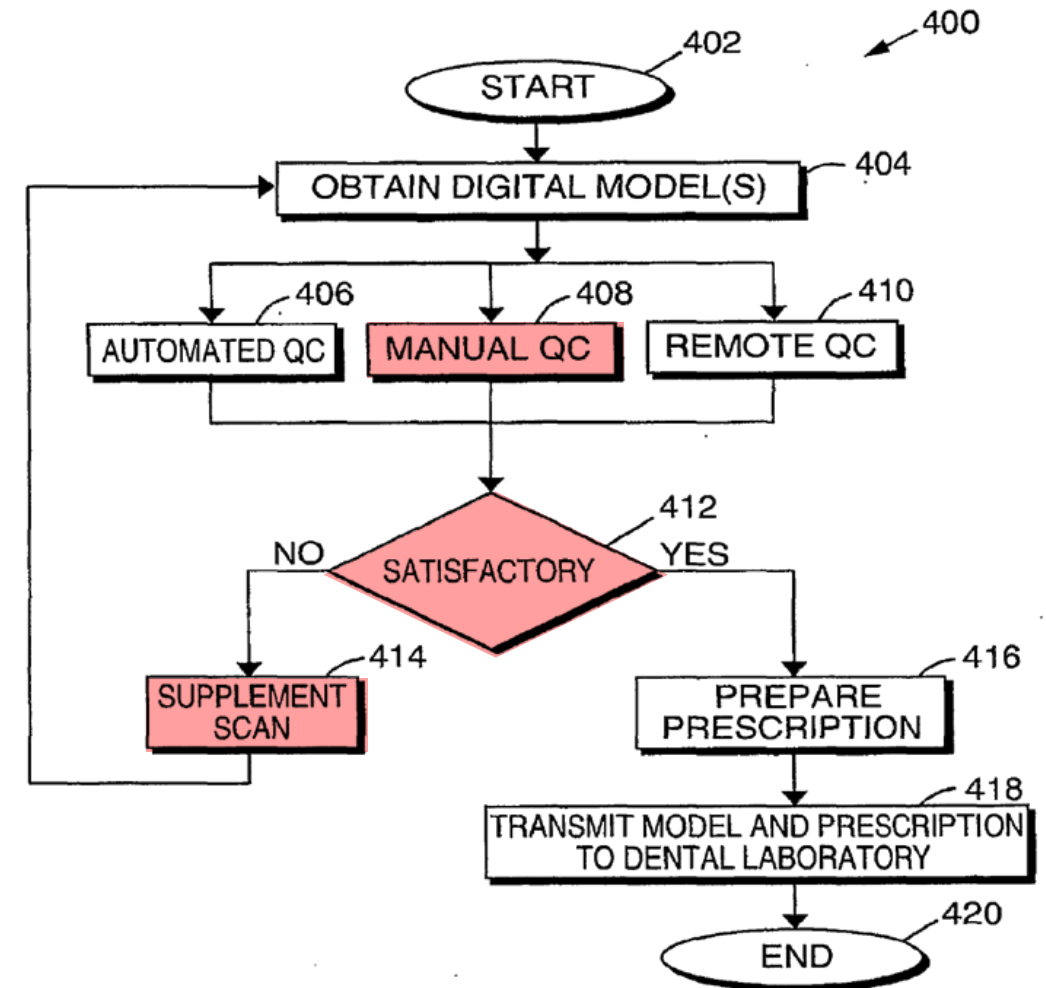


Fig. 4

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

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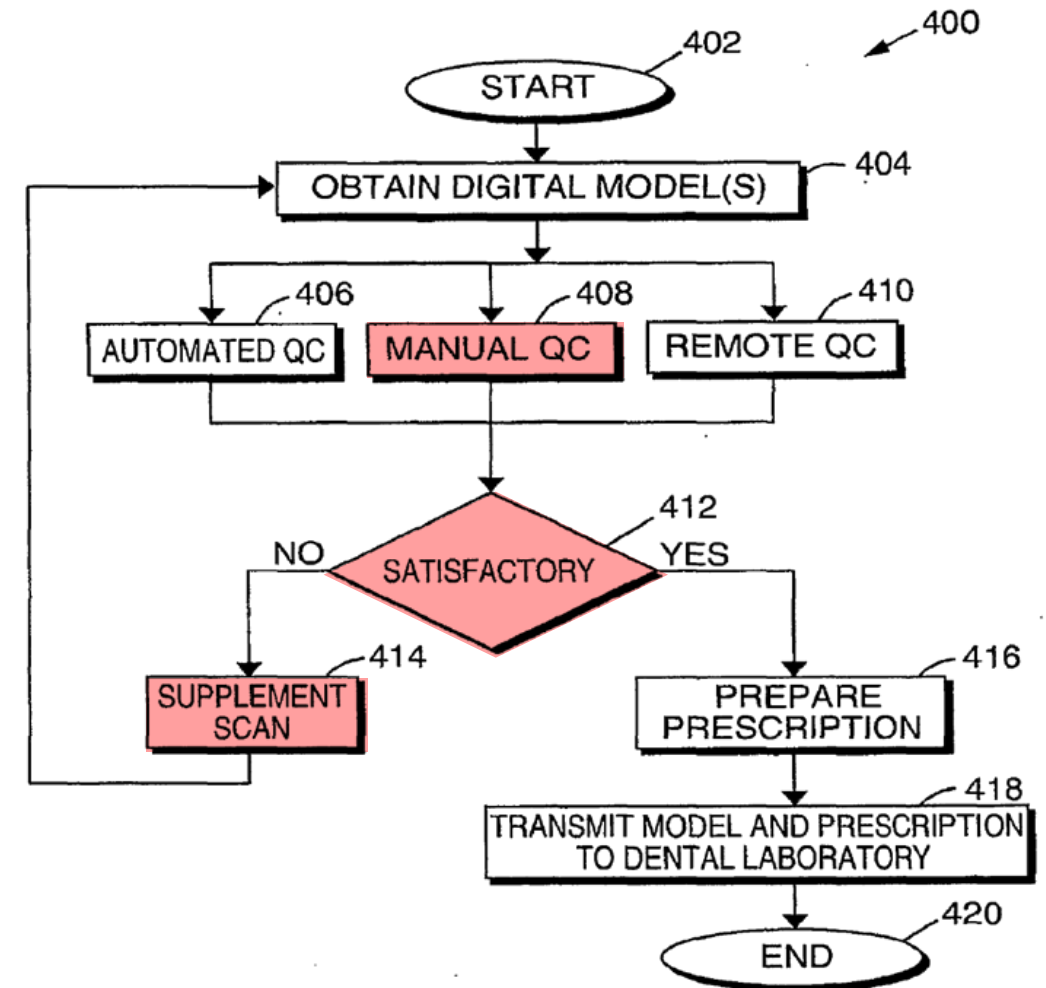


Fig. 4

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

Dr. Karam: Boerjes teaches supplemental scanning of regions of the model

So in Figure 4 it makes it more clear because supplement scan, whether new scan data, additional scan, whatever you want to call it, it doesn't change the fact that it is a supplement scan. The supplement scan has its own 3D model because every time you scan, so supplement doesn't necessarily mean the whole thing, redo the model, you are supplementing with a scan by scanning these regions that are or the region that needs to be improved or prepared more, whatever the scan is,

And that is clearly also depicted in Figure 4 and also in the descriptions in Boerjes of these tools and user given feedback and marking regions and regions that require additional preparation or regions that require additional correction, additional accuracy and so forth.

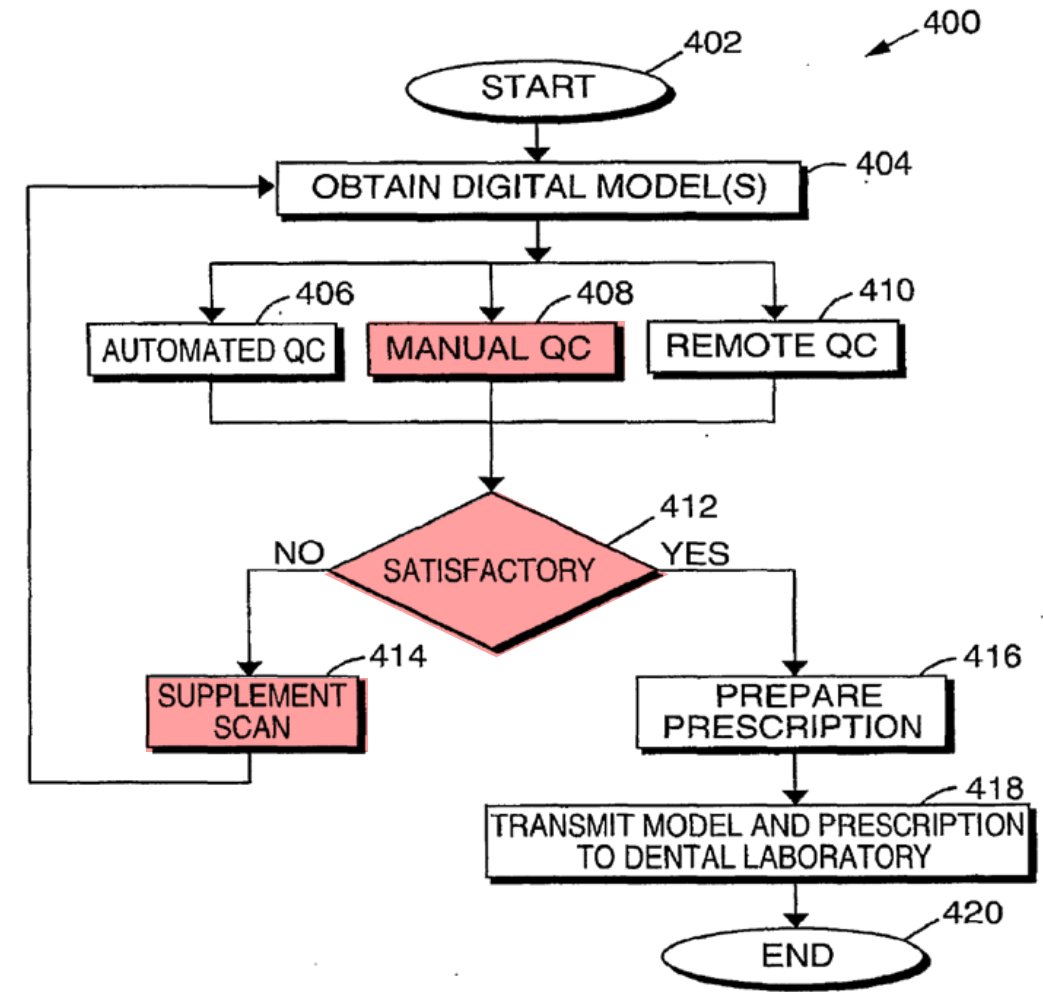


Fig. 4

Boerjes's Region-Specific Quality Control Applies to Both Scan and/or Surface Preparation Deficiencies

Dr. Karam: Boerjes teaches replacing the user-identified portion of the model

identified during quality control.” *Id.*, [00199], Fig. 4. A person of ordinary skill in the art would have understood that in Boerjes, when the user identifies a portion of the model requiring additional preparation or reduction, new scanning following additional surface preparation consistent with the user’s identification would be performed, and that the new scan data would be used to replace the user-identified portion of the model to obtain an updated digital model in step 404. *Id.*, [00196]-[00199]; *see also id.* [00144] (“The three-dimensional data for each newly

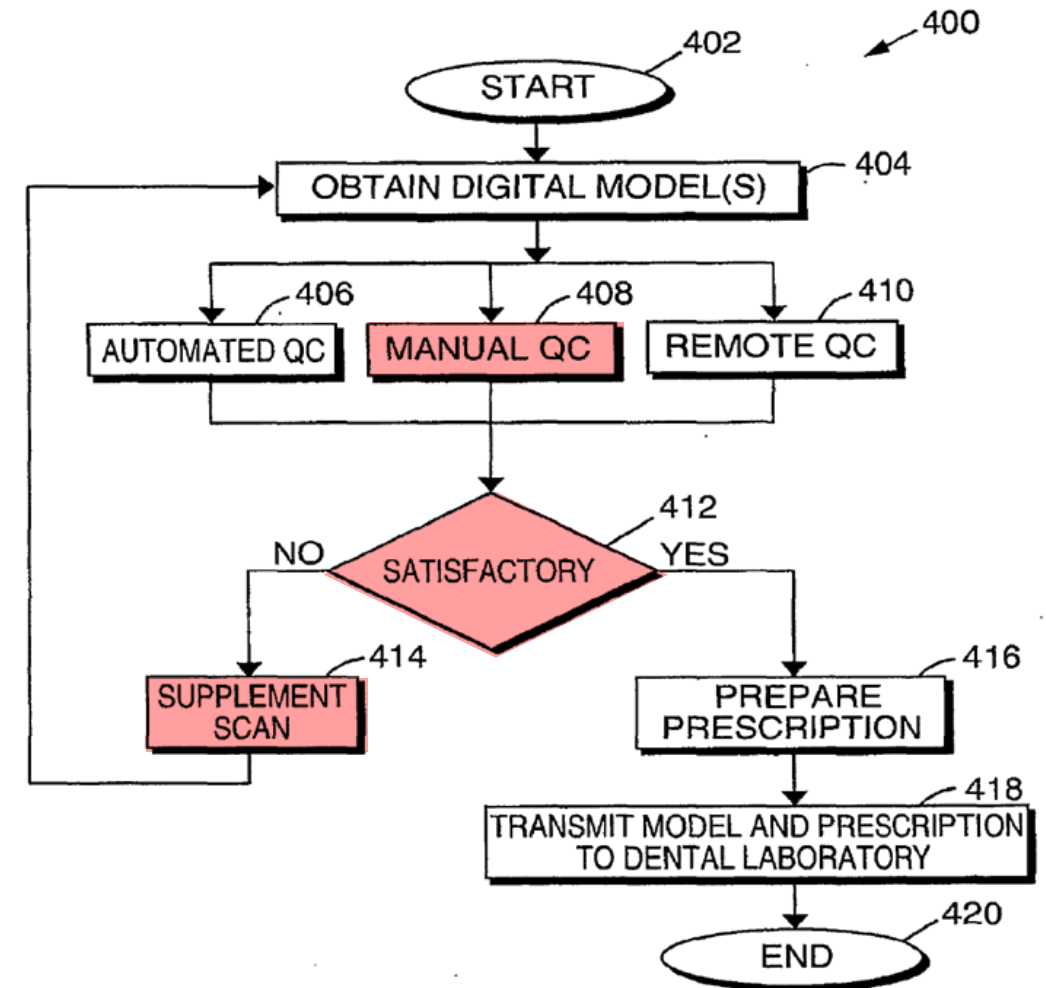


Fig. 4

Patent Owner's "Two Alternatives" Theory

Patent Owner's "two alternatives" theory is based on Boerjes's paragraph [00199].

