United States Patent Application Publication	20250255700
Kind Code	A1
Publication Date	August 14, 2025
Inventor(s)	Butler; Kenn et al.

CUSTOM WAX RIM FOR DENTAL IMPRESSIONS

Abstract

A method according to the disclosure herein includes producing a mold having a base is based on a digital model of a patient mouth, a first mold portion monolithically formed with the mold base and defining a U-shaped recess, and a second mold portion shaped to correspond the U-shaped recess; aligning the first mold portion and the second mold portion; filling the U-shaped recess with a wax; and removing the second mold portion to result in a wax mold comprising the wax, the mold base, and the first mold portion.

Inventors: **Butler; Kenn (New York, NY), Wainwright; Samuel (New York, NY)**

Applicant: **Zima International, Inc. d/b/a Dandy** (New York, NY)

Family ID: **1000007855847**

Appl. No.: **18/436708**

Filed: **February 08, 2024**

Publication Classification

Int. Cl.: **A61C13/00** (20060101)

U.S. Cl.:

CPC **A61C13/0019** (20130101); **A61C13/0004** (20130101);

Background/Summary

BACKGROUND

[0001] Conventionally, the collection of a dental impression (e.g., a negative outline of a portion of a patient's jaw) is an important step in manufacturing a denture or other bespoke dental appliance.

These impressions are commonly produced by the patient biting down onto wax or similarly-impressionable material.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. **1** is a perspective view of a mold base, a mold top, a wax rim, and a dental insert.
[0003] FIG. **2** is a perspective view of the mold base of FIG. **1**.
[0004] FIG. **3** is a bottom view of the mold base of FIG. **1**.
[0005] FIG. **4** is a top view of the mold base of FIG. **1**.
[0006] FIG. **5** is a rear perspective view of the mold base of FIG. **1**.
[0007] FIG. **6** is a rear view of the mold base of FIG. **1**.
[0008] FIG. **7** is a front view of the mold base of FIG. **1**.
[0009] FIG. **8** is a side view of the mold base of FIG. **1**.
[0010] FIG. **9** is a perspective view of the mold top of FIG. **1**.
[0011] FIG. **10** is a bottom view of the mold top of FIG. **1**.
[0012] FIG. **11** is a top view of the mold top of FIG. **1**.
[0013] FIG. **12** is a rear perspective view of the mold top of FIG. **1**.
[0014] FIG. **13** is a rear view of the mold top of FIG. **1**.
[0015] FIG. **14** is a front view of the mold top of FIG. **1**.
[0016] FIG. **15** is a side view of the mold top of FIG. **1**.
[0017] FIG. **16** is a side view of the mold top and mold base of FIG. **1**.
[0018] FIG. **17** is a perspective view of the mold top and mold base of FIG. **1**.
[0019] FIG. **18** is a perspective view of the mold top and mold base of FIG. **1**.
[0020] FIG. **19** is a section view of the mold top and mold base of FIG. **1**.
[0021] FIG. **20** is a perspective view of a dental insert.
[0022] FIG. **21** is a perspective view of a mold for forming the dental insert of FIG. **20**.
[0023] FIG. **22** is a front view of the mold of FIG. **21**.
[0024] FIG. **23** is a top view of the mold of FIG. **21**.
[0025] FIG. **24** is a side view of the mold of FIG. **21**.
[0026] FIG. **25** is a section view of the mold of FIG. **21** taken along line **25-25** in FIG. **23**.
[0027] FIG. **26** is a rear perspective view of a bottom portion of the mold of FIG. **21**.
[0028] FIG. **27** is a perspective view of the mold of FIG. **21** with a base omitted for clarity.
[0029] FIG. **28** is a perspective view of the bottom portion of FIG. **25** with the base omitted for clarity.
[0030] FIG. **29** is a bottom perspective view of a top portion of the mold of FIG. **21**.

DETAILED DESCRIPTION

[0031] Reference will now be made in detail to various embodiments, examples of which are illustrated in the accompanying drawings. While this disclosure includes certain embodiments, it will be understood that the disclosure is not intended to limit the claims to these embodiments. On the contrary, the disclosure is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the claims. Furthermore, in this detailed description, numerous specific details are set forth in order to provide a thorough understanding. However, one of ordinary skill in the art will appreciate that the subject matter of the present disclosure may be practiced without these specific details. In other instances, well known methods, procedures, and components have not been described in detail as not to unnecessarily obscure aspects of the present disclosure.

