July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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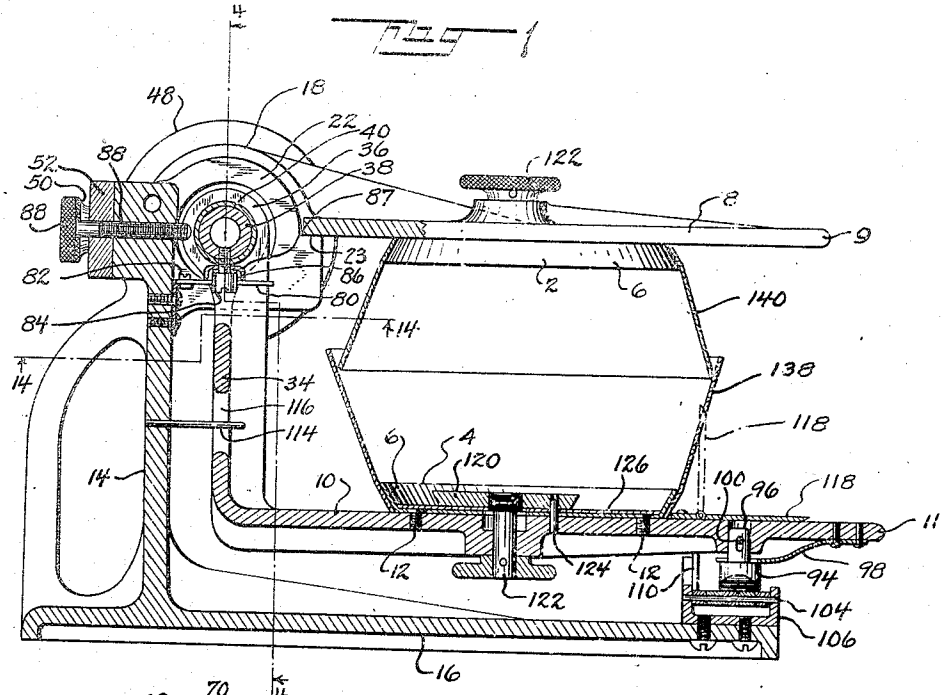
Fig 1



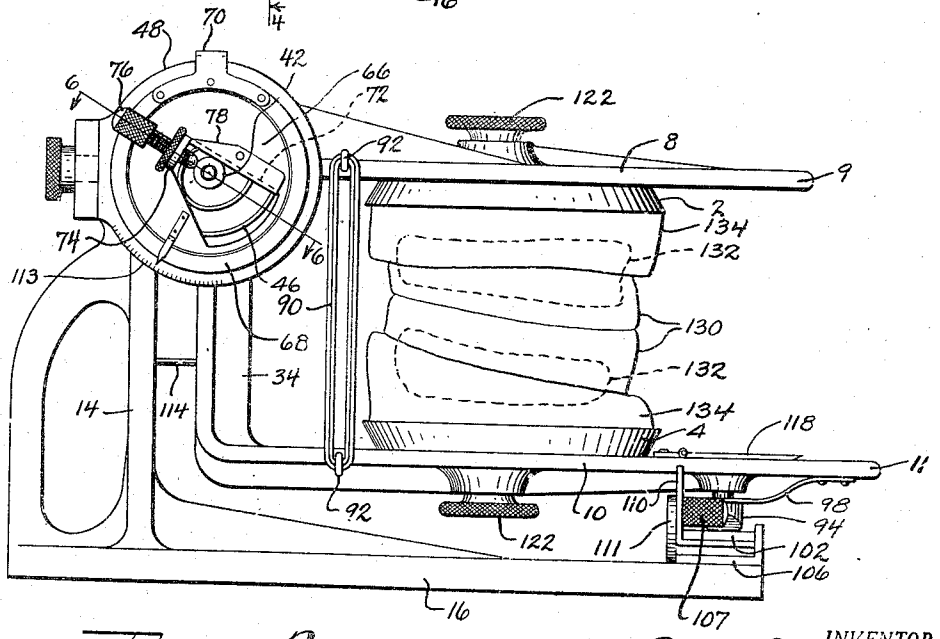


Fig 2

INVENTOR.
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July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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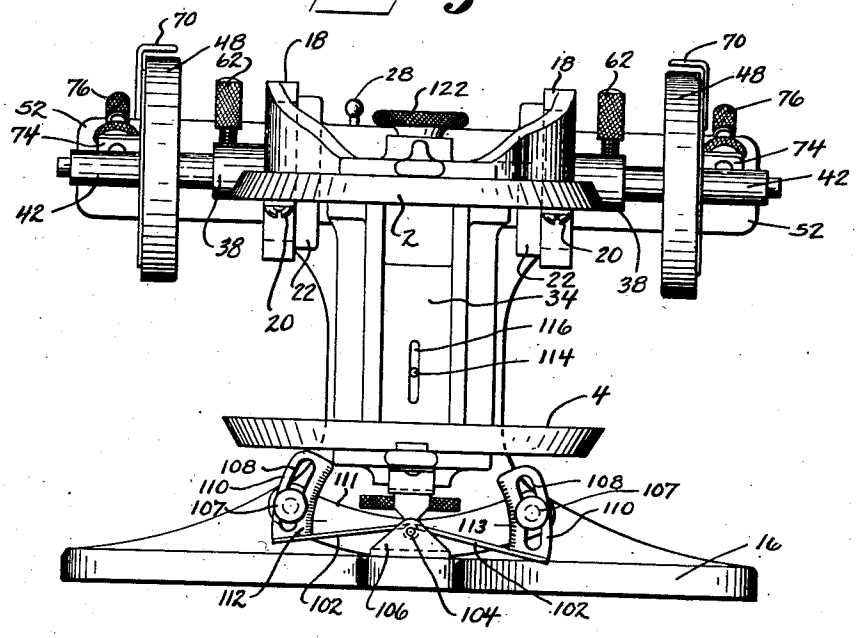
Fig 3