Patent Owner's Response:

This paragraph lays out two alternatives for step 414: (1) the digital model may be supplemented; or (2) the digital model may be replaced. Paralleling these two options, Boerjes describes how each may be performed, in order, disclosing that this can include (1) new scanning to replace apparently erroneous or inadequate scan data; or (2) a new scan of the dental subject matter following, e.g., additional surface preparation. EX2011, ¶69. As stated, the only option Boerjes provides following "additional surface preparation" is an entirely new scan of the dental subject matter. *Id.*

of the 3D model to be modified. EX1004, [00197]; EX2011, ¶58. Paragraph 199 (discussed more below with respect to limitation 1[h]) only discusses two alternatives that may be performed after the quality control steps, supplementing the digital model "to replace apparently erroneous or inadequate scan data" or replacing the digital model with "a new scan of the dental subject matter following, e.g., additional surface preparation." EX1004, [00199]. Again, Boerjes is silent

Patent Owner's "Two Alternatives" Theory

Patent Owner: Boerjes's supplemental scanning replaces erroneous or inadequate scan data

- “Boerjes[’s] replacement operation is of erroneous or inadequate scan data.”
- “Boerjes’s discussion of replacing erroneous or inadequate scan data ... is ultimately beside the point ...”
- “Boerjes ... instead only generally discusses supplementing an existing 3D model or replacing it ...”
- Boerjes’s identification of “regions of a digital model requiring additional or supplemental scanning” is associated with “incomplete, erroneous, or potentially erroneous data,” as opposed to “regions of a prepared tooth surface requiring additional preparation or reduction.”

Patent Owner's "Two Alternatives" Theory

Dr. Foroosh: Supplemental scanning replaces erroneous scan data

A A new scan is performed to handle either of those two cases. So the Case 1, a new scan is taken to supplement the initial model. And in the case of additional surface preparation, a new scan is taken to -- to create and complete a new model.

Q In Case 1, a new scan is to take -- supplement the initial model, or to replace the erroneous scan data. Correct?

A Yes, it's replaced with the new scan data.

Q And in your view, in the second case, a new scan is taken to create a complete new model.

A That's right.

Now, it could be the case that is caused by insufficient or inaccurate data, in which case they are supplementing. So these models are kept all together. In the case of, as Boerjes described it in that paragraph, in case where there is additional surface preparation, in that case the whole new digital model is produced that -- to -- and the old digital model is discarded.

Patent Owner's "Two Alternatives" Theory

Dr. Foroosh: Old model is discarded

Now, it could be the case that is caused by insufficient or inaccurate data, in which case they are supplementing. So these models are kept all together. In the case of, as Boerjes described it in that paragraph, in case where there is additional surface preparation, in that case the whole new digital model is produced that -- to -- and the old digital model is discarded.

Dr. Foroosh: Boerjes does not require the new scan to rescan all dentition in the old model

Q So let's consider an example where the first model covers the whole mouth and a physical change is made to a portion of a tooth.

In Boerjes's second case, when you obtain this new model, do you have to scan the entire whole mouth again to obtain the new model?

MR. ARGENTI: Objection. Form. Scope.

A Boerjes is not teaching -- is not discussing that. Boerjes is just saying that in the second case, create a new model. It doesn't say scan the whole mouth if -- if -- Boerjes is not discussing that. I'm just reading what I'm

Patent Owner's "Two Alternatives" Theory Lacks Reasonable Basis

Dr. Foroosh offered no explanation for the "two alternatives" theory

Q So as a person of ordinary skill in the art, why do you think Boerjes does separate these two cases?

MR. ARGENTI: Objection. Form.

A I did not express any opinion on that. And, I mean, it -- it does what it does. Its teaching is, these are two separate cases, that quality control may return and do this. If these are his teachings, I'm not here to argue why this teaching is the way it is. He's teaching what he's teaching. I mean, I cannot say more than that.

Q So you don't understand why Boerjes is separating these two cases?

MR. ARGENTI: Objection to form.

Q Is that what you are saying?

A I don't need to understand. Because, I mean, why do I need to understand? I am just saying Boerjes is teaching that. I mean, I'm not here to judge whether Boerjes is doing the right thing or wrong thing or why is he doing. I'm just saying that Boerjes is teaching it. This is what Boerjes is teaching.

Patent Owner's "Two Alternatives" Theory Lacks Reasonable Basis

Dr. Foroosh refused to offer an opinion on what happens when there is both erroneous data and an inadequate surface preparation.

Dr. Foroosh:

Q So you don't know what a POSITA would do if there is a scenario where both erroneous data and inadequate surface preparation. Correct?

That -- that sounds like not something that I should be offering an opinion on, I mean.

But Boerjes expressly contemplates both in the same model.

Boerjes

[00199] After one or more quality control steps 406-410, a determination may be made as to whether a scan and/or surface preparations are satisfactory. If the data is not satisfactory, the process 400 may proceed to step 414 where the digital model may be supplemented or replaced with new scan data. This may include, for example, new scanning to replace apparently erroneous or inadequate scan data, or a new scan of the dental subject matter following, e.g., additional surface preparation consistent with errors identified during quality control. The process 400 may then return to step 404 where a new digital model is obtained.

Boerjes Renders Obvious Partial Replacement After Physical Change

Ground 1 explains that Boerjes renders obvious partial replacement of a portion of the model after physical change

Petition:

**i. Boerjes discloses and renders obvious 1[h]
(Ground 1)**

Boerjes discloses, or at least renders obvious, obtaining new (second) scan data to “*replace[]*” at least a portion of the removed surface portion of the model following additional surface preparations of teeth—i.e., after a portion of the patient’s intraoral cavity has been “physically changed.” Ex-1004, [00199]

Ex-1003, ¶ 90. For instance, a POSITA would have understood that removing the identified portion would have been a suitable way to allow new scan data to replace the identified, unwanted portion. Ex-1003, ¶¶ 90-91. A POSITA would

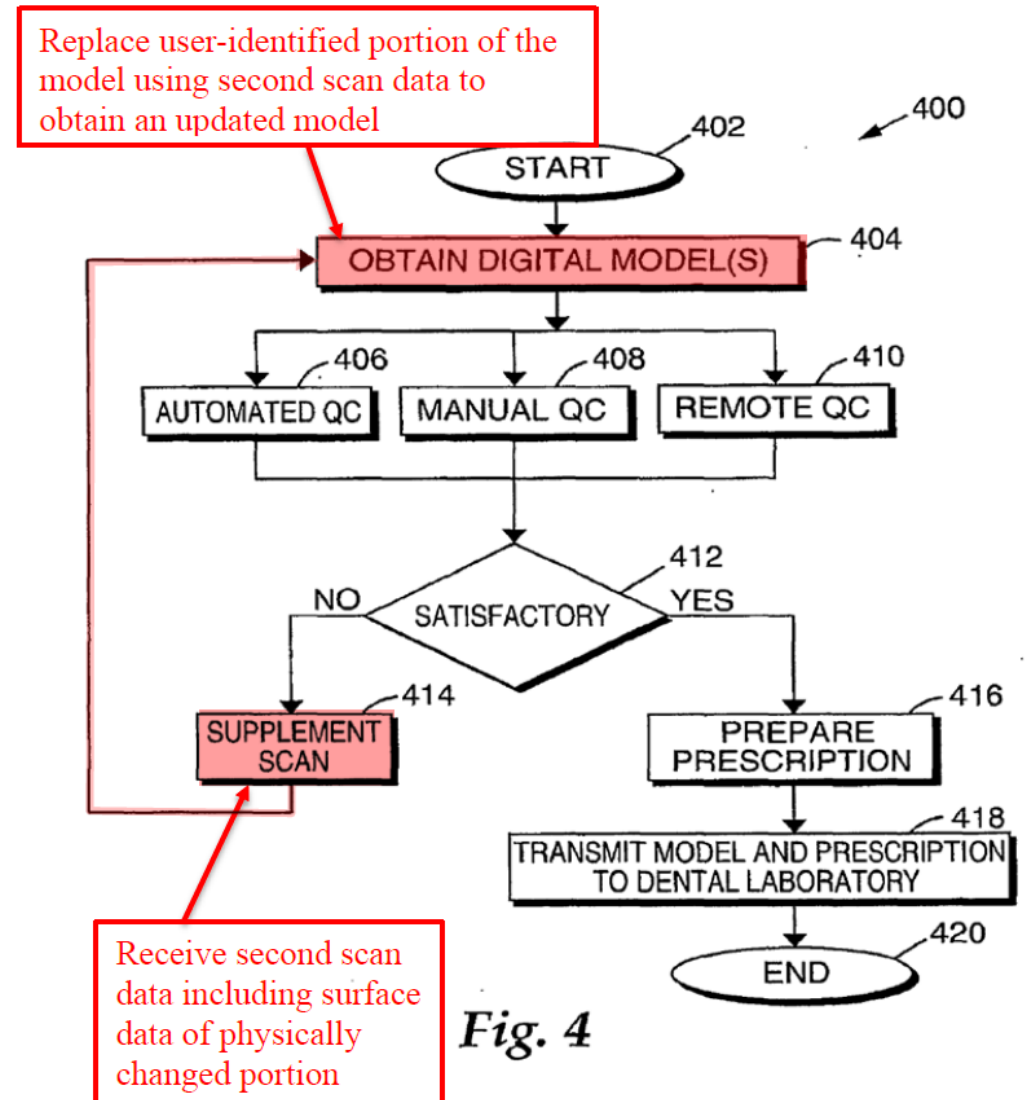
Also, a POSITA implementing Boerjes would have found it preferable to remove the user-identified portion from the model before replacing it with new scan data. Ex-1003, ¶ 92. This is because removing the unwanted data would improve the accuracy and efficiency of replacing the user-identified surface portion with new scan data, reduce time for the dental procedure, and improve patients’ comfort. Ex-1003, ¶¶ 92-94; Ex-1005, 3:23-34.

Boerjes Renders Obvious Partial Replacement After Physical Change

Reply:

One skilled would have understood that Boerjes teaches, or at least suggests, partial replacement to correct various scan and/or preparation deficiencies in the model. Pet., 31-33, 40-45; Ex-1003, ¶¶107-110; Ex-2013, 73:24-75:7, 110:9-112:24; see *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1049 (Fed. Cir. 2019) (consider prior art “not only for what it expressly teaches, but also for what it fairly suggests”); *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013).

limitations 1[e]-1[f]. Pet., 31-35; Ex-1003, ¶¶91-96. Once Boerjes’s quality-control process identifies a portion as having a scan deficiency or surface-preparation deficiency, removing that identified portion would have been a suitable, more efficient way to allow new scan data to replace the identified, unwanted data, and would have also avoided further confusion from retaining deficient data. Pet., 31-35; Ex-1003, ¶¶90-96.



Patent Owner's Alleged "Conventional Approach"

Patent Owner's Response:

references from the same inventive group as the now-asserted prior art, the claimed approach differs from the conventional approach of obtaining an entirely new scan upon physical modification.

intraoral cavity has been physically modified. Instead, both Boerjes and Geng disclose systems that follow the conventional approach at the time: after physically modifying a part of the patient's intraoral cavity, a new scan and model should be obtained, not a composite containing both pre- and post-modification scan data.



US010791936B2

(12) **United States Patent**
Kopelman

(10) **Patent No.:** US 10,791,936 B2
(45) **Date of Patent:** *Oct. 6, 2020

(54) **METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS**

(58) **Field of Classification Search**
None
See application file for complete search history.

(71) **Applicant:** Align Technology, Inc., San Jose, CA (US)

(56) **References Cited**

(72) **Inventor:** Avi Kopelman, Palo Alto, CA (US)

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(73) **Assignee:** Align Technology, Inc., San Jose, CA (US)

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

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(22) **Filed:** Sep. 27, 2019

(65) **Prior Publication Data**
US 2020/0022584 A1 Jan. 23, 2020

Primary Examiner — Bijan Mapar
(74) *Attorney, Agent, or Firm* — Wilson Sonsini Goodrich & Rosati

Related U.S. Application Data

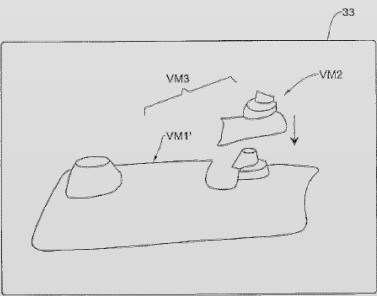
(63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued)

(57) **ABSTRACT**
Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces.