[0032] Various embodiments of this disclosure include a custom-fit insert that is shaped to snugly fit on a patient's edentulous jaw and, when the patient bites down on the insert, the bite generates

an impression of the patient's opposite jaw. By custom-fitting the insert to the patient's mouth (e.g., gum-line), the insert ensures that the resultant impression is accurate and reduces a risk of poor occlusion for the dentures built based on the impression. Occlusion-how teeth from upper and lower jaws fit together—is a crucial factor in denture manufacture, as poor or inaccurate occlusion can cause unintended wear to the dentures or tooth pain for the patient, in addition to being aesthetically unpleasant. Accordingly, a device that reduces the risk of poor occlusion without adding an additional step to the already-lengthy process of denture manufacture is advantageous.

[0033] However, a primary obstacle to bespoke inserts has been that the wax (or similarly-impressionable material) is unable to be additively manufactured (e.g., 3D printed) due to its relatively low melting point. Because this low melting point is also the reason why wax is such an effective material for generating dental impressions, it has been difficult to design around this constraint. The present disclosure overcomes this limitation by additively-manufacturing a bespoke base (that is configured to snugly fit within a patient's mouth) within a top that is shaped to mate with the bespoke base. By then defining a U-shaped (e.g., to trace the dental arch) slot in each component, the base and top collectively define a cavity, when coupled. This cavity is then filled with liquid wax. Once the wax has hardened, the mold top is removed, and the resultant product is the bespoke base with a U-shaped amount of wax that aligns with a patient's tooth-line, such that the patient may position the base against one (i.e., edentulous) jaw and the wax will be positioned over the teeth of the patient's opposite jaw.

[0034] FIG. **1** shows each component involved in the present system: mold base **100***a*, mold top **200***a*, wax rim **300***a*, and insert **400***a*. The insert **400***a* may be a combination of base **100***a* and wax rim **300***a*, such that the insert **400***a* is the ultimate result of the method described herein. FIG. **20** shows an alternative insert **400***b* formed using similar components, shown in FIGS. **21**-**29**.

[0035] Each of the mold base **100***a* and the mold top **200***a* may be additively-manufactured using a material that is suitable for three-dimensional printing and is safe for use within a patient's mouth. Accordingly, the melting temperature (e.g., melting point) of the material used for the mold base **100***a* and the mold top **200***a* may be higher than the melting temperature (e.g., melting point) of the wax rim **300***a*, as wax is generally incapable of being three-dimensionally printed.

[0036] FIGS. **2**-**8** show various views of the mold base **100***a*. In the embodiments shown, the mold base **100***a* is shaped to snugly fit with an edentulous upper jaw (e.g., a toothless gum), such that the impression to be formed by the insert **400***a* is of the lower jaw. Accordingly, reference will be made throughout to the upper jaw and the lower jaw for clarity, but this disclosure should not be read as limited to use of the insert **400***a* in this manner. For example, this disclosure should be read as applicable to the mold base **100***a* shaped to fit about an edentulous lower jaw to take an impression of the upper jaw.

[0037] As shown, the mold base **100***a* may include an outer face **110** and an inner face **130**. In some embodiments, the mold base **100***a* may be produced through additive-manufacturing by designing a three-dimensional digital model defined by the negative space around the patient's edentulous upper jaw (e.g., the patient's gum). This model may be designed using an oral scan of the upper jaw using any suitable method (e.g., CT scan, an MRI, optical scan, etc.). The inner face **130** may be defined as an exterior of the upper jaw, and the outer face **110** may be defined as a preset thickness of material from the inner face **130**.