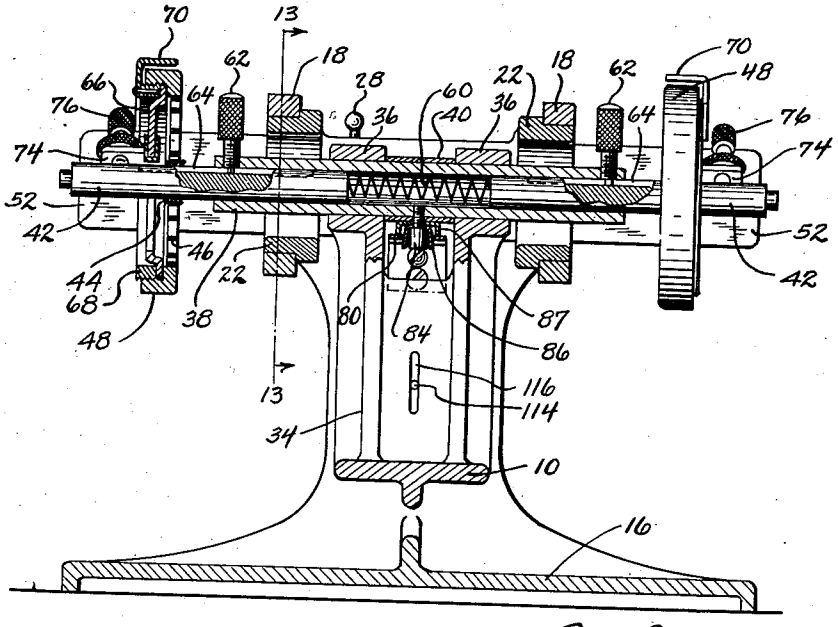


Fig 4

E. D. Ralph INVENTOR.

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July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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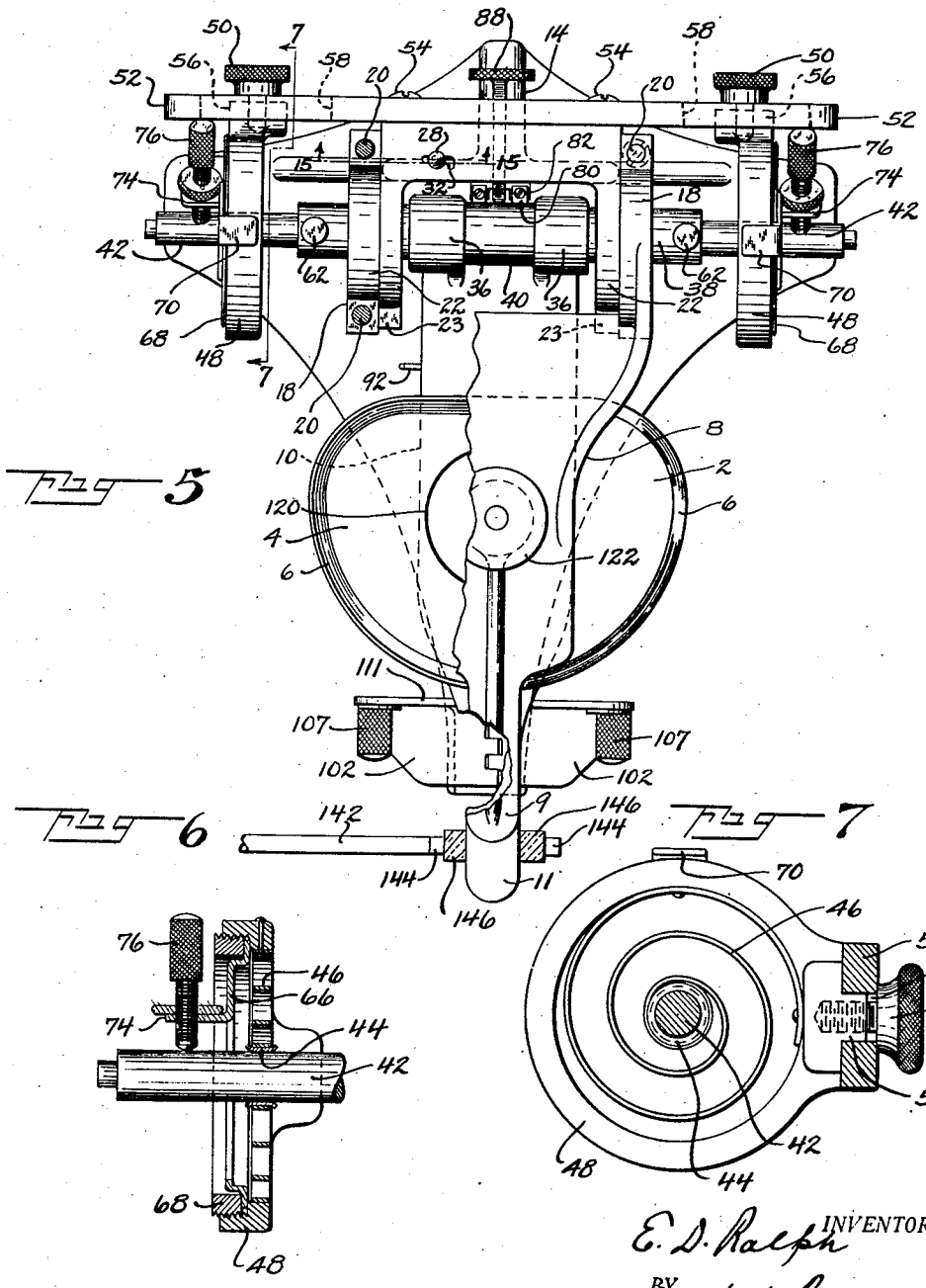

Fig 5

Fig 6

Fig 7

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July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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Fig 8

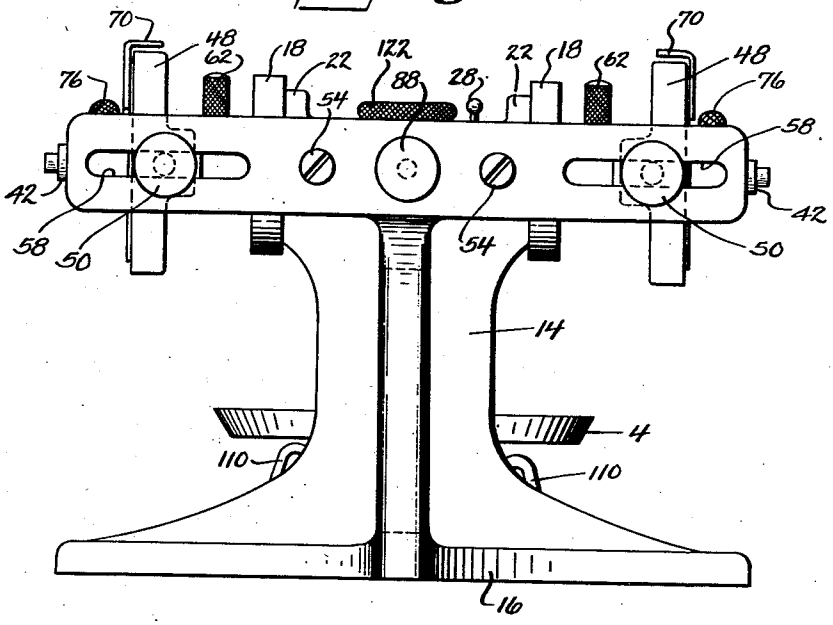


Fig 9

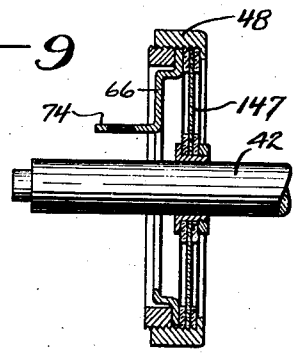
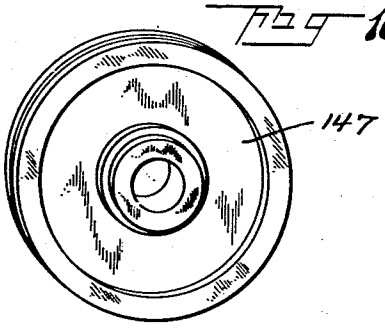