(51) **Int. Cl.**
G06T 19/20 (2011.01)
A61C 7/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **A61B 5/0088** (2013.01); **A61B 5/0062** (2013.01); **A61B 5/4547** (2013.01);
(Continued)

20 Claims, 8 Drawing Sheets



ClearCorrect Exhibit 1001, Page 1 of 30

The Board Previously Found Similar Claims Unpatentable in the '192 Patent



US009299192B2

(12) **United States Patent**
Kopelman

(10) Patent No.: US 9,299,192 B2
(45) Date of Patent: Mar. 29, 2016

(54) METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS

19/20 (2013.01); *G06T 2210/41* (2013.01);
G06T 2219/2021 (2013.01)

(58) **Field of Classification Search**

None
See application file for complete search history.

(75) Inventor: **Avi Kopelman**, Tenafly, NJ (US)

(73) Assignee: **ALIGN TECHNOLOGY, INC.**, San Jose, CA (US)

(56) **References Cited**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 108 days.

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(21) Appl. No.: 13/574,723

(22) PCT Filed: **Jul. 19, 2011**

(86) PCT No.: **PCT/IL2011/000574**

§ 371 (c)(1),
(2), (4) Date: **Jan. 4, 2013**

(87) PCT Pub. No.: **WO2012/011101**

PCT Pub. Date: Jan. 26, 2012

(65) **Prior Publication Data**

US 2013/0110469 A1 May 2, 2013

Chapuis, et al. A new system for computer-aided preoperative planning and intraoperative navigation during corrective jaw surgery. *IEEE Trans Inf Technol Biomed.* May 2007;11(3):274-87.

(Continued)

(Continued)

Related U.S. Application Data

(60) Provisional application No. 61/365,556, filed on Jul. 19, 2010.

Primary Examiner — Said Broome
(74) *Attorney, Agent, or Firm* — Wilson, Sensini, Goodrich
& Rosati

ABOUT A CLIP

(51) **Int. Cl.**

G06T 19/00	(2011.01)
G06T 19/20	(2011.01)

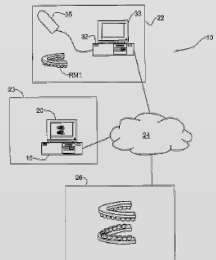
G901 19/20	(2011,01)
A61C 13/00	(2006,01)

A61C 7/00 (2006.01)

(52) U.S. Cl.
CPC: G06T 19/00 (2011)

(57) ABSTRACT

Systems and methods are provided for modifying a virtual model of a physical structure with additional 3D data obtained from the physical structure to provide a modified virtual model.

[illegible]

ClearCorrect Exhibit 1025, Page 1 of 27

1. A method for generating a modified virtual model of a physical structure, comprising:

(A) displaying an image of a first virtual model on a display operatively connected to a computer system, wherein the first virtual model is generated from first 3D scan data of the physical structure, and wherein said first virtual model fails to properly represent a first physical part of the physical structure;

(B) receiving user input identifying at least a portion of the first virtual model that is desired to be modified, wherein the user input is generated by user interaction with the image on the display;

(C) receiving a second virtual model of the physical structure with the computer system, the second virtual model generated from second 3D scan data of the physical structure; and

(D) modifying the system by replacing the first virtual model with the second virtual model.

(D) modifying the first virtual model with the computer system by replacing at least said identified portion of the first virtual model with a corresponding portion of the second virtual model, thereby generating the modified virtual model.

The Board Previously Found Similar Claims Unpatentable in the '192 Patent


US009299192B2

(12) **United States Patent**
Kopelman

(10) **Patent No.:** **US 9,299,192 B2**
(45) **Date of Patent:** **Mar. 29, 2016**

(54) **METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS**

(75) **Inventor:** **Avi Kopelman, Tenafly, NJ (US)**

(73) **Assignee:** **ALIGN TECHNOLOGY, INC., San Jose, CA (US)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 108 days.

(21) **Appl. No.:** **13/574,723**

(22) **PCT Filed:** **Jul. 19, 2011**

(86) **PCT No.:** **PCT/IL2011/000574**
§ 371 (c)(1),
(2), (4) **Date:** **Jan. 4, 2013**

(87) **PCT Pub. No.:** **WO2012/011101**
PCT Pub. Date: **Jan. 26, 2012**

(65) **Prior Publication Data**
US 2013/0110469 A1 May 2, 2013

Related U.S. Application Data

(60) **Provisional application No. 61/365,556, filed on Jul. 19, 2010.**

(51) **Int. Cl.**
G06T 19/00 (2011.01)
G06T 19/20 (2011.01)
A61C 13/00 (2006.01)
A61C 7/00 (2006.01)
(52) **U.S. Cl.**
CPC **G06T 19/00** (2013.01); **A61C 7/002** (2013.01); **A61C 13/0004** (2013.01); **G06T**

(58) **Field of Classification Search**
None
See application file for complete search history.

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(Continued)

ABSTRACT
(57) Systems and methods are provided for modifying a virtual model of a physical structure with additional 3D data obtained from the physical structure to provide a modified virtual model.

32 Claims, 8 Drawing Sheets

ClearCorrect Exhibit 1025, Page 1 of 27

13. The method according to claim 12, wherein at least a part of said surface of interest in said first physical portion of said first physical part was obscured when the said first 3D virtual model was created, and wherein said second physical portion of said second physical part corresponds to said first physical portion of said first physical part wherein said at least a part of said surface of interest is now unobscured.

18. The method according to claim 17, wherein at least a part of said surface of interest in said first physical portion of said first physical part is inadequate for enabling a prosthesis to be mounted with respect thereto, and wherein said second physical portion of said second physical part corresponds to said first physical portion of said first physical part wherein said at least a part of said surface of interest has been physically altered.

19. The method according to claim 18, wherein said at least a part of said surface of interest has been physically altered via a material removal operation to modify topology of said at least a part of said surface of interest.

The Board Previously Found Similar Claims Unpatentable in the '192 Patent

Trials@uspto.gov
571-272-7822

Paper 29
Date: July 20, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

3SHAPE A/S and 3SHAPE INC.,
Petitioner,

v.

ALIGN TECHNOLOGY, INC.,
Patent Owner.

IPR2019-00134
Patent 9,299,192 B2

Before BRIAN J. McNAMARA, NEIL T. POWELL, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

McNAMARA, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

ClearCorrect Exhibit 1026, Page 1 of 61

Claims	35 U.S.C. §	Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–5, 8–13, 15–23, 25–32	103(a)	Paley, Kriveshko	1–5, 8–13, 15–23, 25–32	
14	103(a)	Paley, Kriveshko, Babayoff	14	
24	103(a)	Paley, Kriveshko, Chishti	24	
Overall Outcome	103(a)		1–5, 8–32	

'936 Challenged Claims are Substantially Similar to Unpatentable '192 Claim

Acting Director Referral Decision:

Director_Discretionary_Decision@uspto.gov
571-272-7822

Paper 13
Date: August 29, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE OFFICE OF THE UNDER SECRETARY OF COMMERCE
FOR INTELLECTUAL PROPERTY AND DIRECTOR OF THE
UNITED STATES PATENT AND TRADEMARK OFFICE

CLEARCORRECT OPERATING, LLC,
Petitioner.

v.

ALIGN TECHNOLOGY, INC.,
Patent Owner.

IPR2025-00814 (Patent 10,456,217 B2)
IPR2025-00815 (Patent 10,524,879 B2)
IPR2025-00816 (Patent 11,369,456 B2)
IPR2025-00817 (Patent 10,791,936 B2)
IPR2025-00818 (Patent 10,973,613 B2)
IPR2025-00819 (Patent 11,154,384 B2)
IPR2025-00820 (Patent 11,648,090 B2)
IPR2025-00821 (Patent 11,648,091 B2)

Before COKE MORGAN STEWART, *Acting Under Secretary of
Commerce for Intellectual Property and Acting Director of the United States
Patent and Trademark Office.*

DECISION
Referring the Petitions to the Board

17. In particular, the patent examiner determined that the claims were allowable because the closest prior art did not provide for updating a scan of a patient's teeth after modifications to the intra-oral cavity were made (e.g., tooth movement). *Id.* at 9; IPR2025-00817, Ex. 1002, 374–75. However, the Board had previously conducted an *inter partes* review involving an ancestral patent and issued a final written decision finding a substantially similar scan-after-modification claim unpatentable. IPR2025-00817, Ex. 1026, 32. The patent examiner appears to have been aware of the *inter partes* review prior to allowing the challenged claims because it was cited on an information disclosure statement. *See* IPR2025-00817, Ex. 1002, 368 (IDS providing the final written decision in IPR2019-00134), 376 (patent examiner acknowledging the IDS). The patent examiner, however, did not discuss why the challenged claims were patentably distinct from those the Board found unpatentable, despite the strong similarity between the claims.

Boerjes Renders Obvious Partial Replacement After Physical Change

Trials@uspto.gov
571-272-7822

Paper 16
Entered: October 30, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING, LLC,
Petitioner,

v.

ALIGN TECHNOLOGY INC.,
Patent Owner.

IPR2025-00817
Patent 10,791,936 B2

Before KEVIN F. TURNER, NEIL T. POWELL, and
CYNTHIA M. HARDMAN, *Administrative Patent Judges*.
TURNER, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

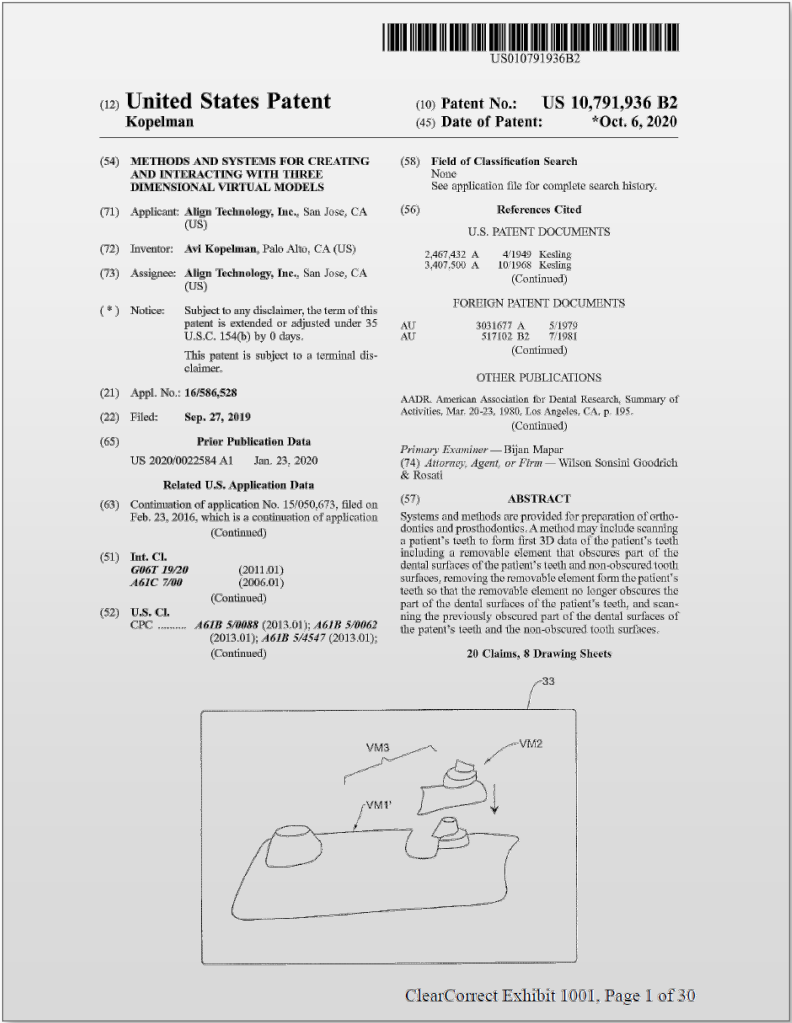
The Board preliminarily made findings supporting that Boerjes discloses all of Claim 1[h] except the physical change

Institution Decision:

suggest such processes. Although Boerjes allows for the *possibility* that portions of a model can be identified as needing replacement or supplementation, it does not disclose the partial replacement required by the instant, independent claims. Boerjes's actual disclosure details that supplemental scanning is used to compensate for an inadequate scan, but not disclosed to be used to stitch together before-and-after models that have undergone an intervening physical change.

Claim 1[h]: “replace at least a portion of the removed surface portion of the model using the received second scan data of the patient’s teeth including surface data of a physically changed portion of the patient’s intraoral cavity”

The '936 Patent: Claim 1



1. A system for scanning a patient's teeth for a dental procedure, the system comprising:
a hand-held intraoral scanner; and
a computer readable medium including instructions that when executed by a computer system, cause the computer system to:
receive first scan data of the patient's teeth from the hand-held intraoral scanner;
display, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;
1[e] receive user input defining a portion of the model to be removed;
remove, from the displayed model, a removed surface portion of the model to be removed according to the user input;
receive second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;
1[h] replace at least a portion of the removed surface portion of the model using the received second scan data of the patient's teeth including surface data of a physically changed portion of the patient's intraoral cavity; and
output, to the display, the model of the patient's teeth with the portion of the removed surface portion replaced using the received second scan data.