[0038] The outer face **110** may include having a molded edge **112***a* and a wax recess **114***a*. The wax recess **114***a* may be generally U-shaped (e.g., a bottom surface of the recess **114***a* is U-shaped relative to the bottom view of FIG. **3**) and configured to align with a dental arch of the lower jaw. In order to construct the wax recess **114***a* within the mold base **100***a* without milling or similar techniques, the wax recess **114***a* may be included in the digital model by digitally-removing the portion of the model (e.g., by digitally inserting a single U-shaped “tooth” on the outer face **110**). The wax recess **114***a* may have substantially-constant wall angles (e.g., the wax recess **114***a* may have right angles within the recess **114***a*), which may define the molded edge **112***a* as non-

uniformly curved to correspond with the bespoke shape of the patient's upper jaw. The shape of the molded edge **112***a* is relevant to production of the wax rim **300***a*, which is discussed in depth below with reference to mold top **200***a*.

[0039] The mold base **100***a* may include one or more apertures (e.g., holes). The illustrated embodiment includes three such apertures: first aperture **121**, second aperture **122**, and third aperture **123**. Each aperture may be formed as part of the digital model, such that the mold base **100***a* may be printed with the apertures included, and the apertures may extend through the entire mold base **100***a*. As described below with reference to the mold top **200***a*, the apertures may be used to align the mold base **100***a* with the mold top **200***a*.

[0040] FIGS. **9**-**15** show various views of the mold top **200***a*. As shown, the mold top **200***a* may include a surface **210** having a wax recess **214***a* and a molded edge **212***a* about the perimeter of the wax recess **214***a*. The shape (e.g., outline, impression, etc.) of the wax recess **214***a* may be a mirror image of the wax recess **114***a* of the mold base **100***a* (e.g., relative to the views of FIGS. **3** and **11**), such that when the surface **210** of the mold top **200***a* abuts the outer face **110** of the mold base **100***a*, the wax recess **114***a* and wax recess **214***a* collectively form a cavity.

[0041] This cavity may be substantially sealed (e.g., only allowing liquid to flow into the cavity via one or more holes **216**) by the interface of the molded edge **112***a* of the mold base **100***a* with the molded edge **212***a* of the mold top **200***a*. To ensure a consistent and reliable seal, the mold top **200***a* may be additively-manufactured based on a digital model designed as the negative space of the mold base **100***a*. In particular, the shape and contour of the molded edge **212***a* may be designed (e.g., in the digital model) as the negative space of the molded edge **112***a*. Put differently, the mold base **100***a* may be designed based on the negative space of a patient's edentulous jaw, and the mold top **200***a* may be designed based on the negative space of the mold base **100***a*.

[0042] Once the mold base **100***a* and mold top **200***a* are aligned, wax (or similar material suitable for taking dental impressions) may be injected into the cavity via the one or more holes **216**. Because the cavity is otherwise sealed (e.g., other than the holes **216**), the wax may fill the cavity and eventually harden as wax rim **300***a*. This fully assembled combination (e.g., the mold base **100***a* and mold top **200***a* on either side of the wax rim **300***a*) may be delivered to the dental technician responsible for taking the impression as a single unit. By removing the mold top **200***a*, the insert **400***a* may be ready to be positioned within the patient's mouth for taking an impression of their lower jaw.

[0043] As shown, the mold top **200***a* may include one or more protrusions (e.g., pegs). The illustrated embodiment includes three such protrusions: first protrusion **221**, second protrusion **222**, and third protrusion **223**. Each protrusion may extend perpendicularly from the surface **210** and may be configured to fit within a corresponding hole of the mold base **100***a*. In particular, the first protrusion **221** may be sized, shaped, and positioned to fit within the first aperture **121**; the second protrusion **222** may be sized, shaped, and positioned to fit within the second aperture **122**; and the third protrusion **223** may be sized, shaped, and positioned to fit within the third aperture **123**. In this manner, although three pairs of protrusions and holes are shown, it should be understood that any number of pairs may be read as within the scope of this disclosure, provided that the number of pairs provided is sufficient to ensure alignment between the mold base **100***a* and the mold top **200***a*.

[0044] FIGS. **16**-**19** show various views of the mold base **100***a* and the mold top **200***a* in alignment for the fully assembled combination. As shown, protrusions **221**, **222**, and **223** of the mold top **200***a* may be inserted into corresponding apertures **121**, **122**, and **123**, which causes molded edge **212***a* to form a seal with molded edge **112***a* and defines the cavity for receiving wax with the wax recess **114***a* and wax recess **214***a*. FIG. **19** shows a section view of this combination, taken along lines **19**A-**19**A and **19**B-**19**B of FIG. **17**.