Fig 10



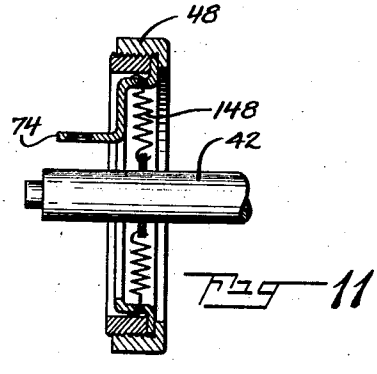


Fig 11

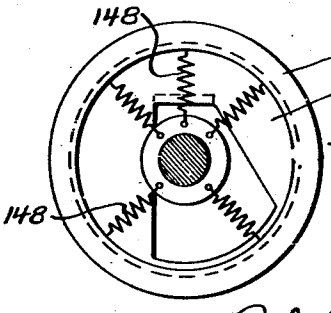


Fig 12

E. D. Ralph INVENTOR.

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July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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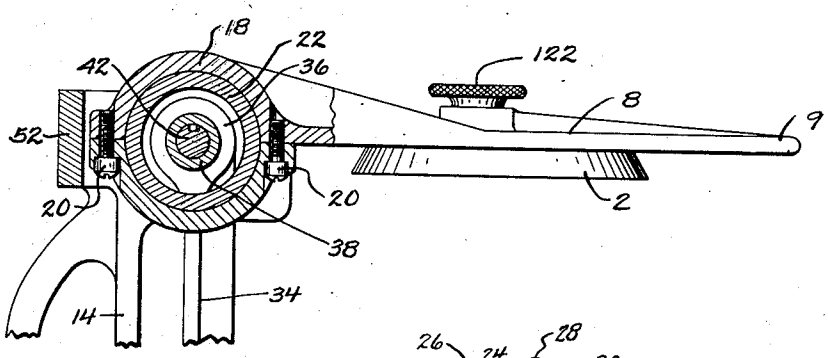
Fig 13



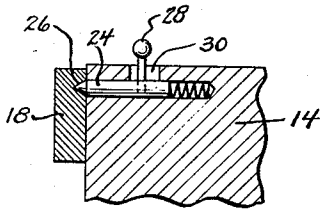


Fig 15

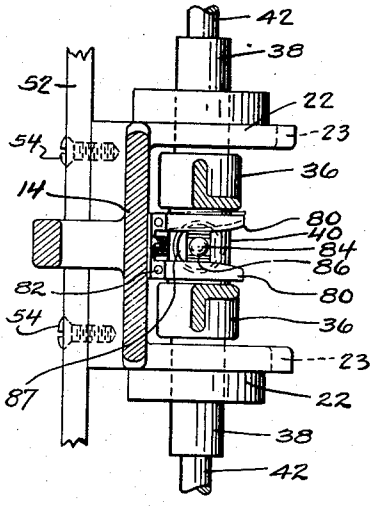


Fig 14

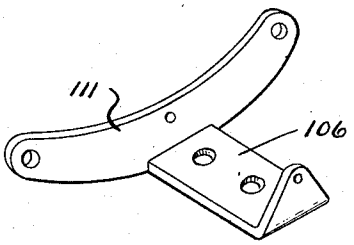
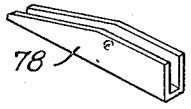


Fig 16

Fig 17



E. D. Ralph INVENTOR.

BY Bartlett Brownell.

ATTORNEYS.

July 28, 1931. E. D. RALPH 1,815,956

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

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Fig 18

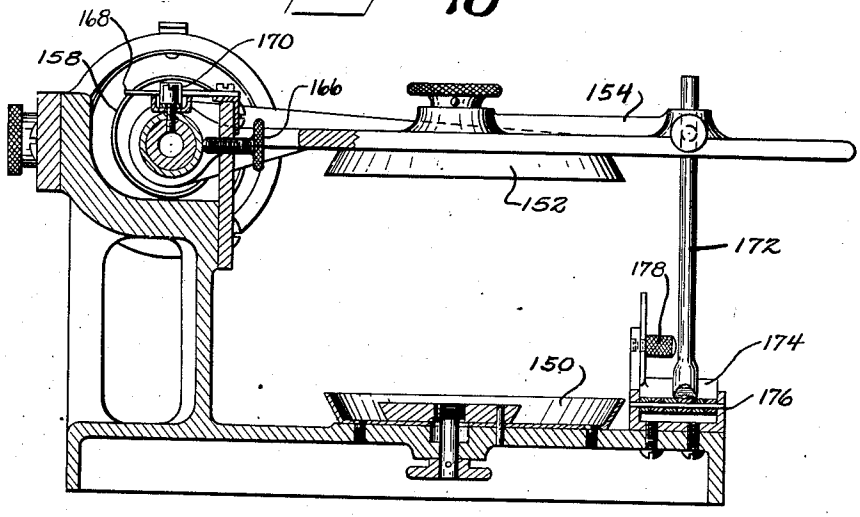

Fig 19

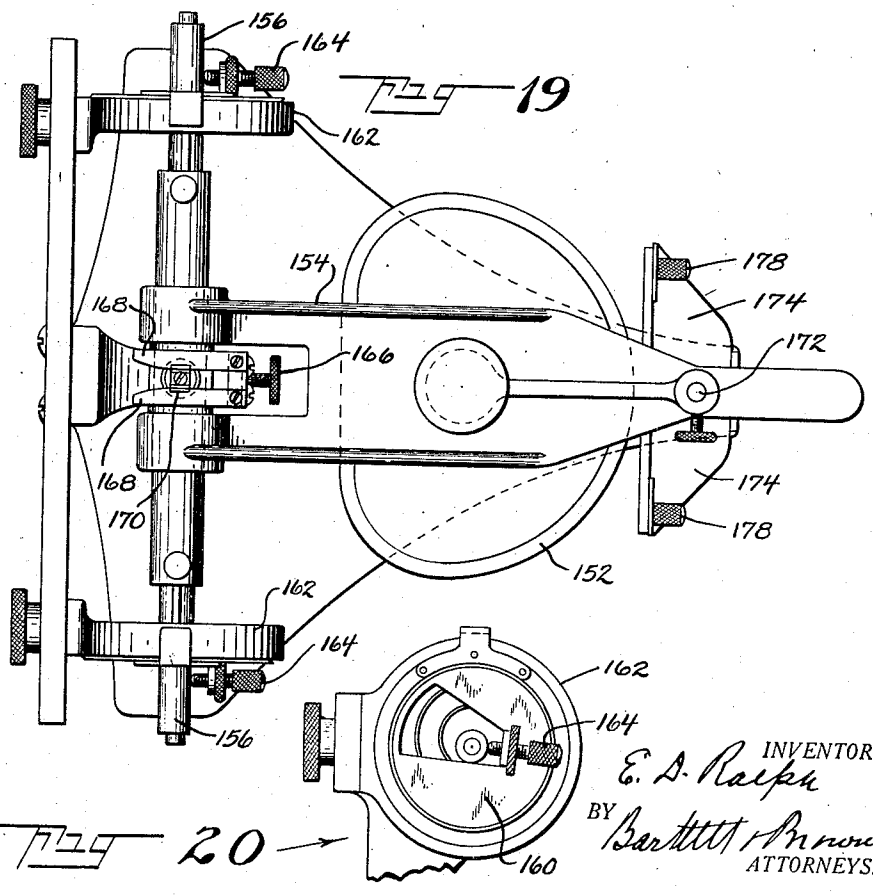

Fig 20

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Patented July 28, 1931 1,815,956

UNITED STATES PATENT OFFICE

EDWARD D. RALPH, OF JAMAICA, NEW YORK

METHOD OF AND APPARATUS FOR CONSTRUCTING ARTIFICIAL DENTURES

Application filed May 5, 1927. Serial No. 189,135.