Disputed

Grounds 1-2: Primary Disputed Issues

- Ground 1 – Boerjes
 - Whether Boerjes renders obvious partial replacement of a user-identified portion of a model after physical change
- **Ground 2 – Boerjes in view of Geng**
 - **Whether Boerjes and Geng render obvious partial replacement of a user-identified portion of a model after physical change**
- Grounds 1-2: Additionally for Claim 9
 - Whether Boerjes's identifying a portion to be replaced renders obvious demarcating a portion to be retained

Geng Overview

Geng discloses an intraoral scanner system and method for interactive 3D dental imaging for dental prostheses fabrication

(12) United States Patent Geng

(10) Patent No.: US 7,474,932 B2
(45) Date of Patent: Jan. 6, 2009

(54) DENTAL COMPUTER-AIDED DESIGN (CAD) METHODS AND SYSTEMS

(75) Inventor: Z. Jason Geng, Rockville, MD (US)

(73) Assignee: Technet Holdings, Inc., Boston, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 382 days.

(21) Appl. No.: 10/973,149

(22) Filed: Oct. 25, 2004

Prior Publication Data
US 2005/0089822 A1 Apr. 28, 2005

Related U.S. Application Data

(60) Provisional application No. 60/514,148, filed on Oct. 23, 2003.

(51) Int. Cl. G06F 19/00 (2006.01)
A61C 13/00 (2006.01)

(52) U.S. Cl. 700/98; 433/167
(58) Field of Classification Search 700/95-98, 700/117-119, 159-163, 179-185; 433/109, 1, 433/201.1, 202.1, 213, 215, 218, 223, 167
See application file for complete search history.

(56) References Cited

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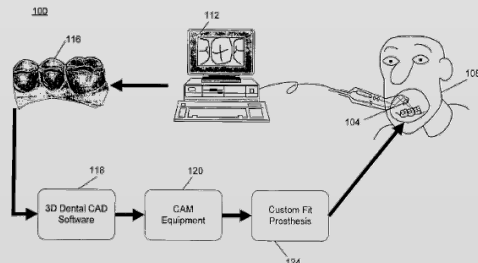
* cited by examiner

Primary Examiner—M. N. Von Bohr
(74) Attorney, Agent, or Firm—Steven L. Nichols; Rader, Fishman & Grauer PLLC

(57) ABSTRACT

The present specification describes systems and methods for interactive three-dimensional dental imaging. More specifically, the present methods and systems provide for interactive computer-aided design (CAD) in dental applications. According to one of many possible embodiments, an interactive dental computer-aided design (CAD) system includes a graphical user interface for displaying at least one three-dimensional (3D) image for viewing by an operator, an access interface for receiving input from the operator, and a prosthesis design module providing design tools for creating a virtual 3D model of a dental prosthesis responsive to operator input.

36 Claims, 5 Drawing Sheets



ClearCorrect Exhibit 1005, Page 1 of 15

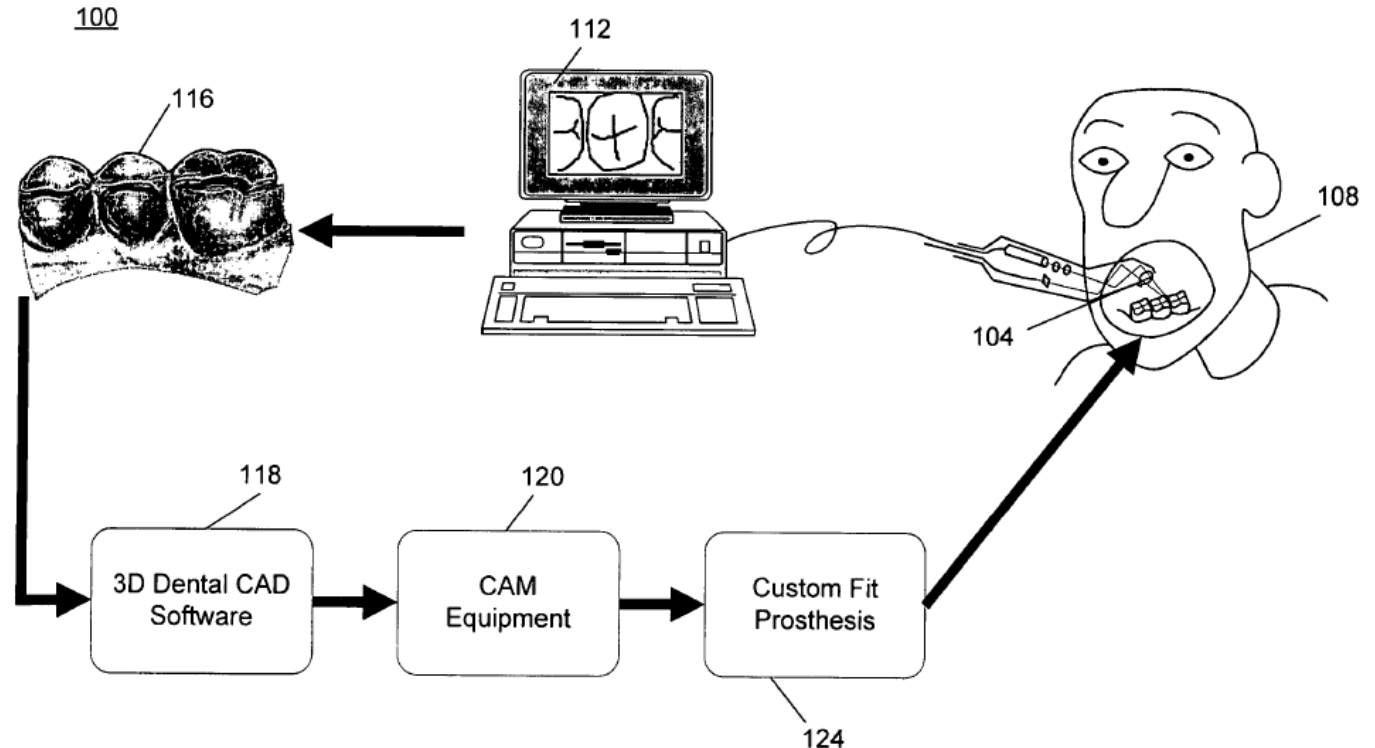


Fig. 1

Geng Discloses an Editor Tool for Removing Undesirable Area(s) on the 3D Model

The editor (312) can include general-purpose 3D model editing software that allows operators to modify 3D data files interactively and conveniently. The editor (312) allows operators to modify and/or eliminate any undesirable area(s) on the original 3D image obtained from the camera (104; FIG. 1), remove abnormal data point(s), and clean up the acquired image data to reduce the sizes of image data files. 3D objects can be edited, including triangular regions, vertices, local areas, and an entire data set. Known editing functions can be employed, including typical editing functions that provide for deleting, creating, and modifying objects. The editor (312) can also provide various filtering functions (e.g., smoothing and noise removal) that can be applied to entire 3D data sets or to selected local areas.

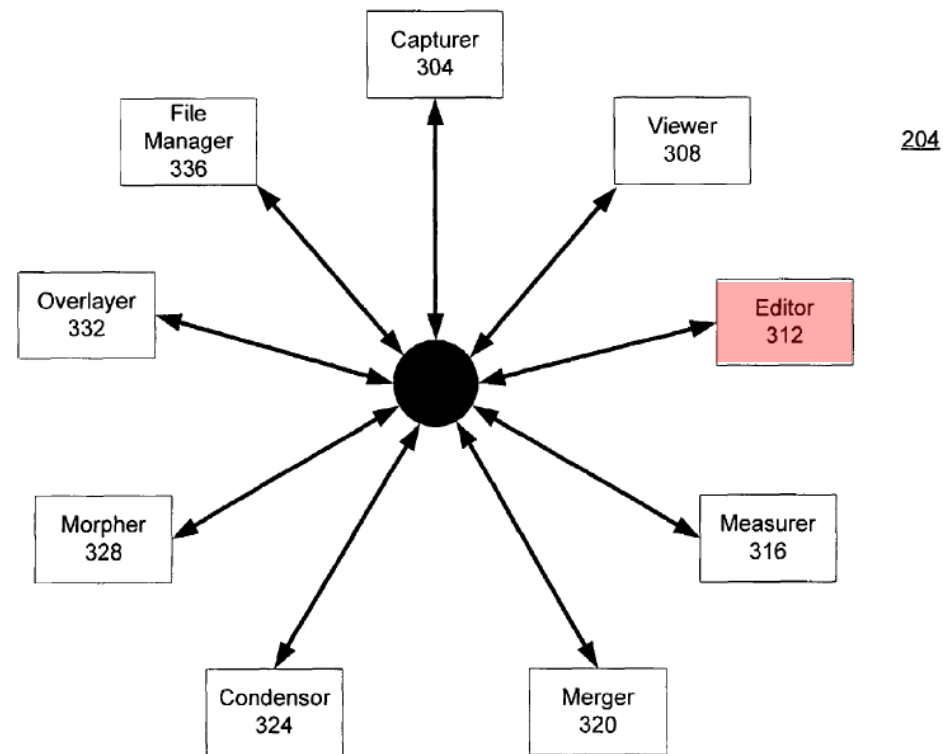


Fig. 3

Geng Discloses a Merger Tool for Integrating Multiple Models into a Single One

The merger (320) provides tools that enable operators to integrate multiple uncalibrated 3D images into a single 3D digital impression (116; FIG. 1). A manual mode requires operators to specify corresponding points among multiple 3D images. The merger (320) is able to bring the 3D images together and optimize the geometric registration of these images. An “auto” mode provides intelligent capability that searches the common points among multiple images based on their geometric features, such as curvatures. From the identified common points, the acquired set of multiple 3D images can be merged automatically. Alternatively, image registration techniques known to those skilled in the art can be used to merge the acquired images together to form the 3D digital impression (116; FIG. 1).

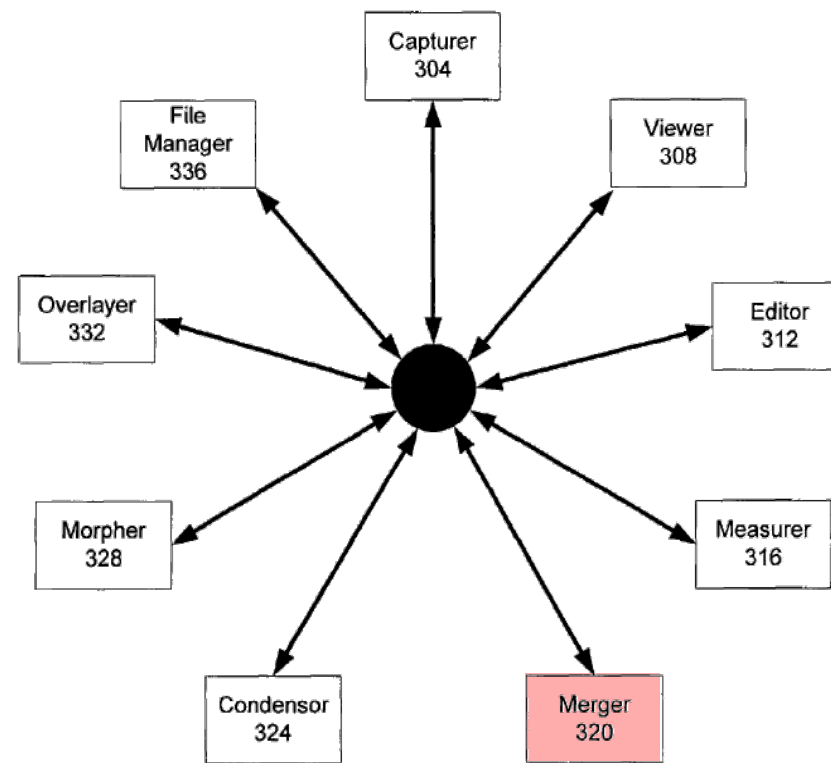


Fig. 3

Geng's Interactive Tools Improve Accuracy, Efficiency, and Quality of Care



US007474932B2

(12) United States Patent Geng

(10) Patent No.: US 7,474,932 B2
(45) Date of Patent: Jan. 6, 2009

(54) DENTAL COMPUTER-AIDED DESIGN (CAD) METHODS AND SYSTEMS

(75) Inventor: Z. Jason Geng, Rockville, MD (US)

(73) Assignee: Technet Holdings, Inc., Boston, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 382 days.

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(51) Int. Cl.

G06F 19/00 (2006.01)

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(52) U.S. Cl. 700/98; 433/167

(58) Field of Classification Search 700/95-98, 700/117-119, 159-163, 179-185, 433/109-1, 433/201.1, 202.1, 213, 215, 218, 223, 167

See application file for complete search history.

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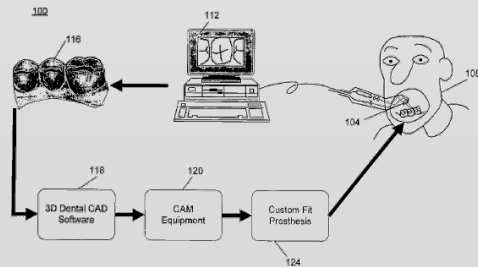
* cited by examiner

Primary Examiner—M. N. Von Bohr
(74) Attorney, Agent, or Firm—Steven L. Nichols; Rader, Fishman & Grauer PLLC

(57) ABSTRACT

The present specification describes systems and methods for interactive three-dimensional dental imaging. More specifically, the present methods and systems provide for interactive computer-aided design (CAD) in dental applications. According to one of many possible embodiments, an interactive dental computer-aided design (CAD) system includes a graphical user interface for displaying at least one three-dimensional (3D) image for viewing by an operator, an access interface for receiving input from the operator, and a prosthesis design module providing design tools for creating a virtual 3D model of a dental prosthesis responsive to operator input.