[0045] FIG. **20** shows a dental insert **400***b* configured—like dental insert **400***a*—to be positioned on a patient's edentulous gum in order to take an impression of the opposite gum. Dental inserts

400*a* and **400***b* are functionally identical, with the primary distinction being that the wax **300***a* of the dental insert **400***a* extends to an interior of the base **100***a*, while the wax **300***b* of the dental insert **400***b* extends from a surface of the base **100***b*, such that a ridge of additional base **100***b* material formed by molded edge **112***b* protrudes above a bottom portion of the wax **300***b*.

[0046] As shown in FIGS. **21**-**24**, the mold **10***b* used to form the dental insert **400***b* includes a base **100***b* and a top **200***b*. Similar to the top **200***a*, several apertures (or holes) **216** provide access to an interior of the base **100***b* and top **200***b* and are configured to receive wax to form the wax **300***b* portion of the insert **400***b*.

[0047] In contrast to the protrusions **221**, **222**, **223** of the top **200***a* and the apertures **121**, **122**, **123** of the base **100***a*, the base **100***b* and top **200***b* may include alignment mechanisms **14** positioned about the seam formed by the corresponding edges of the base **100***b* and top **200***b*. As shown, the alignment mechanism **14** may include a pair of alignment protrusions **14***a* on the base **100***b* (as seen in FIG. **28**) and an alignment protrusion **14***b* on the top **200***b* shaped to fit between the pair of alignment protrusions **14***a*. By positioning these alignment mechanisms **14** at various points about the seam, the base **100***b* and top **200***b* may be aligned to each other. Although this particular configuration for the alignment mechanism **14** is shown, this disclosure should not be read as limited to just this configuration and should be read to include any suitable means for aligning the base **100***b* and top **200***b*. For example, the alignment mechanism **14** could be a snap-fit detent with corresponding protrusion, a male-female friction fit, etc.

[0048] Referring now to FIG. **26**, another difference between base **100***a* and base **100***b* is shown. In contrast to the recess **114***a* being formed by the absence of material in the base **100***a* and the molded edge **112***a* being formed as the rim of the recess **114***a*, the molded edge **112***b* is formed by an extension of material away from the gum-shaped portion **110***b* of the base **100***b* and the recess **114***b* is defined as the interior of this raised material. In this manner, the molded edge **112***b* is substantially flat (e.g., the highest points of the molded edge **112***b* exist on a same horizontal plane), and the bottom surface of the recess **114***b* is contoured to the patient's gum. Consequently, the corresponding molded edge **212***b* of the top **200***b* is similarly flat, such that the seal created by the interaction of the two molded edges **112***b*, **212***b* is formed by the abutment of two flat edges rather than the bespoke curvature of molded edges **112***a*, **212***a*.

[0049] The base **100***b* and top **200***b* are designed such that both components may be additively-manufactured as a single monolithic piece, with the base **100***b* and top **200***b* joined by sacrificial couplings **12**. These couplings **12** are configured to be cut, snapped, or otherwise broken or removed in order to separate (e.g., detach) the two components. Given that the recesses **114***b*, **214***b* are pre-treated (e.g., lubricated) prior to the wax being injected, it is advantageous for the base **100***b* and top **200***b* to be separately worked. However, it is also advantageous for the base **100***b* and top **200***b* to be manufactured in one step to shorten production time and to improve compatibility with various design software and printing technologies. The sacrificial couplings **12** enable both of these advantages by enabling the base **100***b* and top **200***b* to be printed together but easily separated in processing.

[0050] As part of the manufacturing process, the base **100***b* and top **200***b* may be manufactured with a small gap between the corresponding edges **122***b*, **212***b*. This gap is shown in the section view of FIG. **25** and may not be present once the base **100***b* and top **200***b* are separated and aligned for use (e.g., filling with wax).