My invention relates to a method of constructing artificial dentures, and further relates to an apparatus that is particularly adapted for use in carrying out the method.

One of the objects of the invention is to provide a method of the character indicated which may be practiced easily and expeditiously, and which ensures the dentures being accurately oriented so as to function properly in the mouth of the patient during mastication.

Another object of the invention is to provide an articulator which is capable of being easily adjusted to accurately reproduce the various masticatory movements of the mandible of the patient.

The several features of the invention, whereby these and other objects may be attained, will be clearly understood from the following description and accompanying drawings, in which:

Figure 1 is a longitudinal sectional view, partly in elevation, of my improved articulator in its preferred form;

Figs. 2 and 3 are side and front views of the articulator;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a top plan view of the articulator with certain parts broken away;

Fig. 6 is a detail sectional elevation taken on the line 6—6 of Fig. 2;

Fig. 7 is a detail sectional elevation taken on the line 7—7 of Fig. 5;

Fig. 8 is a rear view of the apparatus;

Fig. 9 is a view corresponding to Fig. 6 of a modified form of a component part of the device;

Fig. 10 is a detail view in perspective of a part of the construction illustrated in Fig. 9;

Fig. 11 is a view corresponding to Fig. 9 of another modified form;

Fig. 12 is a side elevation, partly in section, of a part of the device illustrated in Fig. 11;

Fig. 13 is a sectional elevation taken on the line 13—13 of Fig. 4;

Fig. 14 is a detail sectional view taken on the line 14—14 of Fig. 1;

Fig. 15 is a detail sectional view taken on the line 15—15 of Fig. 5;

Fig. 16 is a detail view in perspective of a supporting bracket;

Fig. 17 is a view in perspective of a part of the condyle axis guide means;

Fig. 18 is a view corresponding to Fig. 1 but showing another form of apparatus;

Fig. 19 is a plan view of the construction illustrated in Fig. 18; and

Fig. 20 is a sectional detail side elevation of a portion of the apparatus shown in Fig. 19.

My improved articulator in its preferred form is provided with a maxillary holder 2, and a mandible holder 4. These holders are dish-shaped, each having a flat bottom and an outwardly flaring flange or rim 6. The holder 2 is secured on the under side of a bracket arm or support 8, and the holder 4 is secured on the top side of a bracket arm or support 10. The supports 8 and 10 are provided with forwardly projecting handles 9 and 11, respectively. The holder 4 is secured to the support 10 by means of screws 12, and the holder 2 may be similarly secured to the support 8. These two supports 8 and 10 are mounted, as hereinafter described, on a standard 14 which projects upwardly from the central rear portion of a base 16. The support 8 is provided with rearwardly extending arms which terminate in split collars 18, the two sections of each collar being secured together by screws 20. The collars 18 surround and are pivotally mounted on reduced outer portions of annular bearing members 22 which project forwardly from the upper end of the standard 14. The support 8 rests in horizontal position on shoulders 23 formed on the bearing members 22. The support 8 is locked in horizontal position by means of a suitable latching device comprising an outwardly spring-pressed pin 24 (Figs. 5 and 15) mounted in a socket in the upper end of the standard 14 with its end projecting into a socket or notch 26 in the inner side of one of the split collars 18. The latch pin 24 is adapted to be retracted to permit the support 8 to be swung upwardly, by means of a knob 28 projecting upwardly

through a slot 30 in the standard 14, and when thus retracted may be held in retracted position by turning the knob into a laterally extending notch 32 which forms an extension of the slot 30.

The support 10 for the mandible holder has a vertically extending portion 34 which terminates in upwardly projecting ears 36 that are pivotally mounted on a tubular member or sleeve 38 which extends axially through the annular bearings 22, the sleeve being of considerably less diameter than the inner diameter of the annular bearings. The vertical portion 34 of the lower support 10 is held from axial movement on the sleeve 38 by means of a collar 40 secured on the sleeve and interposed between the ears 36. The sleeve 38 is supported by means of rods 42 inserted in the ends thereof and which extend through bearing collars 44 that are centrally secured to and yieldingly supported by spiral springs 46 mounted in forwardly extending annular portions of bracket members 48. The bracket members 48 are secured by screws 50 to a plate or bar 52 which is secured by screws 54 to the rear side of the upper end of the standard 14. The bracket members 48 are adapted to be adjusted longitudinally of the bar. To provide for this, each of said members is provided with a rearwardly extending lug 56 which extends into an elongated slot 58 in the bar 52, the member being adapted to be held in adjusted position by tightening the clamping screw 50.

The rods 42 are pressed outwardly in the tubular member or sleeve 38 by means of a coil spring 60 interposed between their inner ends. These rods are held in adjusted positions by means of screws 62 which are screw-threaded through apertures in the ends of the sleeve 38 and have reduced ends that are received in elongated key-way slots 64 in the rods. The outer ends of the rods 42 extend through clearance openings in disks 66 mounted in the bracket members 48. Each disk 66 is clamped at its edge against a shoulder on the inner wall of the associated bracket member 48 by an annular clamping nut 68 screw-threaded into the outer face of the bracket member. Each clamping nut 68 is provided with a finger-piece 70 by means of which the nut may be loosened to permit the associated disk 66 to be turned to change its angular position.

The clearance opening above referred to in each disk 66 has a straight wall 72 against which the associated rod 42 is adapted to bear. Each disk 66 is provided with an outwardly turned lip 74 through which is screw-threaded an abutment screw 76 that is arranged radially of the rod 42 when the latter is in normal position and is adapted to be positioned with its inner end arranged adjacent the rod. For reasons hereinafter described the disks 66 are termed condyle path guides.

With this construction it will be apparent that the support 10 for the mandible holder may be freely turned about the axis of the rods 42; that said support may be swung laterally against the tension of the spiral springs 46; and also that the support may be moved bodily outwardly against the tension of said springs. The springs 46 tend to maintain the rods 42 in central position against the guide walls 72 of the disks 66. With each machine there is furnished a number of shim plates 78 of different thickness, (Figs. 2 and 17) which are adapted to be snapped over the walls 72. The lower mandible support 10 is adapted to be guided during lateral bodily movement thereof by means of horizontal guiding members 80 (Figs. 1, 4 and 14), which have their rear ends secured by screws 82 on a suitable bracket secured to the standard 14. These members 80 have their inner edges inclined and are spaced apart to receive a guide screw 84 between them, the screw being secured in an aperture in the supporting sleeve 38. A U-shaped leaf-spring 86 is secured in position by the screw 84 and engages the inner inclined edges of the guiding members 80. With this construction it will be apparent that during the lateral bodily movements of the lower support 10, the latter will be yieldingly guided by the engagement of the U-shaped spring 86 with the inclined edges of the guiding members 80. The guiding members 80 are adapted to be pivotally adjusted about the screws 82 toward and from each other upon loosening the screws, so as to vary the extent of the lateral bodily movement of the support 10.

An inverted dish-shaped washer 87 surrounds the screw 84 and its lower edge engages the top surfaces of the guide plates 80 so as to hold the support sleeve 38 from turning.

The pivotal axis of the lower or mandible support 10 is adapted to be adjusted forwardly against the tension of the spiral springs 46 by means of a set screw 88 screw-threaded through an aperture in the upper end of the standard 14 and is adapted to engage the retaining collar 40 on the supporting sleeve 38. The mandible support 10 is adapted to be pressed upwardly toward the maxillary supporting member 8 by means of a rubber band or spring 90 which is detachably looped over hooks 92 secured on said supports.