36 Claims, 5 Drawing Sheets



ClearCorrect Exhibit 1005, Page 1 of 15

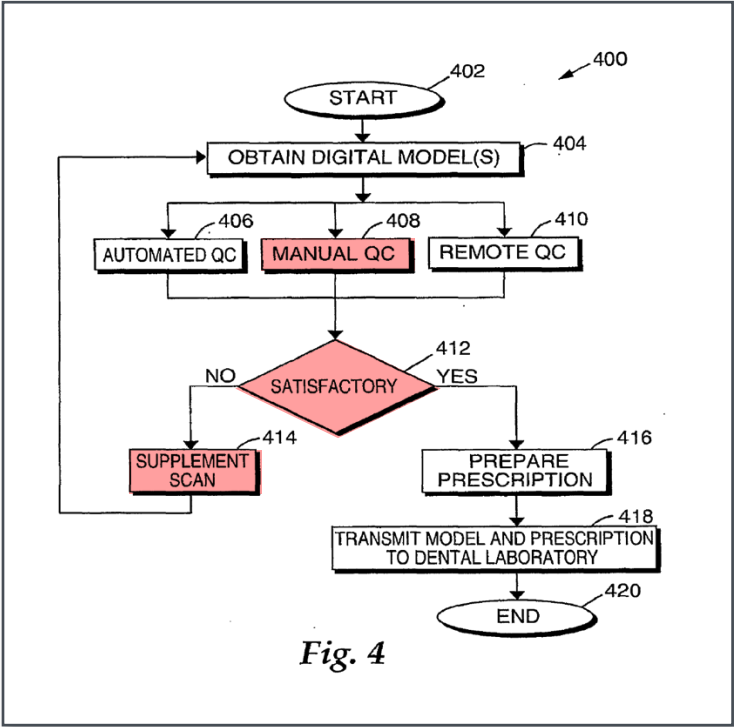
The present specification describes systems and methods for interactive three-dimensional dental imaging. More specifically, the present methods and systems provide for interactive computer-aided design (CAD) in dental applications. The methods and systems provide operators (e.g., dentists and technicians) with comprehensive functionality for interactively manipulating three-dimensional (3D) dental image data to efficiently, accurately, and conveniently diagnose and treat dental conditions, especially conditions that require design of dental prostheses. Functions for manipulating 3D

formed in a single visit. Further, the accuracy provided by the virtual 3D digital models improves the quality of dental care over traditional dental restoration practices. Thus, the systems and methods described above can dramatically reduce dental costs, eliminate unnecessary time waste for both dentists and patients, and create new business opportunities in dentistry.

Boerjes in View of Geng Renders Obvious Partial Replacement After Physical Change

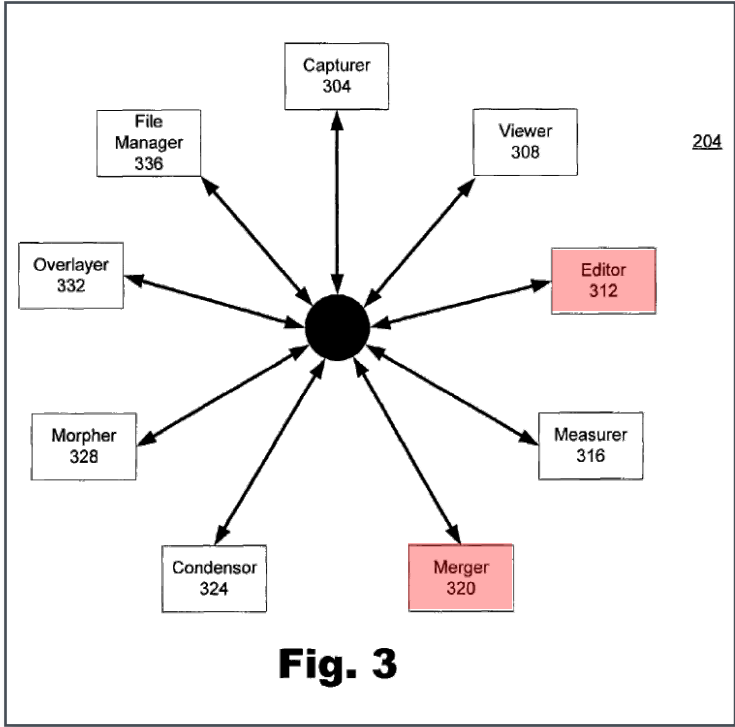
Boerjes + Geng

- 1[e] receive user input defining a portion of the model to be removed;
- 1[f] remove, from the displayed model, a removed surface portion of the model to be removed according to the user input;
- 1[h] replace at least a portion of the removed surface portion of the model using the received second scan data of the patient's teeth including surface data of a physically changed portion of the patient's intraoral cavity; and



Boerjes

+



Geng

Boerjes in View of Geng Renders Obvious Partial Replacement After Physical Change

The Petition shows, supported by Dr. Karam, that one of ordinary skill would have incorporated Geng's editor and merger tools when implementing Boerjes's quality control process for obtaining a satisfactory model

A POSITA would have been motivated to look to Geng, when implementing Boerjes's quality control process, and use Geng's editing function to remove the undesirable portions on the model to improve the efficiency and accuracy of Boerjes's replacement process and improve patient comfort. *Supra* VIII.A.1.f.i; Ex-1003, ¶¶ 100-101.

impression.” (emphasis added)). A POSITA would have known to use conventional image-registration methods to replace Boerjes's undesired portion of the model with second scan data. *Supra* V.III.A.1.f. And Geng's merger function would have been a suitable option because it allows for aligning and integrating the second scan data to the existing model in Boerjes. Ex-1003, ¶¶ 120-123. The combined system would have registered the second scan data to the existing model to replace the undesired, removed portion, thereby obtaining an updated digital model of the teeth (e.g., after additional surface preparation, as described by Boerjes). *Supra* VIII.A.1.f.

Boerjes in View of Geng Renders Obvious Partial Replacement After Physical Change

Institution Decision:

On that basis, we agree with Petitioner that a person of ordinary skill in the art would recognize that Geng's editing function would improve the efficiency and accuracy of Boerjes's system, and the incorporation of that editing function would have involved merely applying known techniques to improve a known and similar system in the same way. *See* Pet. 35–37, 39–40, 48–49, 50–51. We also agree with Petitioner that the references are analogous, and are directed to address similar problems in 3D modeling of dentition. Patent Owner's arguments are not directed to the proffered motivation to combine Boerjes and Geng (*see* Prelim. Resp. 19–21), but rather to the formulation of Ground 2, which we address below. As such, we are persuaded, for purposes of institution, that Petitioner has demonstrated a reasonable likelihood of combining Boerjes and Geng, per the Petition.

Trials@uspto.gov
571-272-7822

Paper 16
Entered: October 30, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING, LLC,
Petitioner,

v.

ALIGN TECHNOLOGY INC.,
Patent Owner.

IPR2025-00817
Patent 10,791,936 B2

Before KEVIN F. TURNER, NEIL T. POWELL, and
CYNTHIA M. HARDMAN, *Administrative Patent Judges*.

TURNER, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

Boerjes in View of Geng Renders Obvious Partial Replacement After Physical Change

Trials@uspto.gov
571-272-7822

Paper 16
Entered: October 30, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING, LLC,
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ALIGN TECHNOLOGY INC.,
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IPR2025-00817
Patent 10,791,936 B2

Before KEVIN F. TURNER, NEIL T. POWELL, and
CYNTHIA M. HARDMAN, *Administrative Patent Judges*.

TURNER, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

Institution Decision:

See Ex. 1004 ¶¶ 146–149, 182, 190–200, Fig. 4; Ex. 1005, 7:38–51. With respect to Ground 1, we are persuaded that the new scan data would likely be an entirely new scan, per the disclosure of Boerjes alone, and Boerjes lacks specific disclosure of how portions of new data could be incorporated into an existing model. With the addition of Geng, specific areas, less than the whole model, can be eliminated and processes are detailed for integrating multiple images into a single 3D digital impression, i.e., filling in or stitching together to create a single 3D model. The section of the Petition addressing limitation 1(h) addresses the disclosures of both Boerjes and Geng. *See* Pet. 47–51. As such, we are not persuaded that the Petition fails to address all aspects of limitation 1(h), per Patent Owner’s arguments.

Geng's Interactive Tools Allow Partial Corrections

Patent Owner's Response:

Indeed, this understanding is further supported by Geng's own teachings. That is, like Boerjes, Geng's disclosure comports with the conventional approach at the time: when a physical structure in the patient's intraoral cavity has been modified, perform a new scan of that structure. EX2011, ¶¶99. For instance, FIG. 5

in a single visit"); EX2011, ¶¶93-94. In fact, as detailed more below with respect to motivation to combine, Geng teaches following the conventional approach of initiating a new scan after additional surface preparation, consistent with Boerjes's teachings. EX2011, ¶¶95-96; *infra*, §V.A.3.

Geng:

FIG. 5. This image provides the final image data upon which the restorations will be designed. To help ensure the accuracy of the final 3D image, the system (100; FIG. 1) can implement evaluations steps, which can include but are not limited to confirming correction of any problems found in preliminary imaging, identifying and correcting any artifact data, and verifying and indicating margins.

25	
	TABLE 1
	3D Prostheses Design Function Menu
	A. Preparation for Fabrication Procedures
30	Individual Tooth Level
	(1) Removal of artifacts
	(2) Die spacer - amount and location
	Single Arch Level
	(1) Analysis and comparison of contralateral teeth
	(2) Analysis of arch occlusal plane profile
35	(3) Analysis of arch width

Patent Owner's Arguments Do Not Address the Boerjes-Geng Combination

Patent Owner's Response:

the sizes of image data files." (emphasis added)). Thus, Geng also does not describe that its editing tool allows a user to identify a portion of a 3D model to be replaced with new scan data. EX2011, ¶61. Not only does this further highlight

preparation. EX2011, ¶101. In other words, Geng itself does not even suggest using **its own tools** in the manner suggested by Petitioner; rather, Geng still follows the conventional approach. *Id.* This confirms that Petitioner's

Federal Circuit:



“Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.”

In re Merck & Co., Inc., 800 F.2d 1091, 1097 (Fed. Cir. 1986)

Federal Circuit:



“[T]he test for obviousness is what the combined teachings of the references would have suggested to those having ordinary skill in the art.”

“A reference may be read for all that it teaches, including uses beyond its primary purpose.”

In re Mouttet, 686 F.3d 1322, 1333 (Fed. Cir. 2012)

Grounds 1-2: Primary Disputed Issues

- Ground 1 – Boerjes
 - Whether Boerjes renders obvious partial replacement of a user-identified portion of a model after physical change
- Ground 2 – Boerjes in view of Geng
 - Whether Boerjes and Geng render obvious partial replacement of a user-identified portion of a model after physical change
- **Grounds 1-2: Additionally for Claim 9**
 - **Whether Boerjes's identifying a portion to be replaced renders obvious demarcating a portion to be retained**

The '936 Patent: Claim 9



US010791936B2

(12) United States Patent Kopelman

(10) Patent No.: US 10,791,936 B2
(45) Date of Patent: *Oct. 6, 2020

(54) METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS

(71) Applicant: **Align Technology, Inc.**, San Jose, CA (US)

(72) Inventor: **Avi Kopelman**, Palo Alto, CA (US)

(73) Assignee: **Align Technology, Inc.**, San Jose, CA (US)

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

(21) Appl. No.: 16/586,528

(22) Filed: Sep. 27, 2019

(65) **Prior Publication Data**
US 2020/0022584 A1 Jan. 23, 2020

Related U.S. Application Data
(63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued)

(51) **Int. Cl.**
G06T 19/20 (2011.01)
A61C 7/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **A61B 5/0088** (2013.01); **A61B 5/0062** (2013.01); **A61B 5/4547** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) References Cited

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(Continued)

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AU 3011677 A 5/1979
AU 517102 B2 7/1981
(Continued)

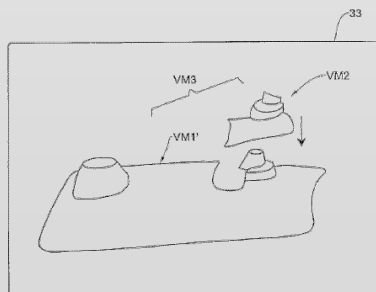
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AADR, American Association for Dental Research, Summary of Activities, Mar. 20-23, 1980, Los Angeles, CA, p. 195.
(Continued)

Primary Examiner—Bijan Mapur
(74) **Attorney, Agent, or Firm**—Wilson Sonsini Goodrich & Rosati

(57) **ABSTRACT**
Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces.

20 Claims, 8 Drawing Sheets



ClearCorrect Exhibit 1001, Page 1 of 30

9. A method for scanning a patient's teeth for a dental procedure, the method comprising:

receiving first scan data of the patient's teeth from a hand-held intraoral scanner;

displaying, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;

9[c] receiving user input via the displayed model demarcating a portion of the model to be retained and a surface portion of the model to be replaced;

receiving second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;

9[e] replacing at least a portion of the surface portion of the model to be replaced according to the user input using at least a portion of the second scan data of the patient's teeth including the physically changed portion; and

outputting, to the display, the model of the patient's teeth with the at least the portion of the surface portion replaced using the second scan data.

