July 17, 1956 J. HIGHKIN 2,754,589

METHOD OF AND APPARATUS FOR MAKING DENTURES

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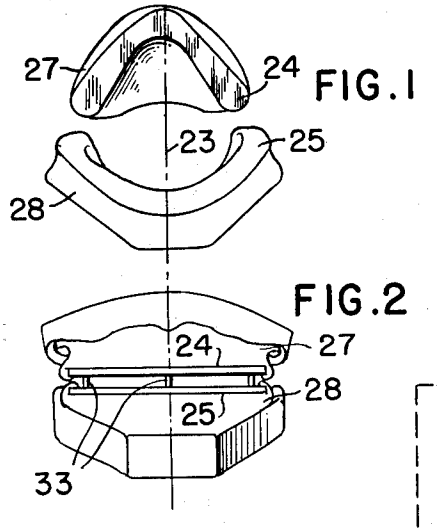

FIG. 1

FIG. 2

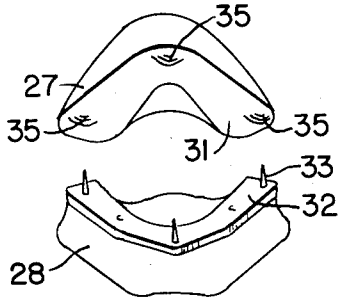

FIG. 4

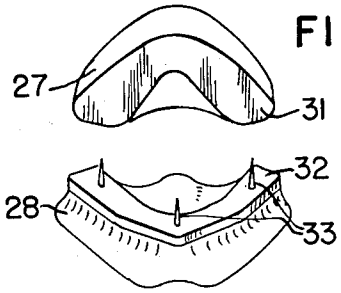

FIG. 3

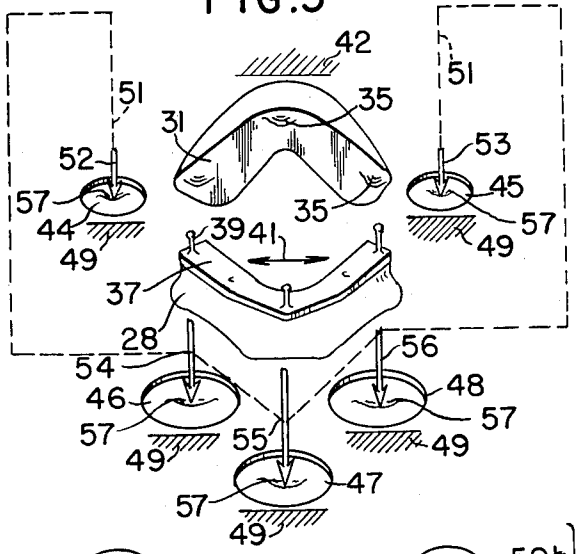

FIG. 5