The forward end of the mandible support 10 is supported by means of a plunger 94 provided with a reduced shank portion that is received in an aperture 96 in the support. The plunger 94 is pressed downwardly by means of a suitable leaf spring 98 having its outer end secured to the outer end of the bracket member, the downward movement of the plunger being limited by means of a pin 100 that extends through a slot in the shank

of the plunger and has its ends secured to the support 10. The head of the plunger 94 has its sides chamfered off and is adapted to ride upon laterally extending supporting leaves 102 which have their inner ends suitably hinged on a pin 104 that extends longitudinally of the machine and is supported on a bracket 106 secured to the base 16 of the machine. The supporting leaves 102 are adapted to be adjusted about the pin 104, and held in adjusted position by means of clamping screws 107 which extend through arcuate slots 108 in upwardly projecting arms 110 on the outer ends of the leaves, and are screw-threaded into the ends of a bracket arm 111 on the bracket member 106 (Fig. 16). A suitable scale 112 is provided on each of the slotted arms 110 so as to determine the angular position of the supporting leaves 102, and similar scales 113 are placed on the outer face of the annular bracket members 48 for determining the angular positions of the guide walls 72 of the disks 66.

To assist in guiding the mandible support 10, a horizontal pin 114 of spring metal is secured to the standard 14 and extends through a suitable guide slot 116 in the vertical portion 34 of the bracket member.

A suitable centering gauge 118 is pivotally mounted on the top side of the support 10 in proximity to the mandible holder 4, which when in use may be swung vertically into position and when not in use may be swung down upon the bracket, the purpose of this gauge being hereinafter described.

The holders 2 and 4 for the maxillary and mandible dentures are each provided with a circular block 120 which is detachably secured on the bottom of the holder by means of a screw 122 which extends through an aperture in the associated support and is screw-threaded into an aperture in the block. The block 120 is held from turning by means of a pin 124 which is received in an aperture in the block. A number of shim plates 126 of different thicknesses are furnished with each machine which are adapted to be placed in the bottom of the holders 2 and 4 so as to vary the depth thereof.

In carrying out my improved method of constructing artificial dentures, in addition to the articulator above described, I also preferably employ the apparatus described and claimed in my pending application, Ser. No. 171,225, filed February 26, 1927. This latter apparatus which is known by the trademark name "Spee-o-graph" is for the purpose of determining and forming the curve of spee in both the upper and lower bite waxes. Also a mark is placed on the front of the bite waxes to indicate the sagittal plane thereof while the waxes are in the mouth of the patient.

After the curve of spee has been formed the two bite wax blocks are replaced in the mouth of the patient. The fork of the face bow is secured in the upper bite wax and the lower bite wax is secured to the upper bite wax by spot fusing in the usual manner. The two bite waxes are then removed from the mouth by means of the face bow which maintains them in proper position with relation to the axis of the condyle rods of the face bow. Plaster casts conforming to the gums of the patient are then placed in the cavities of the two bite waxes, and the bite waxes and plaster casts are transferred to the articulator. In positioning the bite waxes and plaster casts in the articulator, the condyle rods of the face bow are applied to the ends of the rods 42. The face bow described and claimed in said pending application is provided with a spirit level which indicates to the operator the proper vertical position to place the bite waxes in the articulator between the maxillary and mandible holders 2 and 4, so that the bite waxes assume the same position in the articulator with respect to the axis of the condyle rods 42 as they did in the mouth of the patient with respect to the axis of his condyles. Also, by means of the mark on the bite waxes that indicates the sagittal plane thereof, and the centering gauge 118, the bite waxes are properly centered in respect to the sagittal plane of the articulator. While it is preferable to employ the apparatus of said pending application in practicing the present method, it will be apparent that the curve of spee may be formed and the bite waxes positioned in the articulator with the use of other means.

The proper positioning of the bite waxes as above described is permitted in my improved articulator by the peculiar mounting of the condyle rods 42. The set screws 62 are loosened so as to permit axial movement of the rods during the positioning of the bite waxes in respect to the sagittal plane. After the bite waxes are positioned the set screws 62 are tightened so as to hold the condyle rods in their adjusted positions. The bite waxes and plaster casts are held in the articulator by means of soft plaster in which the projecting portions of the plaster casts are embedded. The two beds of soft plaster are held in the dish-shaped holders 2 and 4 by means of the conical disks 120. These beds of soft plaster are permitted to harden so as to securely hold the bite waxes in place. In Fig. 2 of the drawings the upper and lower bite wax blocks are indicated at 130, the plaster casts at 132, and the plaster beds at 134.

After the bite waxes have thus been applied to the articulator, the bracket members 48 that support the condyle path guides 66 are adjusted so that the outer faces of the guides are substantially one-half inch from the ends of the condyle rods 42. This positioning of the condyle plane guides compensates for the amount of tissue overlying or intervening between the condyle head centers of the patient

and the points on the face of the patient from which the reading has been taken on the face bow. After the plaster beds 134 have hardened, the face bow is removed from the articulator, the holding forks being withdrawn from the upper bite wax, and the ends of the face bow being removed from the ends of the condyle rods 42.

When the bite wax blocks have thus been applied to the articulator the teeth may be inserted. If desired, the teeth may be inserted directly in the bite wax blocks by cutting out sufficient area to receive each individual tooth in the usual manner. The more general practice, however, would be to remove one bite wax block and build up the plate model of the form and shape desired, and secure the teeth in their proper position in the usual manner using the opposing bite wax block as a guide so as to insure the cusps of the teeth being all arranged in the curve of spee. In a similar manner the teeth of the other set may be built up using the opposed set as a guide. This fitting of the two sets of teeth together is in accordance with the usual practice up to this point. After the two sets of teeth have been thus mounted the two plate models are removed from the articulator and placed in the patient's mouth where they are tried for normal occlusion, appearance and gross or rough relationship, this being merely a check of the work done so far on the set-up. In case a material error is found in the set-up it should be corrected at this time.

While the two plate models are in the patient's mouth, the patient closes in five different positions on five pieces of softened thin sheet wax, the patient making one bite on each wax. These different positions are central, right lateral and left lateral; and with the lower jaw in protruded position, right lateral and left lateral. The right and left lateral occlusions are taken with the lower jaw displaced laterally five or six millimeters and the protruded positions are taken with the lower jaw protruded forwardly substantially one cuspal distance.

After these five separate impressions or bites have been taken, the plate models are replaced in the articulator, they being placed over the gum portions of the plaster casts projecting from the plaster beds.

The central bite wax register taken as above described, is positioned between the two sets of teeth and the teeth oriented so as to determine whether the two sets are positioned in the articulator the same as they were in the mouth. If it is found that for some reason the two sets of teeth do not properly register then their positions should be corrected at this time.

The annular clamping nuts 68 are loosened so as to cause the condyle path guides 66 to be rotatably loose. The right lateral bite wax register is then placed between the teeth, and the teeth oriented by means of this bite wax. Then the left condyle path guide 66 is positioned angularly to cause the guide shim 78 to contact with the left condyle rod 42, whereupon the annular clamping nut 68 of the left condyle path guide is tightened so as to clamp the guide in the adjusted position. Also, while the mandibular denture is thus displaced the set screw 76 associated with the right condyle guide is adjusted to position its end in contact with the right condyle rod 42, and then it is given a half turn to retract it slightly from the rod.

