

April 10, 1928.

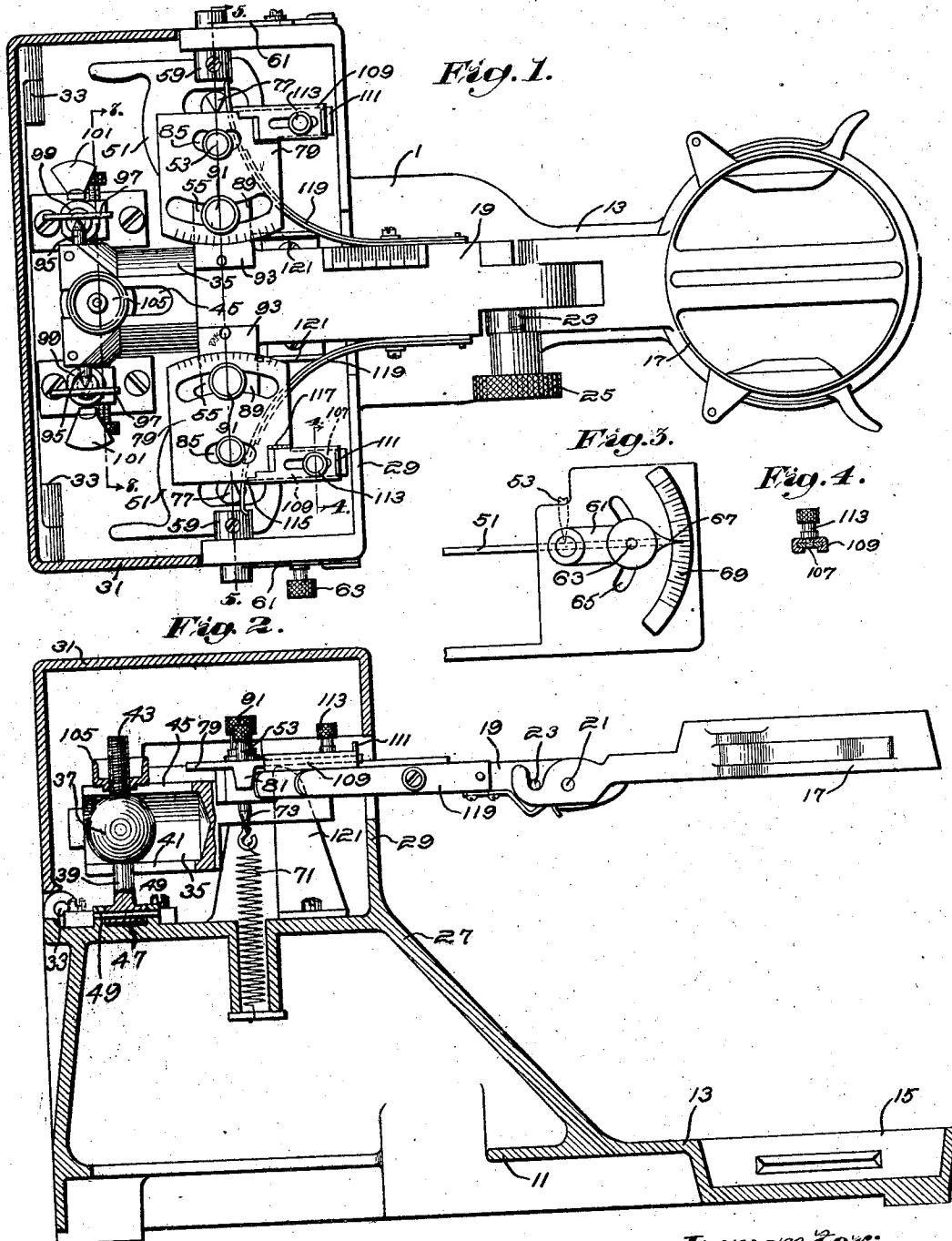
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ARTICULATOR

Filed July 18, 1925.

1,666,022

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 5.