Disputed

The '936 Patent: Claim 9



US010791936B2

(12) United States Patent Kopelman

(10) Patent No.: US 10,791,936 B2
(45) Date of Patent: *Oct. 6, 2020

(54) METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS

(71) Applicant: Align Technology, Inc., San Jose, CA (US)

(72) Inventor: Avi Kopelman, Palo Alto, CA (US)

(73) Assignee: Align Technology, Inc., San Jose, CA (US)

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

(21) Appl. No.: 16/586,528

(22) Filed: Sep. 27, 2019

(65) Prior Publication Data
US 2020/0022584 A1 Jan. 23, 2020

Related U.S. Application Data
(63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued)

(51) Int. Cl.
G06T 19/20 (2011.01)
A61C 7/00 (2006.01)
(Continued)

(52) U.S. Cl.
CPC A61B 5/0088 (2013.01); A61B 5/0062 (2013.01); A61B 5/4547 (2013.01);
(Continued)

(58) Field of Classification Search
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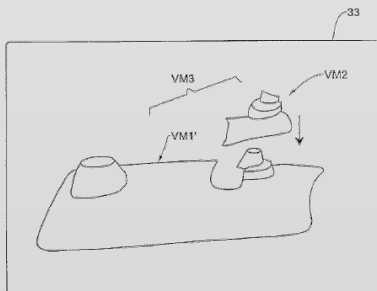
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20 Claims, 8 Drawing Sheets



ClearCorrect Exhibit 1001, Page 1 of 30

9. A method for scanning a patient's teeth for a dental procedure, the method comprising:

receiving first scan data of the patient's teeth from a hand-held intraoral scanner;

displaying, to a display, a model of the patient's teeth, wherein the model of the patient's teeth is based on the received first scan data of the patient's teeth;

9[c] receiving user input via the displayed model demarcating a portion of the model to be retained and a surface portion of the model to be replaced;

receiving second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;

9[e] replacing at least a portion of the surface portion of the model to be replaced according to the user input using at least a portion of the second scan data of the patient's teeth including the physically changed portion; and

outputting, to the display, the model of the patient's teeth with the at least the portion of the surface portion replaced using the second scan data.

Disputed

The '936 Patent Describes Marking a Portion to be Replaced Marks a Portion to be Retained

According to this embodiment, steps **430** to **470** are implemented when part of the first virtual model VM1, designated DVM1, is considered to be unsuitable or undesired, while concurrently it is desired to retain another part of the first virtual model VM1.

In step **430** this part DVM1 of the first virtual model VM1 is marked on the first image of the first virtual model VM1 on the display **33**. By “marked” it is meant that this zone or area of the first image DI1 is at least identified by the user, and may optionally include interacting with the display **33** so that a visual mark is included in the image to show and demarcate this area on the image DI1 that is on the display **33**. For example, wand **34**, operatively connected to the

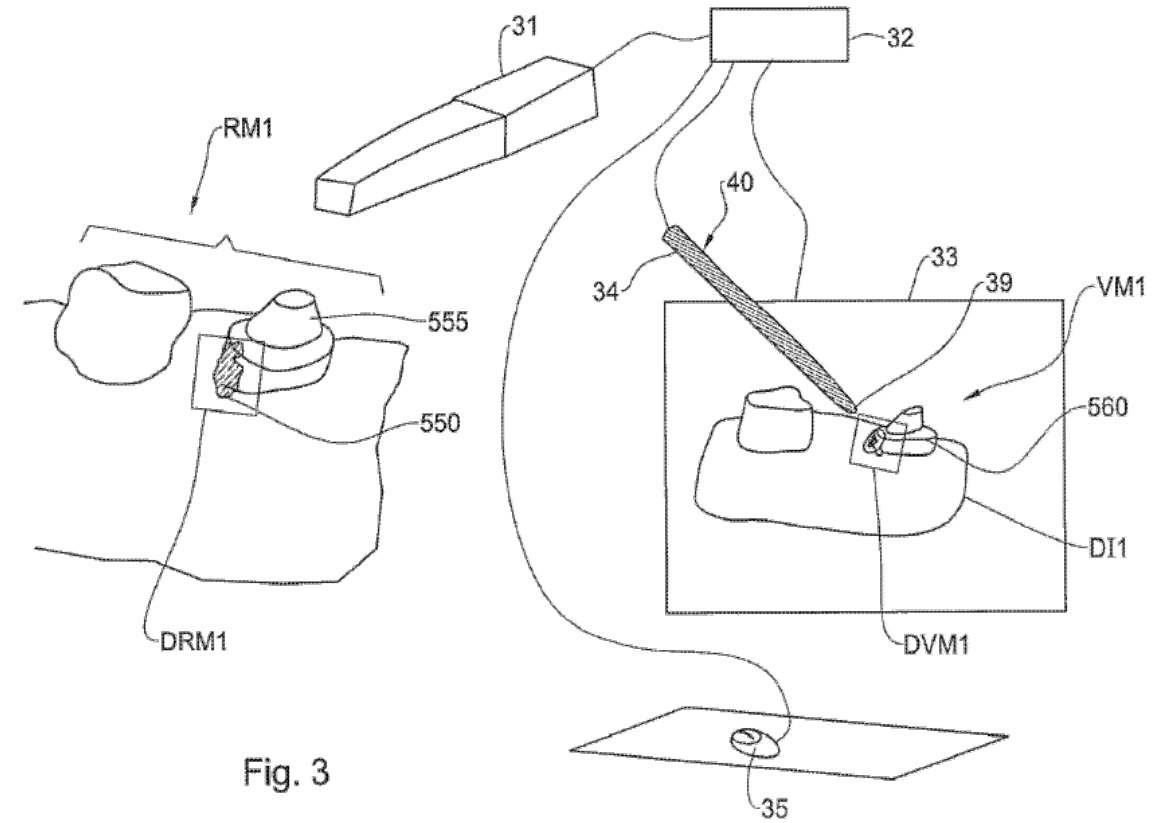


Fig. 3

Identifying a Portion to be Replaced Would Have Demarcated a Portion to be Retained

Dr. Karam:

147. A person of ordinary skill in the art would have understood from Boerjes that by demarcating the portions of the model to be replaced, the user would have likewise demarcated the portions of the model to be retained. For instance, marking points on the displayed model to identify an area of the model to be replaced would have also demarcated portions of the model to be retained, such as the remaining portions on the displayed model not to be replaced. Ex-1014, [0078], [0083], Figs. 1, 5, 7. This is consistent with the '936 patent's disclosure. For instance, the '936 patent explains that a portion of the model may be designated as "unsuitable or undesired," and thus be marked for "deletion, removal[,] or replacement." Ex-1001, 20:59-63, 21:30-40. But it only explains that it will concurrently retain the other undesignated portions. *Id.*, 20:59-63.

Dr. Foroosh:

Q So the patent states -- "By 'marked' it meant that user may optionally interact with this area of the first image in the display, 33, so that a visual mark is included in the image to show and demarcate this area on the image that is on the display."

Correct?

A Correct.

Q So that marking also at the same time indicates the portion of the model to be retained.

Correct?

MR. ARGENTI: Objection. Form. Scope.

A It describes a portion of the model to be -- I mean, portion of the initial scan to be removed. Which by extension I think you would -- say the remaining of it is the part that we retain.

One Skilled Would Have Found It Obvious to Demarcate Portions to be Replaced and Retained

Dr. Karam:

148. Moreover, to the extent something more is required, it would have been obvious to a person of ordinary skill in the art to identify on the display a portion of the model to be retained as well as the portion to be replaced according to the user input. Such a system would present the user with useful graphical information for complex situations where additional information is needed to identify which portions of the model will be replaced and which portions will be retained. A person of ordinary skill in the art would have known how to

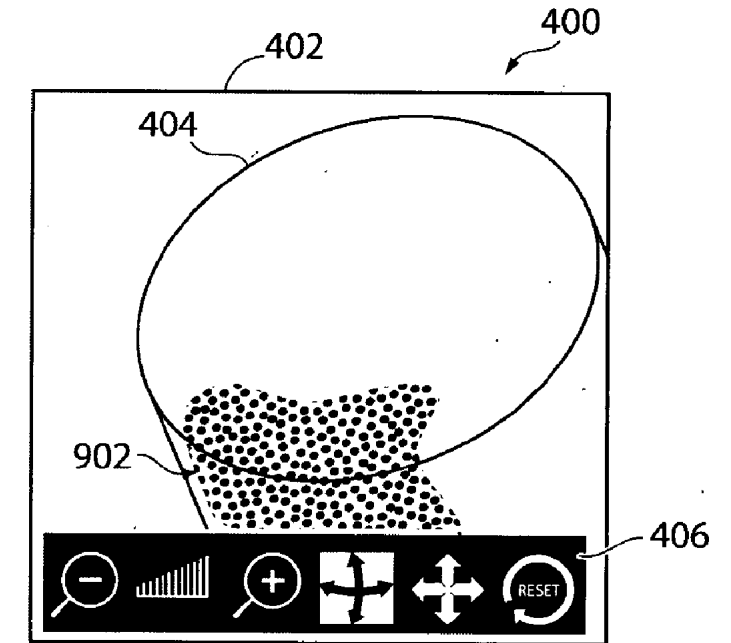


Fig. 9

“[V]isualization ... lets the user know where scanning has been performed and where additional scanning may be appropriate.”

One Skilled Would Have Found It Obvious to Demarcate Portions to be Replaced and Retained

example. The user may visually identify a demarcation profile D (FIGS. 4 and 5) that separates model parts 510 and 520, and for this purpose the model 500 as displayed may be manipulated and viewed at any attitude, rotational angle, magnification etc. as desired. Suitable software for manipulating a virtual model in this manner are well known in the art and will not be described further herein. Then, the user

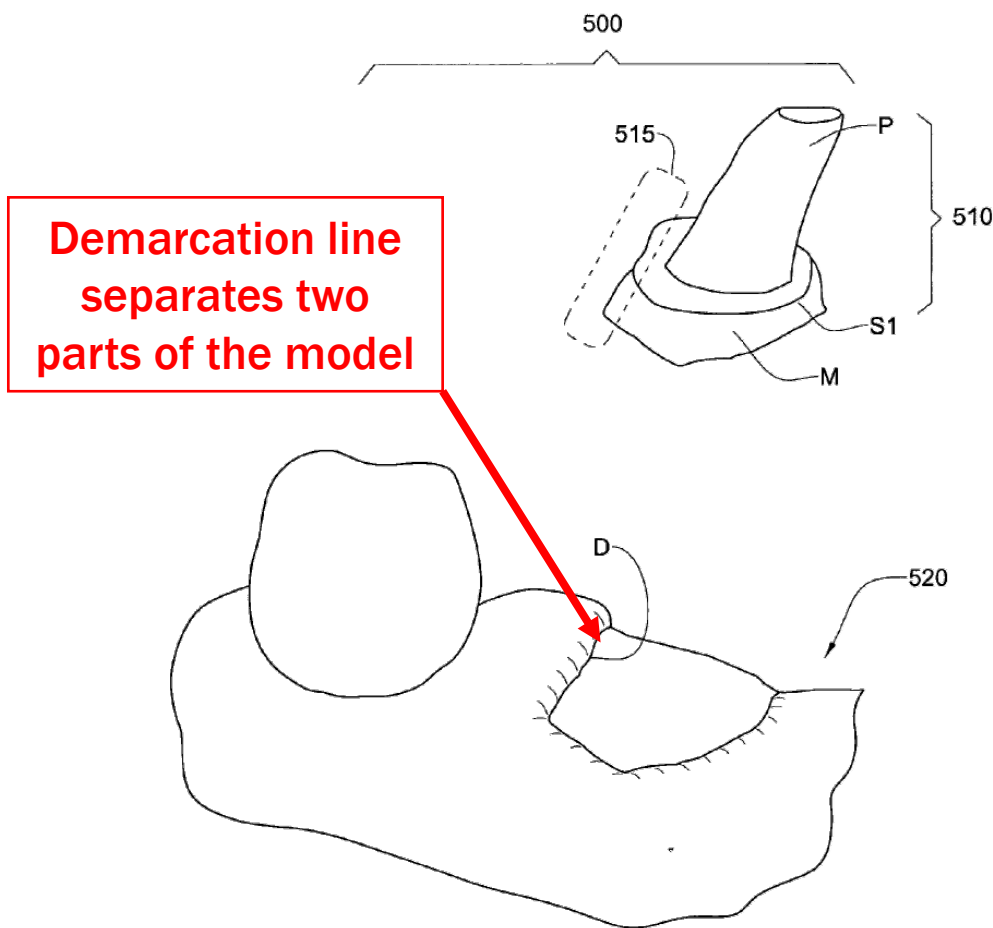


FIG. 5

The '936 Patent: Claim 9



US010791936B2

(12) **United States Patent**
Kopelman

(10) **Patent No.:** US 10,791,936 B2
(45) **Date of Patent:** *Oct. 6, 2020

(54) **METHODS AND SYSTEMS FOR CREATING
AND INTERACTING WITH THREE
DIMENSIONAL VIRTUAL MODELS**

(58) **Field of Classification Search**
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(71) **Applicant:** Align Technology, Inc., San Jose, CA
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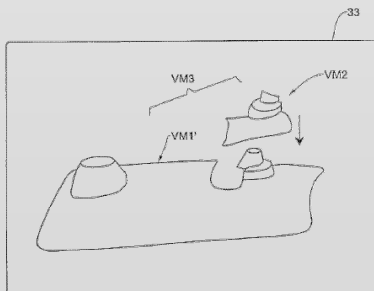
(65) **Prior Publication Data**
US 2020/0022584 A1 Jan. 23, 2020

Primary Examiner — Bijan Mapur
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Systems and methods are provided for preparation of ortho-
dontics and prosthodontics. A method may include scanning
a patient's teeth to form first 3D data of the patient's teeth
including a removable element that obscures part of the
dental surfaces of the patient's teeth and non-observed tooth
surfaces, removing the removable element from the patient's
teeth so that the removable element no longer obscures the
part of the dental surfaces of the patient's teeth, and scan-
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the patient's teeth and the non-observed tooth surfaces.