The left lateral bite wax register is then placed between the teeth and the teeth oriented thereby, after which the right condyle path guide is set in the same manner as the left guide was set, and the left set screw 76 is adjusted the same as the right screw 76 was adjusted as above described. The angles of the two condyle path guides are then read by means of the scales 113, and the guiding leaves 102 are adjusted accordingly by their scales 112, the angle of the left leaf being adjusted in accordance with the angle of the right condyle path guide, and the angle of the right leaf being adjusted in accordance with the angle of the left condyle path guide.

While the foregoing adjustments are being made, the condyle rods 42 and their supporting sleeve 38 are yieldingly held from axial movement by the guide spring 86 and guide plates 80.

After the foregoing adjustments have been made, the protrusive relationship set screw 88 is adjusted to carry the mandible support forward substantially one cuspal distance. This protruded position of the mandible support corresponds to the protruded position of the mandible when the two last-mentioned bite wax registers were taken in the mouth of the patient. One of these bite waxes is then placed between the two sets of teeth and the mandibular denture moved laterally to the lateral position that the mandible in the mouth of the patient assumed when the impression in the bite wax was made. It may be noted that if the human mandible when in protruded position is moved laterally there is a certain amount of lateral bodily movement of the mandible angularly to the sagittal plane, and it will be apparent that in order to translate that movement accurately in an articulator there must be provision for permitting corresponding bodily movement of the mandibular denture in the machine and also for accurately guiding such movement. This is accomplished in my improved machine by means of the guide plates 80 which, as above described, are adjustable to vary the extent of the lateral bodily movements of the mandibular denture. When the two sets of teeth in protruded lateral position are brought together on one of the bite waxes, the corresponding guide plate 80 is adjusted un-

til it is found that the two sets of teeth will properly register on the bite wax in that position, and then by means of the set screw 82 that guide plate is secured in adjusted position. In a similar manner the other bite wax register is placed between the two sets of teeth, and the corresponding guide plate 80 similarly adjusted. It will be apparent that such adjustments of the guide plates 80 accurately determine the extent of the bodily movements of the mandible of the patient when the impressions were taken in the two bite waxes. The U-shaped leaf spring 86 which engages the guiding edges of the guide plates 80 provides for the necessary yielding movement of the mandibular denture to correspond to the compressibility of the tissues in the mandible of the patient during said lateral movements. After the foregoing adjustments in protruded position have been made, the set screw 88 is retracted to permit the mandible support to return to its normal position.

With the articulator thus set, manipulation of the mandible support by means of its handle 11 will give accurate functional reproductive movements of the mandible of the patient. This manipulation consists merely in moving the mandible support sidewise in opposite directions. During such manipulation of the mandible support the plunger 94 will ride on the guide leaves 102, and the condyle rods 42 will be guided by the condyle path guide shims 78. The yielding mounting of the plunger 94 and the spiral springs 46 permits the cusps of the two sets of teeth to ride over each other, and permits the cusp planes to serve as guides during occlusion movements as in nature. It will be apparent that the adjustment of the condyle path guides as above described, will result in the condyle axis of the mandible support being guided in a plane corresponding to the plane of movement of the mandible in the patient. The set screws 76 limit the retrusive movements, and after one of the condyle rods 42 engages its associated set screw 76 the movement in the same direction may continue against the tension of the opposite spiral spring 46. The adjustment of the screws 76 to position their ends a slight distance back of the condyle rods 42, permits limited retrusive movements of the rods against the tension of the spiral springs 46, which corresponds to the retrusive movements of the human mandible permitted by the compressibility of the tissues in the condyles.

If during the described manipulation of the mandible support it is found that there are any interfering points in the two sets of teeth, these should at this time be ground in so as to function properly.

In case it has been found that the two sets of teeth properly function during the manipulation of the mandible support with the parts of the articulator adjusted in normal position as above described, then one of the guide shims 78 is removed and the mandible support again manipulated to determine whether or not with such adjustment there are any interfering points in the two sets of teeth. If such interfering points are found these are ground in so as to properly function.

After the two sets of teeth have thus been caused to properly function with one of the shims 78 removed, that plate is again applied to the condyle path guide and the other shim 78 is removed. The mandible support is then manipulated to determine whether or not with such adjustment there are any interfering points in the two sets of teeth which should be ground off.

Then the mandible support is manipulated with both shims 78 removed to determine whether or not with such adjustment there are any interfering points in the two sets of teeth.

The purpose of manipulating the mandible support with first one shim 78 and then the other removed and then with both removed, is to translate in the machine the various movements of the human mandible caused by the compressibility of the tissues that support the dentures.

When the two sets have been found to properly function in the different positions of normal occlusion above noted, the set screw 88 is adjusted to protrude the mandibular denture one cuspal distance as above described. With such repositioning of the mandible support in protruded position, the support is manipulated in the same manner as it was manipulated during the normal positions to determine whether or not there are any interfering points in the two sets of teeth which should be ground off. Upon such manipulation it will be found that the lower molars will not function properly with the upper molars. This is due to the fact that the curve of spee differs in the lower jaw from that in the upper jaw. In order to compensate for this it is necessary to reposition the lower molars by depressing them until they will function without interference when the mandible is manipulated, the wax of the plate models being softened so as to permit this to be done.

After the foregoing operations have been performed, first one guide shim 78 and then the other is removed, and then both are removed, the mandible being manipulated after each of these adjustments to determine whether there are any interfering points in the two sets of teeth that should be ground off.

From the foregoing it will be apparent that the two sets of teeth have been oriented in the articulator in accordance with the different positions that the teeth may assume in the mouth of the patient. When this has been accomplished vulcanized rubber is substituted

in the plate models, in the usual manner, and then the completed plates are placed in the mouth of the patient. Registers are taken by means of five new thin sheets of softened wax in the five different positions of the human jaw above referred to. The plates are then placed back in the articulator and the two sets of teeth re-oriented in the same way that they were oriented in the plate models as above described. In case in any of the various positions of the two sets of teeth it is found that there are any interfering points these points of course should be ground off.

After the foregoing operations have been performed the plates are ready for the final finishing. To provide for this operation, a frusto-conical member 138 of sheet rubber is placed over the lower flange of the mandible holder 4 and this is substantially filled with a suitable fluid grinding compound. A similar frusto-conical sheet rubber member 140 is placed over the flange of the maxillary holder 2, with its lower end telescoping into the lower member 138. The two dentures are then brought together with the upper member 140 telescoping into the lower member 138. The springs or rubber bands 90 are then attached to the upper and lower holders 8 and 10 so as to yieldingly press the dentures together. The mandible support is then manipulated with the articulator in each of the various adjustments, above described, until the engaging surfaces of the two sets of teeth in each of said adjustments have been thoroughly milled and finished. The sheet rubber members 138 and 140 serve to retain the abrasive in and about the occlusal surfaces of the teeth during trituration so as to insure proper milling and also prevent spilling of the abrasive.

The manipulation of the mandible support during the final milling or finishing operation may be either performed by hand or by power operated means. Such power operated means may be of any suitable construction and as shown in Fig. 5, consists of a horizontally reciprocating rod 142 having an upstanding forked end 144 which receives the handle 11 of the mandible support 10, the handle having cushioning members 146 of soft rubber on the sides thereof so as to permit the mandible to be operated without undue shock or jar.