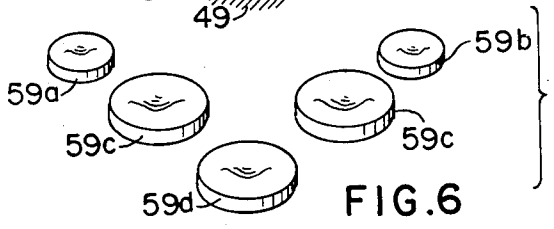

FIG. 6

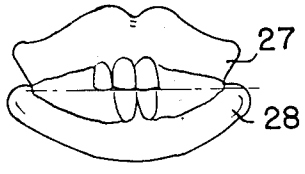

FIG. 8

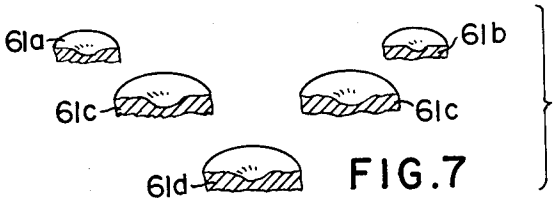

FIG. 7

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FIG.9

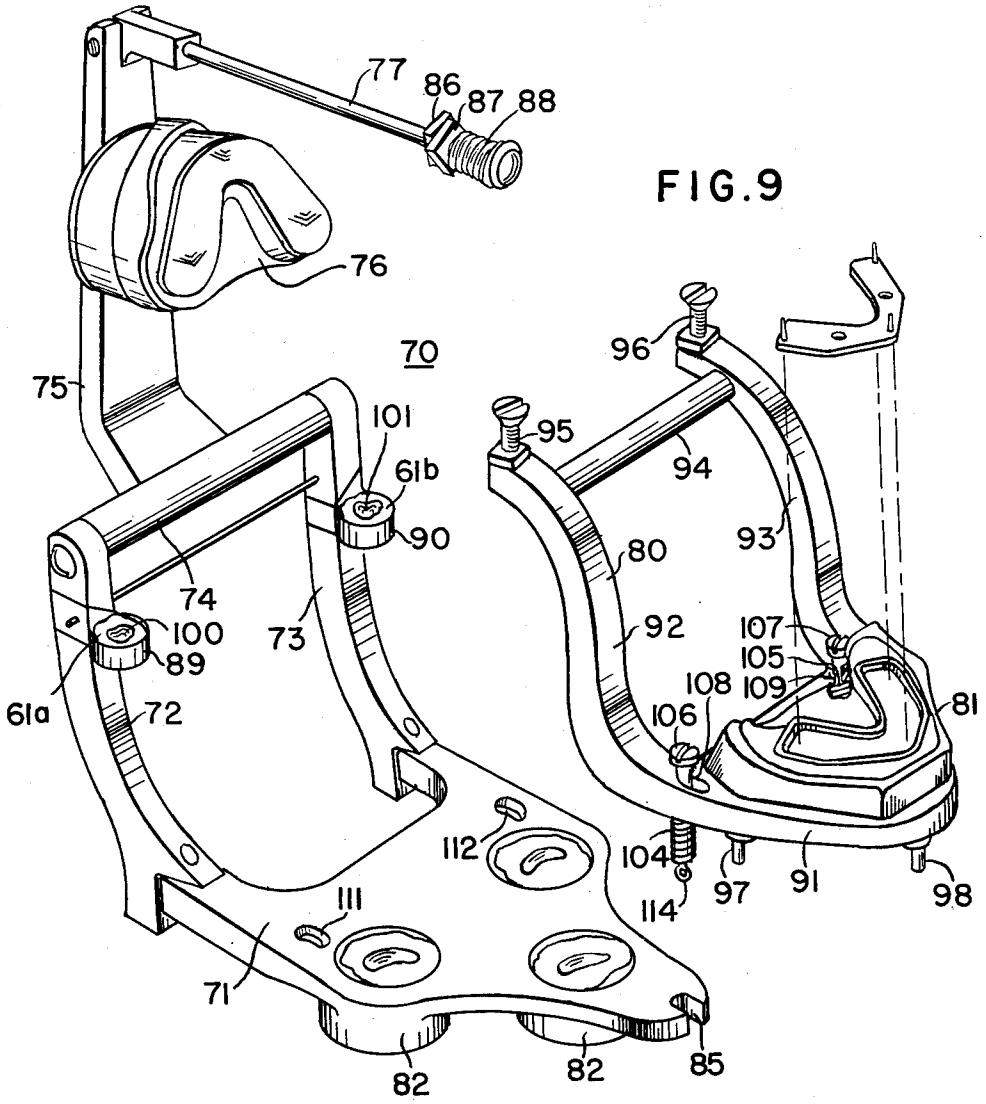

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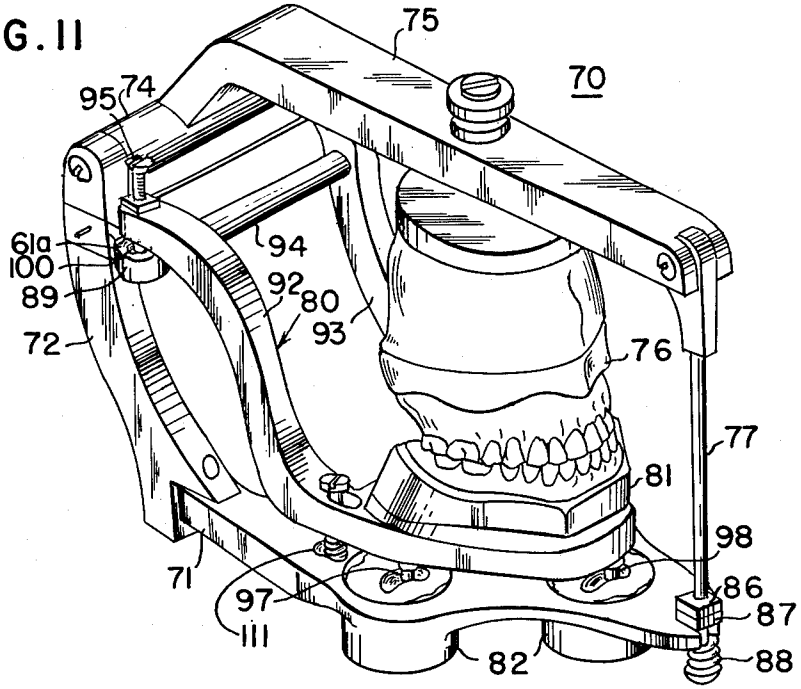
FIG. 11