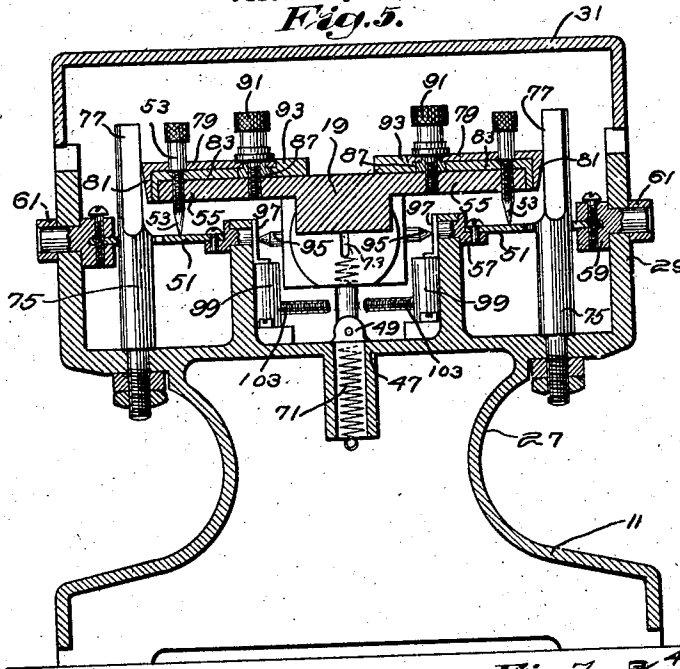


Fig. 6.

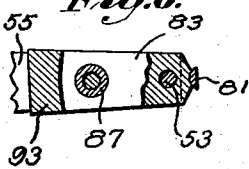


Fig. 7.

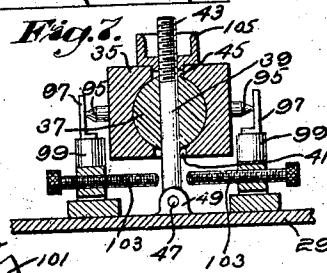
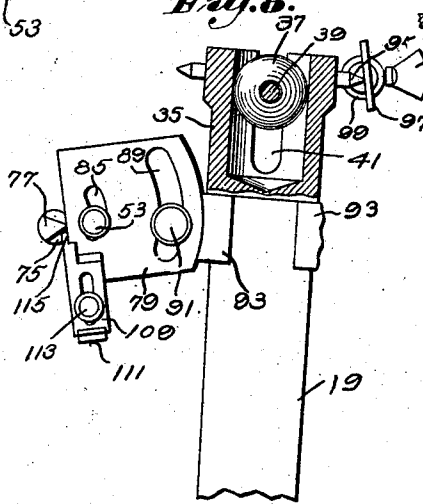


Fig. 8.



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UNITED STATES PATENT OFFICE.

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ARTICULATOR.

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This invention relates to articulators utilized for making artificial dentures and consists in improvements which provide a mechanically simple apparatus so constructed as to permit ready adjustment for the accurate reproduction of the extreme movements of the jaw or mandible of a patient.

The natural masticatory movement of the mandible takes place in three planes,—longitudinal or fore and aft, lateral or sidewise, and vertical,—the protrusive movement of the jaw usually consisting of a forward movement combined with a downward movement, or sometimes of a forward movement combined with an upward movement. These movements are due to the joint action of the two sides of the temporomandibular joint and, in the absence of the inclined planes of the teeth, are controlled or directed by the condyle paths at each joint, including the floor and lateral walls of the condyle path, and by the muscles of mastication and ligaments of the joint.

These elements impose conditions which undergo wide variations in different patients, and in the same patient are different in the case of the right and left sides, so that there results in different patients an innumerable number of different masticatory mandibular movements.

The purpose of the articulator is to locate and reproduce in the model-carrying arm the extreme lateral and forward positions of the movable jaw, these lateral movements being ordinarily compounded of movements in three different directions, forwardly, laterally and downwardly (or upwardly) inclined, and to reproduce the intermediate positions so far as possible between the neutral position of central occlusion and these extreme positions.

A study of the movements of the mandible discloses that there is no apparent center nor centers of rotation for the jaw and no apparently fixed pivoting action at either of the condyles. What actually takes place is that each condyle moves independently of, and usually dissimilarly from, the other, its movement being subject to the control or interference exercised by the lateral and horizontal walls of the glenoid fossa and the associated ligaments and muscles, with the

result that the jaw as a whole undergoes a bodily movement, producing the effect of a floating connection to its supports.