[0051] FIG. **27** is a perspective view of the base **100***b* and top **200***b* with the gum-shaped portion **110***b* removed for clarity. In practice, the mold **10***b* may be designed by scanning a patient's gum to generate a digital model of the gum-shaped portion **110***b*, and digitally-positioning the base **100***b* and top **200***b* within the gum-shaped portion **110***b* model. The depth of the base **100***b* within the gum-shaped portion **110***b* may be based on a desired depth of the wax **300***b*. FIGS. **28** and **29** are perspective views of the base **100***b* and top **200***b* respectively, with the gum-shaped portion **110***b* omitted in both.

[0052] The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

Claims

1. A method comprising: producing a mold comprising: a mold base that is based on a digital model of a portion of a patient mouth; a first mold portion monolithically formed with the mold base and defining a U-shaped recess; and a second mold portion shaped to correspond with the U-shaped recess; aligning the first mold portion and the second mold portion; filling the U-shaped recess with a wax; and removing the second mold portion to result in a wax mold comprising the wax, the mold base, and the first mold portion.
2. The method of claim 1, further comprising inserting the wax mold into the patient mouth, wherein: the mold base is configured to form a snug fit with a gum portion of the patient mouth; and the wax is configured to form an impression of a tooth portion of the patient mouth.
3. The method of claim 2, wherein the gum portion is of a first jaw of the patient mouth and the tooth portion is of a second jaw of the patient mouth, the second jaw different from the first jaw.
4. The method of claim 1, wherein the U-shaped recess is positioned to align with a tooth portion of the patient mouth.
5. The method of claim 1, wherein producing the mold comprises: additively-manufacturing the mold base, the first mold portion, and the second mold portion as a single component; and detaching the second mold portion from the first mold portion by removing at least one sacrificial coupling.
6. The method of claim 1, wherein the mold has a higher melting temperature than a melting temperature of the wax.
7. The method of claim 1, wherein filling the U-shaped recess with wax comprises injecting wax via at least one aperture in the second mold portion.
8. A method for producing a wax mold for dental impressions, the method comprising: processing a scan of a patient mouth to generate a gum scan; producing, via additive manufacturing, a first mold corresponding to the gum scan; producing, via additive manufacturing, a second mold comprising a recess configured to receive wax and to mate with the first mold; aligning the first mold and the second mold, such that the recess is substantially sealed by the first mold; injecting wax into the recess; and removing the second mold to isolate the wax mold.
9. The method of claim 8, further comprising inserting the wax mold into the patient mouth, wherein: the first mold is configured to form a snug fit with a gum portion of the patient mouth; and the wax is configured to form an impression of a tooth portion of the patient mouth.
10. The method of claim 9, wherein the gum portion is of a first jaw of the patient mouth and the tooth portion is of a second jaw of the patient mouth, the second jaw different than the first jaw.
11. The method of claim 8, wherein the recess is positioned to align with a tooth portion of the patient mouth.
12. The method of claim 8, wherein: the first mold and the second mold are produced as a single component; and the second mold is configured to detach from the first mold by removing at least one sacrificial coupling.
13. The method of claim 8, wherein the first mold and the second mold comprise a material having a higher melting point than the wax.
14. The method of claim 8, wherein filling the recess with wax comprises injecting wax via at least one aperture in the second mold.

15. An apparatus for producing dental impressions, the apparatus comprising: a base comprising: an inner surface that is shaped based on a gum of a patient mouth; and a first recess that is defined on an outer surface based on at least one tooth of the patient mouth; and a top comprising: a second recess having at least one aperture, wherein: the first recess and the second recess collectively form a cavity while the base and the top are mated; and the cavity is configured to receive wax via the at least one aperture.

16. The apparatus of claim 15, wherein the base and the top are additively-manufactured.

17. The apparatus of claim 16, wherein: the base and the top are additively-manufactured as a single component; and the top is configured to detach from the base by removing at least one sacrificial coupling.

18. The apparatus of claim 15, wherein: the gum is of an upper jaw of the patient mouth, and the at least one tooth is of a lower jaw of the patient mouth.

19. The apparatus of claim 15, wherein the base and the top comprise a material having a higher melting point than the wax.

20. The apparatus of claim 15, wherein the first recess and the second recess are U-shaped.