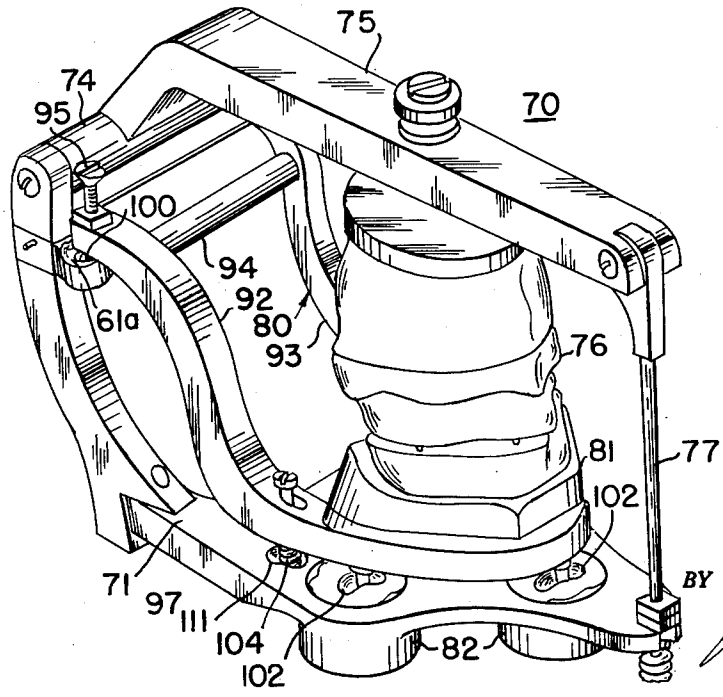


FIG. 10

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United States Patent Office 2,754,589 Patented July 17, 1956

2,754,589

METHOD OF AND APPARATUS FOR MAKING DENTURES

Joseph Highkin, New York, N. Y.

Application August 20, 1954, Serial No. 451,138

9 Claims. (Cl. 32—32)

This invention relates to dentistry, and particularly to full dentures or dental plates, and to an apparatus and a process for making such dentures or plates.

One object of this invention is to provide an apparatus, and a method utilizing the apparatus, for making dentures or complete sets of dentures or plates so they can have freedom of relative transverse or lateral movement in response to mastication motion of the mandible or lower jaw.

In forming dental plates, mainly as full plates to replace the entire arch of a set of teeth, it is naturally desirable to form the plates in such a manner that the two sets of plates of artificial teeth will fit together to provide the natural bite and follow the relative motion established by masticating motion of the jaw structure of the wearer.

The natural bite and motion of a natural set of teeth normally includes a vertical motion, or relative up-and-down movement of the sets of teeth, a relative front and back movement between the two sets of teeth, and a relative lateral or transverse oval movement of the two sets of teeth. Such relative movement between the upper and lower jaws of the mouth is possible because of the nature of the pivotal support of the lower jaw on the two rear hinge points where the lower jaw is supported on the maxillary or upper jaw.

One of the problems in shaping engaging tooth surfaces of artificial tooth plates has been due to the lack of an articulator or mechanical device that could reproduce all of the movements of the human jaw, which would then permit the dental operator to correspondingly shape the plate that was to be fitted to that jaw, so the plate could respond to all of the movements of that jaw.

One of the primary objects of this invention is therefore to provide an articulator which can reproduce the entire range and degree and type of movement of each jaw of an individual for whom the dental plates are to be made.