Its movement forward and downward is determined largely by the form of the horizontal plane of the floor of the glenoid fossa. Its movement laterally toward either side, however, is determined not only by the outer lateral walls of the glenoid fossa and the associated muscles and ligaments on the side toward which movement takes place, but is additionally modified by the interference at the inner lateral walls of the glenoid fossa on the side opposite to that toward which movement takes place. During the lateral movements of the jaw both condyles are in motion, and the extreme position the jaw assumes in either direction is determined by these limitations or interferences imposed at two different points, namely, the outer walls of one condyle path and the inner walls of the opposite condyle path.

One object of the present invention is to provide an articulator having a movable model-carrying arm or member provided with a floating connection to its support, or one permitting the bodily movement of the model carrier in all three planes,—vertical, lateral and horizontal,—to correspond to the actual movement of the mandible, such articulator preferably being provided with adjustable devices to define the downward and forward movement of the arm in being projected to its extreme lateral positions, and being further provided with means which reproduce in the extreme lateral positions of the arm the two differently located factors of interference embodied in the outer walls of one condyle path and the inner walls of the opposite condyle path and define the extreme lateral-protrusive movement of the jaw.

In the described embodiment of the invention, this is accomplished by providing two sets of separately adjustable, lateral, limiting devices, one set for defining the lateral movement of the arm in one direction and the other for defining the lateral movement of the arm in the opposite direction, each set comprising independently adjustable and differently located control or limiting devices corresponding in function to the limit-

ing factors presented by the two condyles with respect to lateral movement in that particular direction.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings,—

Fig. 1 is a plan view of an articulator embodying one form of the invention;

Fig. 2 is a side elevation in partial section showing the apparatus illustrated in Fig. 1;

Fig. 3 is a side elevation of a portion of the side casing of the apparatus showing the adjustable guide utilized to define the downward masticatory movement of the model arm;

Fig. 4 is a detail in front sectional elevation taken on the line 4—4 in Fig. 1;

Fig. 5 is a transverse, sectional elevation taken on the line 5—5 in Fig. 1;

Fig. 6 is a plan view of the end of one of the lateral branches of the movable model-carrying arm with certain of the parts removed;

Fig. 7 is a transverse, sectional elevation taken through the ball adjustment of the model-carrying arm; and

Fig. 8 is a plan illustrating the adjustment of the limiting devices for the lateral and protrusive movements of the arm in one direction.

Referring to the drawings and to the illustrated embodiment of the invention, the articulator is provided with a base or rest 11 by which the apparatus may be placed on any suitable support, the base being prolonged at the front to serve as a fixed arm or jaw 13 for holding the lower jaw model. The end of the prolongation for this purpose is provided with the model holder 15, this being directly under and confronting a similar model holder 17 which is adapted to hold the upper jaw model. The upper model holder 17 is supported by the movable model-carrying arm 19 which is so supported as to be capable of reproducing the movements and positions of the mandible or lower jaw of the patient.

Relative movement only between the model holders is required. It will be observed that the lower model holder 15 in which is placed the model taken from the lower movable jaw of the patient is fixed like the natural upper jaw, while the upper model holder 17 in which is placed the model taken from the upper fixed jaw of the patient is movable like the lower natural jaw. Accordingly the relation of the models in the articulator as regards actual movement becomes the reverse of the relation of the jaws of the patient; that is to say, the pro-

trusive movement of the lower jaw model is reproduced by a backward movement of the model holding arm 17 instead of a forward movement, as in the case of the natural jaw, and a right lateral movement in the model holding arm corresponds to a left lateral movement in the case of the natural jaw.

In the use of the articulator, the upper model holder 17 is rigidly connected to the model-carrying arm 19 to move therewith as a unit. For convenience in arranging the teeth, however, the model holder 17 is jointed to the arm so that it can be swung upwardly with relation thereto. For this purpose the model holder is forked and hinged at 21 to the reduced forward end of the arm 19. One branch of the forked arm extends back beneath a stop pin 23 carried by the arm 19, the stop pin being in the form of a threaded stud and provided with the thumb piece 25, so that by setting the latter up tightly the model holder and arm 19 may be locked rigidly together.