The provision of the removable holding disks 120 for the plaster beds, permits the beds together with the plaster casts and teeth models or bite wax blocks to be removed from and replaced in the articulator without destroying the set-up, and thus when the set-up is removed permits the articulator to be used for other set-ups.

The shim disks 126 for the holders 2 and 4 permit raising or lowering of the models to either open or close the bites slightly as may be desired, yet keeping the models correctly oriented.

From the foregoing it will be apparent that my improved articulator is capable of accurately translating all movements of the human mandible, and when employed in accordance with my improved method will result in accurate articulation of the two sets of teeth in the mouth of the patient.

The machine is simple in construction and easily adjusted and controlled, and the manipulation of the mandible support during final milling may be performed either by hand or by power operated means. Also, the construction is such that there are no parts interfering with clear vision all around the dentures.

In place of the spiral spring 46 for supporting each of the condyle rods, a disk 147 of soft rubber may be employed, or if desired coiled springs 148 extending radially may be employed, the disk and springs being mounted in any suitable manner.

In the articulator above described the movements of the human mandible are translated by the mandible support, while in the articulators in general commercial use the movements are translated by the maxillary support. It will be apparent, however, that it is much easier for the operator to make the necessary adjustments in an articulator in which the movements of the human mandible are translated to the mandible support, than it is to translate the movements to the maxillary support as the latter requires the tedious mental process of reversing or inverting the readings of the positions and the movements of the human mandible in order to properly translate them to the maxillary support. Some of the older practitioners, however, may possibly find it convenient to use a machine in which the movements of the human mandible are translated to the maxillary support as, of course, they are more accustomed to that type of machine, and accordingly the articulator illustrated in Figs. 18, 19 and 20 has been constructed so that the mandible support is held in fixed position, while the maxillary support is the moving element. As shown the mandible holder or support 150 is secured on the base of the machine and the maxillary holder 152 is secured on a movable support 154, which is mounted to turn about the axis of condyle rods 156 corresponding to the condyle rods of the machine above described. These condyle rods are supported by spiral springs 158 and are guided by condyle path guide plates 160 mounted in axially adjustable bracket members 162. This machine also is provided with set screws 164 for limiting the retrusive movements of the maxillary support and also is provided with a protrusive relationship screw 166 and with guide plates 168 cooperating with a guide spring 170 for controlling the lateral thrust or bodily movements of the maxillary support. The

forward end of the maxillary support is supported by the vertically adjustable pin 172, the lower end of which rides upon guide leaves 174 having their inner end adjustably hinged on a pivot pin 176 and adapted to be secured in adjusted position by suitable clamping screws 178. It will be apparent that with the articulator shown in Figs. 18, 19 and 20, the various movements may be imparted to the maxillary support 154 that may be imparted to the mandible support of the machine first described, except that these movements are of course in the reverse direction.

While the articulator above described is particularly adapted for use in the construction of artificial dentures, it may also be used as a diagnostic agent in functionally deranged natural dentures.

As will be evident to those skilled in the art, my invention permits various modifications without departing from the spirit thereof or the scope of the appended claims.

What I claim is:

1. An articulator having, in combination, a mandible holder, a maxillary holder, means for retaining the maxillary holder in fixed horizontal position adapted to be released to permit said holder to be swung upwardly, means for supporting the mandible holder, said holder being adapted to be moved to move the mandibular denture about an axis corresponding to the condyle axis of the patient and adapted to be bodily moved laterally, and condyle path guides for guiding the mandible holder during said lateral movements.

2. An articulator having, in combination, a maxillary holder, a mandible holder, means for supporting the rear portion of the mandible holder, said holder being adapted to be moved to move the mandible denture about an axis corresponding to the condyle axis of the patient, and adapted to be bodily moved laterally, condyle path guides for guiding the rear part of said mandible holder during the lateral movements thereof, and yielding means for correspondingly guiding the fore part of said mandible holder during said lateral movements thereof.

3. An articulator having, in combination, a maxillary holder, a mandible holder, means for supporting the rear part of the mandible holder, said holder being adapted to be moved to move the mandible denture about an axis corresponding to the condyle axis of the patient, and adapted to be moved laterally, condyle path guides for guiding the rear part of said mandible holder during the lateral movements thereof, and yielding means for correspondingly guiding the fore part of said mandible holder during said lateral movements thereof comprising a downwardly spring pressed member, and two transversely extending angularly adjustable guiding members upon which said member rides during the lateral movements of the mandible holder.

4. An articulator having, in combination, a maxillary holder, a mandible holder, members on which one of said holders is mounted for movement about an axis corresponding to the condyle axis of the patient with relation to the curve of spee of the dentures supported by the said holders, the ends of said members being adapted to be engaged by the condyle axis rods of a face bow, and each of said members being adapted to be adjusted axially to move its outer end toward and from the sagittal plane of the articulator, means tending to press said members outwardly and means for holding said members in adjusted position.

5. An articulator having, in combination, a maxillary holder, a mandible holder, means on which the rear part of one of said holders is mounted, said holder being adapted to move about an axis corresponding to the condyle axis of the patient and to move laterally, yielding devices supporting said means tending to maintain said axis in a definite position, said movable holder being adapted to be laterally moved pivotally and bodily, and condyle path guides for guiding the mandible holder during said lateral movements having provision for adjustment to vary the paths of said lateral movement.

6. An articulator having, in combination, a maxillary holder, a mandible holder, means on which the rear part of one of said holders is mounted, said holder being adapted to move about an axis corresponding to the condyle axis of the patient, yielding devices supporting said means to tend to maintain said axis in a definite position, said movable holder adapted to be moved to vary the angular position of said axis in all directions, condyle path guides for guiding said movable holder during the lateral movements thereof, and adjustable devices for limiting the retrusive lateral movements of said movable holder in either direction.

7. An articulator having, in combination, a maxillary holder, a mandible holder, a device on which one of said holders is mounted for movement about an axis corresponding to the condyle axis of the patient with relation to the dentures supported by said holder, the ends of said device being adapted to be engaged by the condyle axis rods of the face bow, yielding means for supporting said device at points corresponding in relative positions to the centers of the condyle heads of the patient and tending to maintain said device in a definite position, said device being adapted to be yieldingly moved laterally adjacent said points in all directions and said movable holder being adapted to be laterally moved bodily, and condyle path guides associated with said device for guiding the mov-

able holder during said lateral movements having provision for adjustment to vary the paths of said lateral movements.

8. An articulator having, in combination, a maxillary holder, a mandible holder, a device on which one of said holders is mounted for movement about an axis corresponding to the condyle axis of the patient with relation to the dentures supported by the mandible holder, the ends of said device being adapted to be engaged by the condyle axis rods of the face bow, yielding means for supporting said device at points corresponding in relative positions to the centers of the condyle heads of the patient and tending to maintain said device in a definite position, said device being adapted to be yieldingly moved laterally adjacent said points in all directions, condyle path guides associated with said device for guiding the movable holder during said lateral movements, and adjustable abutments for limiting the retrusive movements of said movable holder adjacent said points.