Another object of this invention is to provide dentures so properly mated as to enable the wearer to substantially reproduce the relative movements originally enjoyed with his natural teeth.

The general method of operation involved herein, contemplates several steps, to obtain a record or diagram of the patient's jaw-setting position, and of the relative movements of the two jaws in the various biting and grinding or chewing operations.

Those records are used to form control surface elements or cams for an articulator, on which certain movable elements serve as mechanical followers to control the shaping and inclination of the surfaces of the engaging artificial teeth in the two engaging dentures or plates to be prepared to be worn by the patient.

The steps of the dental procedure for forming the dental plates by means of the articulator, and the detailed construction of the articulator, may be more readily comprehended upon reference to the drawings, in which:

Figure 1 is a schematic open view of auxiliary denture models for application to two arches of a human mouth that are to be equipped with artificial plates;

Figure 2 is a front schematic view showing the auxiliary models of Fig. 1 in closed position with scribing pins applied;

Figure 3 is schematic front view, in perspective, of the two denture models of Fig. 2 in open position to expose the scribing pins and record plate supported on the two models;

Figure 4 is a schematic front view, in perspective, of the two auxiliary denture models of Fig. 3, in open position, with the markings representative of the range of relative movement of the patient's jaws during mastication;

Figure 5 is a schematic front perspective view of the auxiliary denture models of Fig. 4 in operating position on the articulator, and illustrates the bottom jaw model as being movable with respect to the other elements that are indicated to be held in stationary position during such movement, in order to reproduce by pantographic operation, a mastification range outline of the bottom denture model in five wax molds to provide a record for preparation of control discs for the articulator;

Figure 6 is a schematic view, in perspective, of five conjugate molds, of plaster-of-Paris, for making final metal control molds for the articulator;

Figure 7 is similar to Fig. 5, except that soft wax buttons have been replaced by hard metallic button molds to serve as the actual cam controls for the articulator;

Figure 8 is a front elevational view of a final set of artificial teeth in the two denture plates to be worn by the patient;

Figure 9 is a perspective exploded view of the articulator of this invention;

Figure 10 is a perspective view of the articulator of Fig. 9 in closed position; and

Figure 11 is similar to Fig. 10 with the finished denture plates in position on the articulator for final processing.

The first preparatory steps are as follows:

1. An impression is taken by the dentist in suitable impression material that will harden in the mouth, to give impression of the full upper and the full lower gum arches; these impressions are essentially negatives;

2. The negative gum impressions are then used in the laboratory to receive poured stone or equivalent self-hardening material to form the models or true reproductions of the patient's upper and lower gun arches to be used in later operations;

3. The next operating step is to obtain a measure of proper vertical spacing of the patient's jaws, as a guide to proper positioning of the teeth on the dentures; for that operation, an arch-shaped channel, internally filled with impression bite material, is provided for each gum and is equipped with an outer layer of wax (so the two opposed channels can be compressed by a direct bite, and the outer layers of wax will be in direct contact and in compression;

4. The dentist places these two channel arches in the patient's mouth for the direct vertical bite, and the wax layers are then gradually respectively shaved horizontally, as may be necessary, until their relative size and shape hold the jaws in proper position corresponding to normal closure position of the original teeth of the patient. These spacing plates may then be fitted on the models of the gums to provide a true measure of proper spacing for the patient's jaws and thus guide the proper size and spacing of the dentures with the artificial teeth to be disposed therein;

5. The two channel arches are then placed on an articulator to get the proper vertical measure, as by a vertical front pin of adjustable length on the articulator; the articulator is then opened and the channels removed,

leaving the front pin to record the proper spacing of the articulator jaws;

6. The next step then becomes the initial procedural step of the procedure or method of this invention, and will now be explained with reference to the drawings.

As shown in Fig. 1, two auxiliary denture models, as upper and lower 27 and 28, are formed with internal impressions formed to fit the top and bottom dental arches of the patient to be fitted, as taken from the arch models previously made. These auxiliary denture models will be shaped first to have external flat seating surfaces 24 and 25, and be properly aligned relative to a center line 23.

These auxiliary denture models will then be equipped, as shown in Figs. 2 and 3, with scribing or recording plates 31 and 32, to obtain a record of the various possible movements of the patient's jaws.

For this purpose the two metallic recording plates 31 and 32, are cemented to the auxiliary denture models 27 and 28.