20 Claims, 8 Drawing Sheets



ClearCorrect Exhibit 1001, Page 1 of 30

9. A method for scanning a patient's teeth for a dental procedure, the method comprising:

receiving first scan data of the patient's teeth from a hand-held intraoral scanner;

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9[c] receiving user input via the displayed model demarcating a portion of the model to be retained and a surface portion of the model to be replaced;

receiving second scan data of the patient's teeth from the hand-held intraoral scanner, the second scan data including surface data of a physically changed portion of the patient's intraoral cavity;

9[e] replacing at least a portion of the surface portion of the model to be replaced according to the user input using at least a portion of the second scan data of the patient's teeth including the physically changed portion; and

outputting, to the display, a model of the patient's teeth with the at least the portion of the surface portion replaced using the second scan data.

Disputed

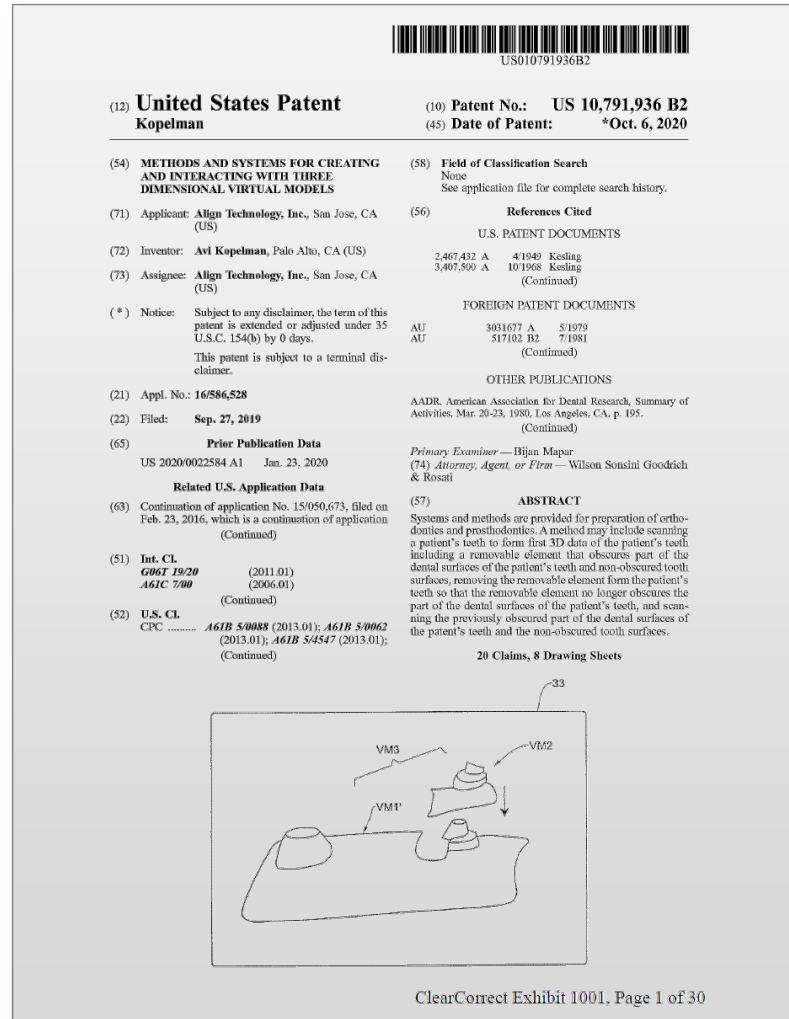
- **Motivation to combine**
- Whether the combinations render obvious “discarding” remainder of second scan data including “identifying [surface] data” of Claims 7, 13, and 17

Babayoff Overview

Claims 2 and 18 recite structural features of intraoral scanners

2. The system of claim 1, wherein the hand-held intraoral scanner comprises a probing member with a sensing face, an illumination unit, a light focusing optics defining one or more focal planes forward the sensing face, and a translation mechanism for displacing the one or more focal planes relative to the sensing face.

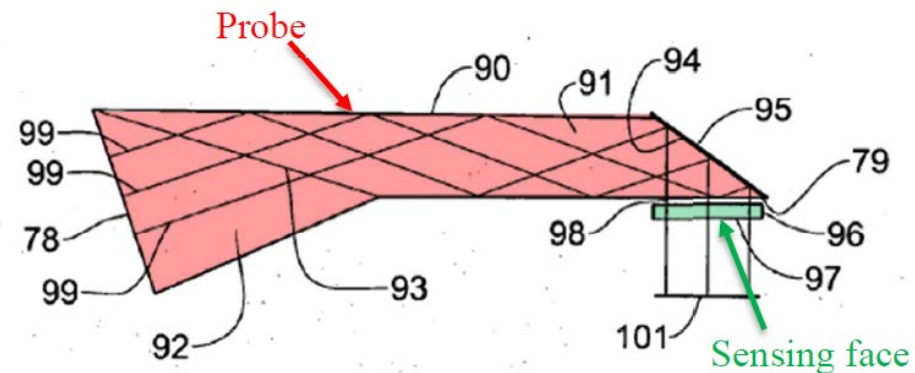
18. The system of claim 17, wherein the hand-held intraoral scanner comprises a probing member with a sensing face, an illumination unit, a light focusing optics defining one or more focal planes forward the sensing face, and a translation mechanism for displacing the one or more focal planes relative to the sensing face.



Babayoff Overview

Babayoff discloses these structural features of intraoral scanners

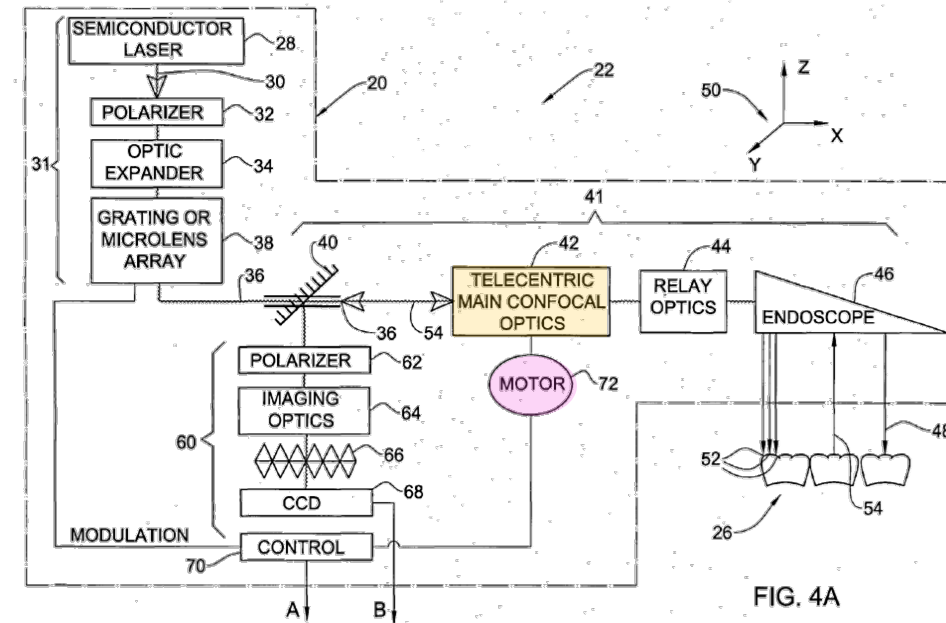
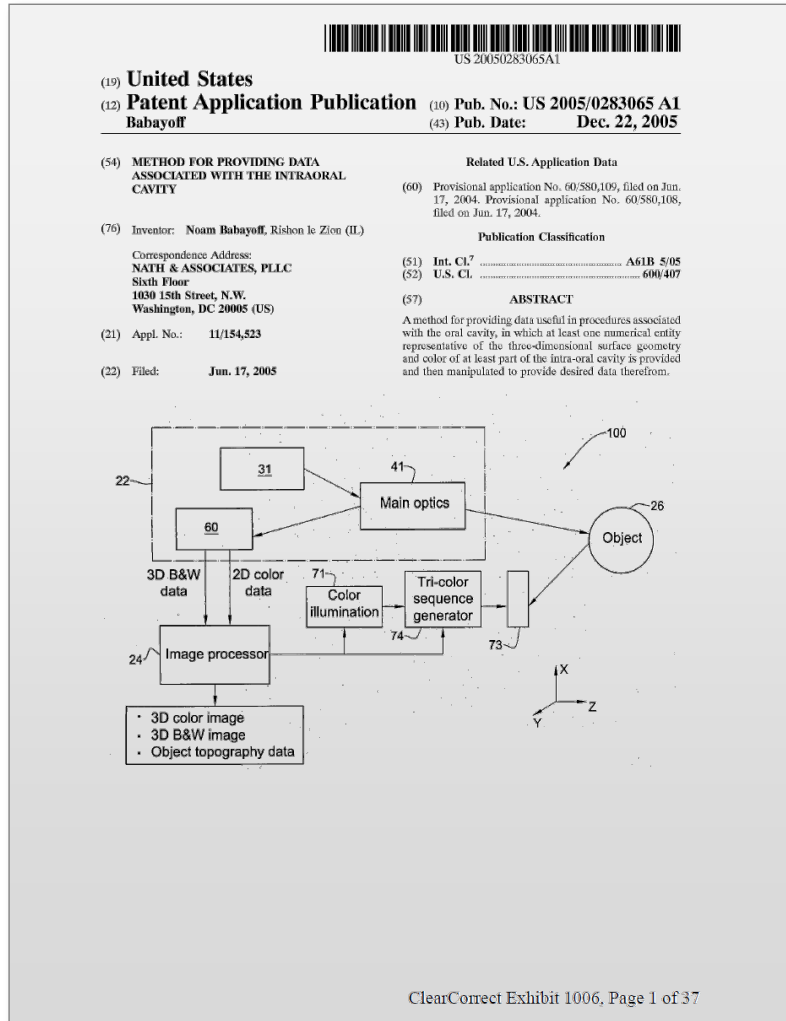
2. The system of claim 1, wherein the hand-held intraoral scanner comprises a **probing member** with a **sensing face**, an illumination unit, a light focusing optics defining one or more focal planes forward the sensing face, and a translation mechanism for displacing the one or more focal planes relative to the sensing face.



Babayoff Overview

Babayoff discloses these structural features of intraoral scanners

2. The system of claim 1, wherein the hand-held intraoral scanner comprises a probing member with a sensing face, an illumination unit, a light focusing optics defining one or more focal planes forward the sensing face, and a translation mechanism for displacing the one or more focal planes relative to the sensing face.



Babayoff Overview

Babayoff discloses these structural features of intraoral scanners

2. The system of claim 1, wherein the hand-held intraoral scanner comprises a probing member with a sensing face, an illumination unit, a light focusing optics defining one or more focal planes forward the sensing face, and a translation mechanism for displacing the one or more focal planes relative to the sensing face.