9. An articulator having, in combination, a maxillary holder, a mandible holder, a device on which one of said holders is mounted for movement about an axis corresponding to the condyle axis of the patient with relation to the dentures held by said holders, yielding means for supporting said device at points corresponding to the centers of the condyle heads of the patient and tending to maintain said device in a definite position, means adapted to be adjusted to engage said device adjacent its center to move one of said holders longitudinally with relation to the other to cause the mandibular denture to be in protruded relation, and condyle path guides associated with said device for guiding the movable holder during lateral movement thereof.

10. An articulator having, in combination, a maxillary holder, a mandible holder, a device on which one of said holders is mounted for movement about an axis corresponding to the condyle axis of the patient with relation to the dentures held by said holders, yielding means for supporting said device at points corresponding to the centers of the condyle heads of the patient and tending to maintain said device in a definite position, means adapted to be adjusted for engaging said device adjacent its center to move one of said holders longitudinally with relation to the other to cause the mandible denture to be in protruded relation, condyle path guides associated with said device for guiding the movable holder during lateral movement thereof, and devices for controlling the lateral bodily movements of the movable holder while the mandible denture is thus protruded to correspond with similar movements of the mandible of the patient.

11. The method of constructing artificial dentures which comprises positioning the dentures in normal occluded relation with one of the dentures mounted for pivotal movement about an axis with relation thereto corresponding to the condyle axis of the patient, orienting the dentures in this position, repositioning the pivotally mounted denture while maintaining its axis in a definite relation thereto to cause the mandible denture to assume a longitudinally protruded position with relation to the other denture, and orienting the dentures while in the latter position.

12. The method of constructing artificial dentures which comprises positioning the dentures in occluded relation with one of the dentures mounted for pivotal movement about an axis with relation thereto corresponding to the condyle axis of the patient, orienting the dentures in this position, repositioning the pivotally mounted denture while maintaining its axis in a definite relation thereto to cause the mandible denture to assume a longitudinally protruded position with relation to the other denture, moving one of the dentures laterally in both directions while maintaining the teeth in said protruded position, and orienting the teeth in each of said positions.

13. The method of constructing artificial dentures which comprises positioning the dentures in normal occluded relation with the mandibular denture mounted for pivotal movement about an axis corresponding to the condyle axis of the patient, yieldingly supporting the mandibular denture so as to tend to hold said axis in a definite position at points corresponding to the centers of the condyle heads of the patient, said mandibular denture at said points being adapted to be moved under strain in all directions transversely of said axis, moving the mandibular denture from said normal occluded position into right and left lateral occluded positions while guiding it at said points so as to cause said points to move in paths corresponding to the paths of movement of the centers of said condyle heads, guiding the fore part of the mandibular denture in paths corresponding to said condyle paths of said points, said fore part being adapted to be yieldingly moved vertically, under strain, yieldingly pressing the mandibular denture bodily against the other denture during said movements, and orienting said dentures in each of said relative positions.

14. The method of constructing artificial dentures which comprises positioning the dentures in normal occluded relation with one of the dentures mounted for pivotal movement about an axis corresponding to the condyle axis of the patient, yieldingly supporting said pivotally mounted denture so as to tend to hold said axis in a definite position at points corresponding to the cen-

ters of the condyle heads of the patient, said points being adapted to be moved under strain in all directions transversely of said axis, moving said pivotally mounted denture from said normal position into right and left lateral occluded positions while guiding it at said points so as to cause said points to move in paths corresponding to the paths of movement of said condyle head centers, yieldingly pressing the mandibular denture bodily against the other denture during said movements, and orienting said dentures in each of said relative positions.

15. The method of constructing artificial dentures which comprises positioning the dentures in normal occluded relation with the mandibular denture mounted for pivotal movement about an axis with relation thereto corresponding to the condyle axis of the patient, yieldingly supporting the mandibular denture so as to tend to hold said axis in a definite position at points corresponding to the centers of the condyle heads of the patient, said points being adapted to be moved under strain in all directions, moving the mandibular denture longitudinally so as to position it in protruded relationship to the maxillary denture, moving the mandibular denture while maintaining it in protruded relation into central and right and left lateral occluded positions while guiding it at at said points so as to cause said points to move in paths corresponding to the paths of movements of said condyle head centers, guiding the mandibular denture at a point substantially midway between said points to control the lateral bodily movements of said mandibular denture in accordance with the corresponding movements of the mandible of the patient, and orienting said dentures in each of said longitudinally protruded positions of the mandibular denture.

16. An articulator having, in combination, a maxillary holder, a mandible holder, means for supporting the rear portion of the mandible holder to provide for movement thereof to move the mandible denture about an axis corresponding to the condyle axis of the patient, and to provide for lateral movements of the mandible holder, condyle path guides for guiding the rear part of said mandible holder during the lateral movements thereof, and means comprising a spring for supporting the fore-part of said mandible holder during said lateral movements thereof.

17. An articulator having, in combination, a maxillary holder, a mandible holder, means for supporting the rear portion of the mandible holder to provide for movement thereof to move the mandible denture about an axis corresponding to the condyle axis of the patient, and to provide for lateral movement of the mandible holder, condyle path guides for guiding the rear part of said mandible holder during the lateral movements thereof, and yielding means for guiding the fore-part of said mandible holder during said lateral movements thereof comprising a downwardly spring pressed member, and suitable guiding means upon which said member rides during said lateral movements.

18. An articulator having, in combination, a maxillary holder, a mandible holder, means on which the rear part of said mandible holder is mounted for movement thereof about an axis corresponding to the condyle axis of the patient, yielding devices supporting said means tending to maintain said axis in a definite position, the mandible holder being adapted to be moved to vary the angular position of said axis, condyle path guides for guiding the mandible holder during the lateral movements thereof, and adjustable devices for limiting the retrusive lateral movements of the mandible holder in either directions.

19. An articulator having, in combination, a maxillary holder, a mandible holder, a hinged connection for the mandible holder to provide for movement thereof about an axis corresponding to the condyle axis of the patient, condyle path guides for the ends of said hinged connection, adjustable abutments for limiting the retrusive movements of the respective ends of the hinged connection, and a device for engagement with the rear side of said hinged connection midway of said condyle path guides on which said hinged connection is adapted to be swung about a vertical axis, said device being adjustable to protrude said mandible holder with relation to the maxillary holder.

20. An articulator having, in combination, a maxillary holder, a mandible holder, a hinged connection for the mandible holder to provide for movement thereof about an axis corresponding to the condyle axis of the patient, condyle path guides for the ends of said hinged connection, adjustable abutments for limiting the retrusive movements of the respective ends of the hinged connection, a device for engagement with the rear side of said hinged connection midway of said condyle path guides on which said hinged connection is adapted to be swung about a vertical axis, and yielding means tending to retain the ends of said hinged connection in engagement with said abutments.

21. An articulator having, in combination, a maxillary holder, a mandible holder, a hinged connection for one of said holders to provide for movement thereof about an axis corresponding to the condyle axis of the patient, condyle path guides for the ends of said hinged connection, adjustable abutments for limiting the movement of the respective ends of the hinged connection in a direction to cause the mandible holder to be protruded with relation to the maxillary holder, and a device for engagement with the hinged con-

nection midway of said condyle path guides on which said hinged connection is adapted to be swung about a vertical axis, said device being adapted to be adjusted to cause said mandible holder to be protruded with relation to the maxillary holder.

In testimony whereof, I have signed my name to this specification this 3rd day of May, 1927.

EDWARD D. RALPH.