The material of recording plate 31 is relatively soft so that it may accept a recording or scribing mark, from three marking or scribing pins 33 secured to and integral with the plate 32 on the bottom auxiliary denture 28. The auxiliary denture models and the three scribing pins are formed so the three pins engage the top plate at the same time, in initial still position.

These two marking plates 31 and 32 are similar in purpose and function to corresponding plates shown in Patent Number 1,669,335, issued May 8, 1928, to David Highkin. These marking plates may be variously modified in form and construction, and are illustrated here in the simplest manner, merely to indicate the purpose and function of the plates, which is to obtain a record of the nature and extent of movement possible by the jaws relative to each other in the patient's mouth, as during mastication.

The individual auxiliary denture models 27 and 28, as now equipped with the recording plates 31 and 32, are then placed in the patient's mouth in order to obtain such record of his jaw movements. Such a record of markings resulting in a groove or concavity is indicated on the upper plate in Fig. 4. Each of the three marking pins 33 will have formed a groove or cavity 35 in the upper plate 31. The two auxiliary denture models 27 and 28, with the record grooves 35 in the plate 31, are now ready for use on the articulator, to serve as guide controls in the design construction of the final dental plates with the artificial teeth. At this stage of the procedure, the scribe or bottom plate 32 with the sharp pins 33 of Fig. 4 is removed, and a plate of similar size and dimensions, shown as plate 37 in Fig. 5, is substituted for plate 32 on the bottom auxiliary denture 28.

A functional disposition of the control plates 31 and 37 and the supporting auxiliary denture models 27 and 28 on the articulator is represented schematically in Fig. 5. The substituted plate 37 is provided, however, with pins of equal length to the pins 33 but with rounded heads 39, which may be merely blunt points, but are shown as enlarged rounded heads solely for illustrative emphasis. The upper plate 31 is retained, however, with its record grooves 35 which now serve as cam surfaces to guide and control the nature and extent of movement of the blunt points 39 of the pins on the substituted lower plate 37. In terms of cam theory, the lower plate 37 may be considered a cam follower plate.

The lower plate 37 is indicated as being relatively movable in both directions laterally by the double headed arrow 41, to indicate that the entire lower denture 28 with the follower plate 37 is thus movable.

The upper plate 31 with the record grooves 35 is indicated as being held stationary on the articulator, by the symbolic indication of the structural backing.

Similarly, five other elements are shown as being held in stationary positions on the stationary supporting structure of the articulator. These five elements are shown

as wax disc elements, two of which marked 44 and 45 are supported above the transversely movable bottom model 28 and plate 37, and three other similar disc elements 46, 47 and 48 are disposed below that transversely movable model 28 and follower plate 37. Each of the five wax discs 44 to 48, inclusive, is indicated to be held in anchored position by the articulator structure, indicated in each case by a structural symbol 49.

The lower jaw auxiliary plate model 28 is mounted, as previously stated, for lateral or transverse movement in both directions horizontally, as indicated by the arrow 41. For this purpose, the auxiliary plate model 28 is supported on a movable frame of the articulator, as indicated generally by the broken dash line 51, so that the lateral or transverse movement, of the lower jaw auxiliary plate model 28, is imparted to five scribing elements supported on the frame 51 of the articulator.

Those five scribing elements, marked 52 to 56, inclusive, engage the wax discs 44 to 48, inclusive, and form grooves or markings in those wax discs, corresponding to the cam groove markings 35 in the stationary upper auxiliary plate model 31, as the follower pins 39 are moved in those cam grooves 35 in said upper plate model 31.

The grooves 57 that are thus now formed in the wax discs 44 to 48, inclusive, are similar to the original records or grooves 35 that were formed directly by the patient with plates 31 and 32 in his mouth, the only difference being due to the difference, if any, in the dimensions of the grooves or records 57 made on the articulator because of the relative dimensions of the pantographic action of the articulator.

The function of the wax discs on the articulator is to serve as easily deformable models from which hard metallic discs may be formed, having the same contour grooves or cavities, which will then provide rigid control surfaces in the nature of cam surfaces in material that is relatively wear-resisting. Then the articulator may be operated against those wear-resisting surfaces as cam surfaces without any loss of accuracy in reproducing the functional movements of the patient's jaw, as a guide toward forming proper inclined surfaces on the ultimate artificial teeth.