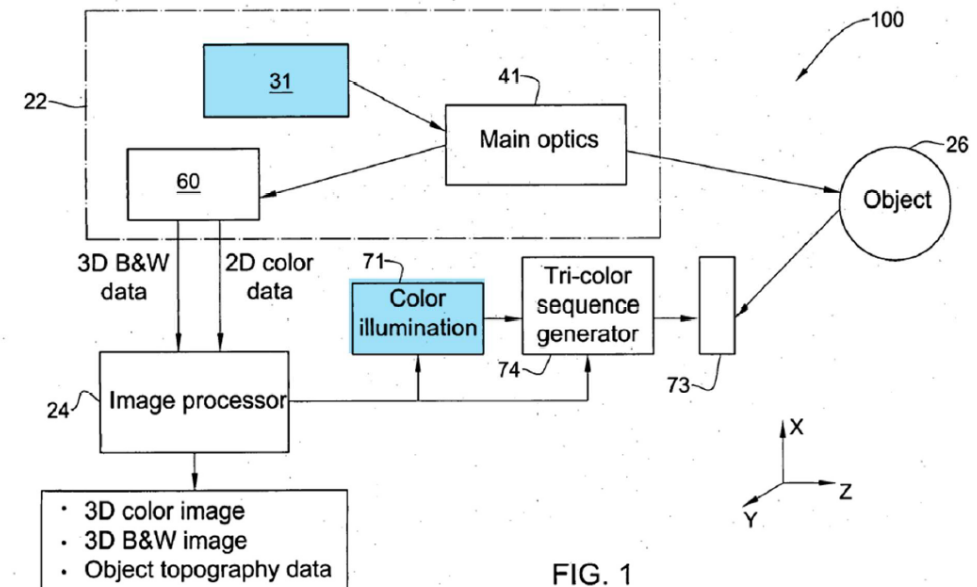
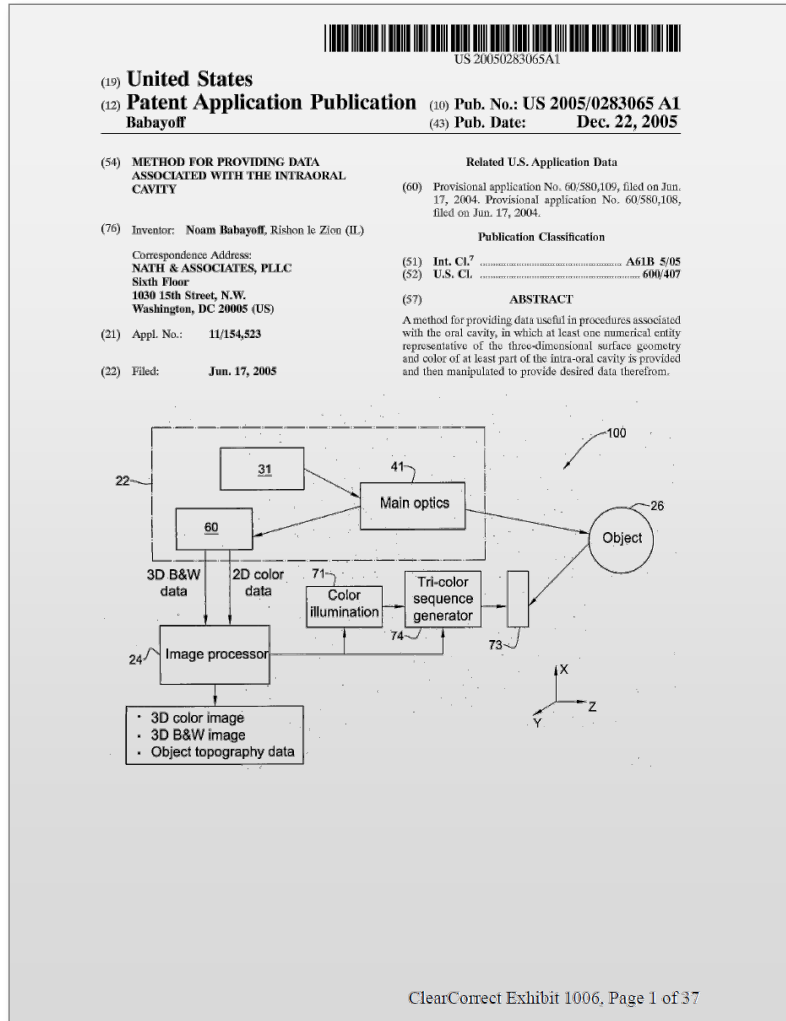


FIG. 1

Boerjes or Boerjes-Geng in View of Babayoff

While Boerjes suggests using an intraoral scanner that supports color imaging, it does not provide details on how to implement it

Petition:

the prosthesis a natural appearance. Ex-1006, [0007]-[0014]. A POSITA would have understood that the color scan data or 3D color model would allow the dentist to more accurately match the color and shade of a prosthesis, such as a crown, by performing digital colorimetric measurements in addition to or instead of only visual comparison. *Id.*, [0190]-[0198]. Indeed, Boerjes suggests evaluating color and shade matching. Ex-1004, [00194]; Ex-1003, ¶ 191.

Boerjes or Boerjes-Geng in View of Babayoff

Babayoff discloses a suitable intraoral scanner that provides color scan data for Boerjes's system

Petition:

A POSITA would have had a reasonable expectation of success in using Babayoff's scanner in Boerjes's or Boerjes-Geng's system. Boerjes teaches its scanner can use any camera system suitable for acquiring two-dimensional data of a three-dimensional object or from which a three-dimensional point cloud may be obtained. Ex-1004, [00133]. Babayoff's intraoral scanner would be a suitable option for acquiring such scan data while providing the benefit of precise color matching and margin-line identification. Using Babayoff's intraoral scanner would be using a known device in a known, similar system ready for improvement to yield predictable results. Ex-1003, ¶ 194.

Boerjes or Boerjes-Geng in View of Babayoff

Patent Owner contends that Boerjes already teaches color scanning, so there was no need to incorporate Babayoff's teachings

Patent Owner:

already captures color data for its 3D digital model. EX2011, ¶¶112-14. For example, Boerjes explains that “after completing a scan, a dental office may transmit a digital model to a dental laboratory or a fabrication facility for evaluation of adequacy of the scan,” where the dental laboratory may “evaluate color and suggest shade matching for a dentist.” EX1004, [00194]. A POSITA would have understood this to mean that the digital model includes color data, and thus, Boerjes’s system already performs color scanning. EX2011, ¶114. Indeed,

Boerjes or Boerjes-Geng In View of Babayoff

Patent Owner's argument conflicts with the law

Reply:

But obviousness does not require showing that Boerjes was deficient before adding Babayoff. *United Servs. Auto. Ass'n v. PNC Bank N.A.*, No. 2023-2171, 2025 WL 339662, at *3 (Fed. Cir. Jan. 30, 2025); *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1002-03 (Fed. Cir. 2016) (rejecting patentee's argument of no motivation to combine where the first reference had a feature that would already achieve the claimed functionality). It is enough to show that Boerjes suggests using color-scan data, Babayoff discloses a known and suitable color intraoral scanner, and that a skilled person would have reasons to use that known scanner architecture in either Boerjes or the Boerjes-Geng combination with predictable results. Pet., 75-76; Ex-1003, ¶¶189-194.

- Motivation to combine
- **Whether the combinations render obvious “discarding” a remainder of second scan data including “identifying [surface] data” of Claims 7, 13, and 17**

The '936 Patent: Claims 7, 13, 17[i]

US010791936B2

(12) **United States Patent**
Kopelman

(10) **Patent No.:** US 10,791,936 B2
(45) **Date of Patent:** *Oct. 6, 2020

(54) **METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS**

(71) Applicant: **Align Technology, Inc.**, San Jose, CA (US)

(72) Inventor: **Avi Kopelman**, Palo Alto, CA (US)

(73) Assignee: **Align Technology, Inc.**, San Jose, CA (US)

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CPC (Continued)

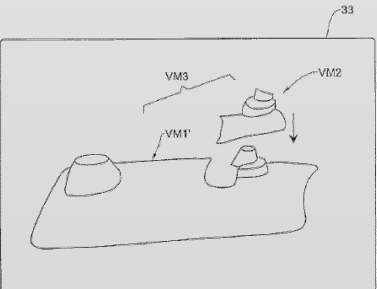
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20 Claims, 8 Drawing Sheets

33



ClearCorrect Exhibit 1001, Page 1 of 30

7. The system of claim 6, wherein the instructions to replace the at least the portion of the removed surface portion of the model using the received second scan data comprise instructions to further **discard a remainder of the received second scan data, the remainder including the identifying surface data,** after stitching the portion of the received second scan data with the model.

13. The method of claim 12, wherein replacing the at least the portion of the surface portion of the model to be replaced according to the user input using the at least the portion of the second scan data further comprises **discarding a remainder of the second scan data, including the identifying surface data,** after stitching the at least the portion of the second scan data with the model.

17[i] **discarding a remainder of the second scan data, including the identifying data,** after registering the second scan data with the model; and

Disputed

 US010791936B2	
(12) United States Patent Kopelman	(10) Patent No.: US 10,791,936 B2 (45) Date of Patent: *Oct. 6, 2020

(54) METHODS AND SYSTEMS FOR CREATING AND INTERACTING WITH THREE DIMENSIONAL VIRTUAL MODELS (71) Applicant: Align Technology, Inc., San Jose, CA (US) (72) Inventor: Avi Kopelman, Palo Alto, CA (US) (73) Assignee: Align Technology, Inc., San Jose, CA (US) (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. This patent is subject to a terminal disclaimer. (21) Appl. No.: 16/886,528 (22) Filed: Sep. 27, 2019 (65) Prior Publication Data US 2020/0022584 A1 Jan. 23, 2020 Related U.S. Application Data (63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued) (51) Int. CL G06T 19/20 (2011.01) A61C 7/00 (2006.01) (Continued) (52) U.S. CL CPC A61B 5/0088 (2013.01); A61B 5/0062 (2013.01); A61B 5/4547 (2013.01); (Continued)	(58) Field of Classification Search None See application file for complete search history. (56) References Cited U.S. PATENT DOCUMENTS 2,467,432 A 4/1949 Kesting 3,407,500 A 10/1968 Kesting (Continued) FOREIGN PATENT DOCUMENTS AU 3011677 A 5/1979 AU 517102 B2 7/1981 (Continued) OTHER PUBLICATIONS AADR, American Association for Dental Research, Summary of Activities, Mar. 20-23, 1980, Los Angeles, CA, p. 195. (Continued) <i>Primary Examiner</i> — Bijan Mapar (74) <i>Attorney, Agent, or Firm</i> — Wilson Sonsini Goodrich & Rosati (57) ABSTRACT Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth, including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces. 20 Claims, 8 Drawing Sheets
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33

ClearCorrect Exhibit 1001, Page 1 of 30

5. The system of claim 4, wherein the received second scan data is registered with the model by aligning identifying data of the received second scan data with corresponding parts of the model.

11. The method of claim 9, wherein replacing the at least the portion of the surface portion of the model to be replaced according to the user input using at least the portion of the second scan data comprises registering the second scan data with the model by aligning identifying data of the second scan data with corresponding parts of the model.

17[h]	register the second scan data with the model by aligning identifying data of the second scan data with corresponding parts of the model;
-------	--

Dr. Karam:

- The “remainder” of the second scan data is the left-over portion to be disposed of after registration and stitching
- The “remainder of the second scan data” includes the “identifying [surface] data” for alignment that would be “repetitive” or “duplicative” after registration and stitching

Boerjes or Boerjes-Geng's Partial Replacement Discards the "Remainder"

Dr. Karam:

Discarding the repeated data after registration and stitching as taught in Babayoff would improve the smoothness in the stitched boundary. For example, discarding the repeated data, or some of the repeated data, can reduce artifacts, ghosting, or blurring that can occur in the stitched model if the repeated data is not removed due to differences between the two scans, such as different light exposure or small misalignment from the registration. A person of ordinary skill in the art also would have understood that discarding the repeated data after registration and stitching would reduce data redundancy, and thus reduce data size and the required memory space and processing power for storing and further manipulating the stitched model.

Federal Circuit:



“[C]ombinations of prior art that sometimes meet the claim elements are sufficient to show obviousness.”

Unwired Planet, LLC v. Google Inc., 841 F.3d 995, 1002 (Fed. Cir. 2016)

Federal Circuit:



“[A] prior art product that sometimes, but not always, embodies a claimed method nonetheless teaches that aspect of the invention.”

Hewlett-Packard Co. v. Mustek Sys., Inc., 340 F.3d 1314, 1326 (Fed. Cir. 2003)

The '936 Patent: Claims 7, 13, 17[i]


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US 2020/0022584 A1 Jan. 23, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/050,673, filed on Feb. 23, 2016, which is a continuation of application (Continued)

(51) **Int. Cl.**
G06T 19/20 (2011.01)
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(Continued)

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CPC **A61B 5/0088** (2013.01); **A61B 5/0062** (2013.01); **A61B 5/4547** (2013.01); (Continued)

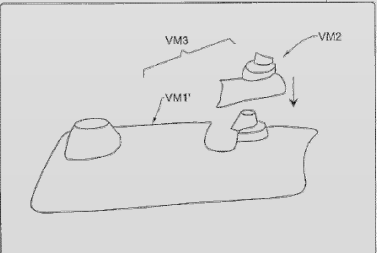
(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**
Systems and methods are provided for preparation of orthodontics and prosthodontics. A method may include scanning a patient's teeth to form first 3D data of the patient's teeth including a removable element that obscures part of the dental surfaces of the patient's teeth and non-observed tooth surfaces, removing the removable element from the patient's teeth so that the removable element no longer obscures the part of the dental surfaces of the patient's teeth, and scanning the previously obscured part of the dental surfaces of the patient's teeth and the non-observed tooth surfaces.

20 Claims, 8 Drawing Sheets

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7. The system of claim 6, wherein the instructions to replace the at least the portion of the removed surface portion of the model using the received second scan data comprise instructions to further discard a remainder of the received second scan data, the remainder including the identifying surface data, after stitching the portion of the received second scan data with the model.

13. The method of claim 12, wherein replacing the at least the portion of the surface portion of the model to be replaced according to the user input using the at least the portion of the second scan data further comprises discarding a remainder of the second scan data, including the identifying surface data, after stitching the at least the portion of the second scan data with the model.

17[i] discarding a remainder of the second scan data, including the identifying data, after registering the second scan data with the model;

Disputed

Conclusion

- ✓ Ground 1 (Boerjes) — Claims 1, 4-6, 8-12, 14-16 – **OBVIOUS**
- ✓ Ground 3 (Boerjes and Babayoff) — Claims 2-3, 7, 13, 17-20 – **OBVIOUS**
- ✓ Ground 2 (Boerjes and Geng) — Claims 1, 4-6, 8-12, 14-16 – **OBVIOUS**
- ✓ Ground 4 (Boerjes, Geng, and Babayoff) — Claims 2-3, 7, 13, 17-20 – **OBVIOUS**

All challenged claims of the '936 patent are obvious under 35 U.S.C. § 103

CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing **PETITIONER'S DEMONSTRATIVES** was served on July 28, 2026, via email directed to counsel of record for Patent Owner at the following:

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