In order to form such wear-resisting cam buttons or discs, the wax discs 44 to 48, with the grooves formed therein, are removed from the articulator, suitable conjugate molds 59–*a* to 59–*e* are formed of plaster-of-Paris, using conventional dental techniques, and then the ultimate metallic buttons 61 are formed from the plaster-of-Paris conjugate molds 59, to provide final cam discs 61–*a* to 61–*e* as in Fig. 7, which have the same shaped cavities and recesses that were originally formed in the wax buttons 44 to 48, inclusive.

The metallic cam buttons 61–*a* to 61–*e*, of Fig. 7, are now placed in corresponding positions in the articulator, as substitutes for the original respective wax buttons 44 to 48. This articulator is now ready for any of the mechanical or grinding operations that may be necessary for properly locating and shaping the artificial denture teeth ultimately on their supporting plates, to enable those teeth to have free movement in response to masticating operations of the patient's jaws. Such proper shaping of the artificial teeth prevents any traumatic stresses that would tend to displace the plates of the patient from their proper positions during such masticating operations. The final appearance of the dentures is generally indicated in Fig. 8.

In a variant procedure, the plaster-of-Paris conjugate molds may be formed in the articulator itself, directly on top of the several scribed wax discs. When such plaster-of-Paris molds are hardened, the wax may be melted out through suitable passages, and replaced by molten metal, using standard dental techniques. Upon solidification of the metal to form duplicates of the scribed wax discs, the plaster-of-Paris molds may be removed to expose the metallic cam buttons thus formed.

Referring now to Fig. 9, the elements of the articulator 70 of this invention are shown with the several parts separated for simple illustration.

The articulator 70 comprises a base or platform 71 extending backwardly into two vertical standards 72 and 73 that serve as supports for a pivoted shaft 74. That shaft 74 carries an arm 75 to support and position various elements representative of the upper jaw of the patient. Shaft 74 also carries a pivoted locking and spacing post 77 for controlling the proper elevation or vertical disposition of the upper jaw support element 76 on the articulator. The articulator 70 further comprises a bracket 80 to support the denture elements 81 associated with the lower jaw of the patient. This articulator, as illustrated in Fig. 9, is intended to reproduce all of the mandibular gyrations of mastication, which have been generally referred to above as the possible relative movements of the two jaws of the patient.

Returning now to the platform or base 74, for a more detailed description of its construction, it will be observed, in Fig. 9, that the base is provided with three bosses 82 suitably recessed from the top surface of the base 71 to receive and accommodate first the wax buttons 46, 47 and 48 indicated in Fig. 5, and then, later, the metallic buttons 61–*c*, 61–*d*, and 61–*e* shown in Fig. 7. In accordance with the variant procedure previously referred to, the wax buttons 46, 47 and 48, after being scribed may be covered, in place, in the bosses 82, with plaster-of-Paris, to form hardened inverted molds in the bosses. The wax may then be melted out through suitable openings in the side or bottom of each boss, and molten dental metal substituted to form hard metallic cam button discs, shaped by the plaster-of-Paris molds to correspond to the removed scribed wax discs.

The front edge of the base 71 is provided with a slot 85 to receive a portion of the shank at the front or lower end of the positioning rod 77, as, for example, between two positioning stop nuts 86 and 87 on that rod. A coiled helical spring 88 serves to provide an additional holding force to press the positioning nuts 86 and 87 together, to prevent any casual displacement of the rod during work on the articulator.

The two vertical standards 72 and 73 that rise upward from the base or platform 71 support two similar bosses 89 and 90 that serve as retaining cups, first for the wax buttons 44 and 45 of Fig. 5, and later for the metallic buttons 61–*a* and 61–*b* of Fig. 7.

The mandible or lower jaw element 80 of the articulator may now be considered in its detailed construction and functional operation. That element corresponds, in operation, on the articulator, to the mandible or lower jaw of the patient. The mandible consists, as indicated in Fig. 9, of a base or platform portion 91 with two backwardly extending side arms 92 and 93 suitably braced and connected by a cross-bar. The top ends of the two side arms 92 and 93 respectively support two pivot pins 95 and 96, whose lower bluntly rounded ends function respectively as cam followers, or guide pins, when seated in the cam discs 61–*a* and 61–*b* in the two retaining seats 89 and 90 on the side arms of the main base 71. The base 91 of the mandible 80 is similarly provided with three guide pins 97, 98 and a third pin that is not visible in Fig. 9. These bottom guide pins 97, 98 and the unseen third pin, fit into the cam discs 61–*c*, 61–*d* and 61–*e* in the base 71.

The action of the articulator 70 may now be better appreciated upon referring to Fig. 10. It will be observed that the mandible frame 80 resembles the mandible or lower jaw of the patient. The two upper pivot pins 95 and 96 at the top of the mandible frame 80, of which only the pivot pin 95 is visible in the showing in Fig. 10, are relatively free to move within the limits of the concave markings 100 and 101 reproduced in the cam discs 61–*a* and 61–*b*.

In similar manner, the three pins 97, 98 and the third pin on the under side of platform 91, are seated in the cam discs 61–*c*, 61–*d* and 61–*e*, that are anchored in the respective pockets of the bosses 82 on the base of the bottom base plate 71.

The mandible 80 is thus free to move at its upper end, where it is supported by the pivot pins 95 and 96, and is similarly free to move at its lower end, where it is supported by the pivot pins 97, 98 and the unseen third pin.

Since the cavities in the metallic cam discs 61–*a* to 61–*e* correspond essentially to those formed and established in the initial test plates by the actual jaw movements of the patient, these cavities in the control discs of the articulator will, in turn, cause a type of movement between two artificial plates that are supported on the articulator, that will correspond to the movements which the test plates experienced while being moved in the mouth of the patient in response to his general masticating jaw movements.

In order to hold the two movable plate elements of the articulator within a predetermined limited range of relative movement, the mandible element 80 is pivotally floated on the base plate 71 by means of two resilient pivots formed by two individual helical springs 104 and 105 at each side edge of the mandible 80, at a region directly behind the base 91 of the mandible 80.

These two pivotal springs 104 and 105 are mounted on supporting pins 106 and 107 which extend through appropriately positioned holes 108 and 109 in the mandible frame 80. When the two pins 106 and 107 are pressed down through similarly positioned holes 111 and 112 in the base 71, the pins are then suitably anchored against casual displacement by the insertion of a pin or thin rod through the eyes 114 at the lower ends of the rods 106 and 107.

The mandible frame 80 is thus pivotally supported on the base 71 so the same full degree of relative movement between the two frames of the articulator may be established, that corresponds to the same relative movements in the jaw of the patient, from whose movements the several control discs have been shaped.

The final operation of shaping or grinding the teeth surfaces after the teeth have been assembled on the plates that are to be fitted to the patient, may be readily realized upon reference to Fig. 11. As there shown, the two final dental plates or dentures are assembled on the articulator where they may then be subjected to the same relative masticating movements that will occur in the mouth of the very patient to whom they are to be fitted.

Under the conditions which dictated the forming and shaping of the control disc buttons, the cam control action of those buttons, in turn, assures that the tooth surfaces of the two dental plates will be shaped to have the exact inclinations that will be necessary to enable those teeth to move relatively to each other without introducing traumatic shocks or stresses that would cause discomfort to the patient or would dislodge the dentures from their proper normal positions.

Appropriate relief or relative separating movement between the two dental plates during such grinding-in operation is permitted by the compressible spring 88 at the bottom of the front spacing pin 77, and by the pivoting compressible helical springs 104 and 105 between the mandible bracket 80 and the base.

By means of the articulator herein disclosed, it is now possible to duplicate the full and exact movements of a patient's jaws, so as to be able to make a set of dentures whose tooth surfaces have proper relative inclinations to enable the teeth to move properly without interference.

The invention is not limited, of course, to the specific details of construction of the articulator itself. In the general form the articulator does resemble the conventional articulator, but it has been modified to embody various features of construction that enable the parts to move and operate in accordance with the movements of the human jaw.

What is claimed is:

1. An articulator comprising a main base plate for supporting an upper denture; a mandibular frame structure for supporting a lower denture in engagement with the upper denture; means for supporting the mandibular frame for relative movements on the main base plate to reproduce the universal gyratory movements of a human mandible during mastication; means constituting scribed cam disc records representative of such gyratory movements in the mouth of the patient; means holding said cam disc records in pre-determined fixed positions on the main base plate; and means fixed on the mandibular frame and constituting cam follower pins to ride in the cam disc records and guide the movements of the mandibular frame.

2. An articulator for reproducing the mandibular gyrations of mastication, comprising a main base plate having a platform at the front of the base plate and two vertical posts at the rear of the base plate; a socket element supported on each vertical post; a mandibular element having a front platform and two side rearwardly extending arms, with a downwardly depending pivot pin on the back end of each arm, the pivot pins being adapted to be seated in the socket elements and to have freedom of movement therein; three socket elements supported on and within the platform of said main base plate; three pivot pins depending from the front platform of the mandibular element and fitting into said three sockets respectively, and being adapted to have freedom of movement therein; means pivotally supported from the two vertical posts of the main base plate and serving to hold an upper denture in predetermined fixed position above the platform of the main base plate; and means on the mandibular element for holding a lower denture in operative position relative to the upper denture to enable the two dentures to be mated.

3. An articulator comprising a base having two spaced posts; an arm pivotally supported for angular movement about a horizontal axis across said posts from a non-operating position to an operating position above the base; a pole of adjustable length for supporting the free end of the pivoted arm at a selected height above the base; means for supporting an upper denture plate on the under side of the pivoted arm; a frame having the general form of a human mandible or lower jaw for supporting a lower denture in a position under an upper denture on said pivoted arm; spring means pivotally supporting said frame and biassing the frame upwardly toward said arm to cause the two dentures to engage when the arm and the frame are in place; means supported from the under side of the lower jaw frame to serve as follower elements to guide and limit the relative pivotal movement of the frame on its pivotal supports; and guide means supported on the base and adapted to be engaged by the guide follower elements, said guide means having pre-shaped cavities whose surfaces serve as cam surfaces to control the movement of the guide follower elements during manual manipulation of the jaw frame to establish proper correlation between the two dentures for mastication movements.

4. The method of making an artificial denture and shaping the denture on an articulator, which consists in generating a record of the universal relative movement of a patient's lower jaw relative to the upper jaw; preparing models of the gum arches; preparing and fitting dentures to said models of the gum arches; subjecting the two dentures of a matched pair to gyratory movements corresponding to mastication; and utilizing the record of the patient's jaw movements as a control guide in shaping the inclination of the engaging surfaces of the denture teeth as the dentures are correlated on the articulator.

5. A method as in claim 4, in which the record of relative jaw movement of a patient is formed as a cavity in a soft wax material; and then the cavity is reproduced exactly in a wear-resisting material to serve as a guide cam surface for controlling the relative movements of the final dentures to establish the required correlation between them.

6. An articulator for reproducing the mandibular gyrations of mastication, comprising a main base member, cam disc records on said base member representing gyratory movement of a human mandible during mastication, a mandibular element, means fixed on the mandibular element and constituting cam followers engaging the cam disc records for guiding the movement of the mandibular element, means on the mandibular element for holding a lower denture, a member movably attached to the base and overlying said mandibular element, and means on said last member serving to hold an upper denture in operative position relative to said lower denture.

7. The combination of claim 6, in combination with resilient means to press said overlying member toward said base whereby to resiliently press said dentures toward each other.

8. The combination of claim 6, said overlying member being pivoted to said base member, a rod pivoted to said overlying member, and spring means on said rod engaging said base.

9. The method of making an artificial denture which comprises taking negative impressions of upper and lower jaws in an edentureless mouth, then making upper and lower positive models from said negative impressions, then making base plates complementary to said upper and lower models, then applying a bite rim of relatively soft material to the upper of said base plates and fastening hard pins to the lower of said base plates, then placing the base plates in a patient's mouth and having the patient perform the mandibular gyratory movement whereby said pins form grooved cam records in said bite rim representing the gyratory mandibular movement in the mouth of the patient, then placing the models with the base plates into an articulator in which the upper model base plate and bite rim is stationary and in which the lower model base plate with its pins can move following the movement of the pins within said cam records, then making permanent record discs from the movement of the lower model and base plate, and forming upper and lower dentures to replace the upper and lower base plates and placing them on the upper and lower models in the articulator, and causing the lower model and lower denture to move, following the record disc whereby the teeth of the lower denture will have movement corresponding to the mandibular movement relative to the upper jaw, and putting grinding material between the teeth during such movement whereby the teeth may be ground.

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