The base 13 is provided with a pedestal or raised portion 27 which supports a box-like casing 29 within which are provided the adjustments and connections for accurately guiding the movements of the upper model-carrying arm 19. This casing is provided with a cover 31 hinged at 33 so that it may be thrown back at will to permit manipulation and inspection of the necessary adjustments.

To provide the required floating connection between the arm 19 and the base and casing so that the movement of the arm may simulate that of the movable natural jaw, the rear end of the arm has rigidly secured thereto a barrel-shaped casing 35 which has a longitudinal sliding movement on the ball 37. The ball 37 is vertically slidable on the upright pin 39 which passes through the slot 41 in the bottom of the barrel and has a threaded end 43 protruding through the longitudinal slot 45 in the upper part of the barrel casing. The barrel and casing therefore, besides being capable of fore and aft or protrusive movement, are also capable of a rocking movement in a horizontal plane about the ball and a movement in a vertical plane due both to the sliding action of the ball on its pin and the capacity of the arm to rock vertically about the ball.

The supporting stem 39 for the ball, furthermore, is not fixed or rigid, but is itself capable of a sidewise rocking movement, being hinged or pivoted at 47 between upright lugs 49 carried in the casing. This provides a floating connection for the movable model holding arm which does not restrict but permits all possible movements of the arm within the required range to correspond to the bodily movements of the mandible which, as before stated, has no ap-

parent fixed center of rotation. Thus, it will be seen that the arm in moving laterally may be moved not only bodily rearwardly and downwardly (or upwardly) but bodily laterally as well.

For defining the position reached in lateral and forward masticatory movements of the mandible, guiding and limiting devices are provided comprising an independently adjustable guide for each opposite side of the arm to define the downward movement thereof, separate independently adjustable sets of lateral guiding and limiting devices each comprising differently located and independently adjustable controls for defining the lateral movement, and limiting devices for each opposite side thereof to limit the protrusive distance of the lateral movement.

To define the downward masticatory movement of the model arm there is provided at each side thereof adjustable guide plates 51 on each of which the arm has bearing contact by means of a supporting pin 53 (see Fig. 5). Each pin 53 is adjustably threaded into a lateral branch 55 of the arm 19 and defines the downward (or upward) path of the arm in its protrusive movement. For the purpose of the protrusive movement the plates 51 supply the function of the horizontal walls of the condyle paths and the pins the function of the condyles themselves. The parts which guide opposite sides of the arm 19, while independently adjustable, are substantially identical in construction and those on one side only need be specifically described.

Each pin is provided with a threaded shank and a thumb nut so that it may be screwed down tight into the arm or partly unscrewed therefrom raising it away from the plate. The plate 51 is carried in opposite trunnions 57 and 59 which are journaled in the walls of the casing 29 so that the plate may be adjustably rocked about a transverse axis. The outer trunnion 59 has secured thereto at the outside of the casing an adjusting arm 61 (see Fig. 3), the opposite end of which is provided with a clamping screw 63 passing through an arc-shaped slot 65 in the casing. By means of the arm and clamp screw the guide plate 51 may be tipped and set at any required angle to the horizontal and the adjustment noted by means of an indicating pointer 67 which cooperates with a series of graduations on the scale 69 on the face of the casing. This permits the plates to be reset at any future time to reproduce the adjustment to which the instrument may have been set, the scale readings having been noted at that time. In the neutral position of the arm 19, or that corresponding to a position of central occlusion, the points of support of the condyle pins 53 on the guide plates coincide

with the axis on which the plates are adjusted. Accordingly, no matter what the adjustment of the plate may be, the arm can always be brought back to the neutral position of central occlusion with the pin remaining in contact with the plate.

During the use of the apparatus the supporting pins are caused to engage with the condyle plates by means of a tension spring 71 (see Fig. 2), one end of which is secured to the under side of the casing 29 and the opposite end to a hook fastening 73 on the under side of the arm. The spring exerts a gentle pressure in the same transverse plane in which the condyle guide pins and the axis of the adjusting plates are located, so that it exerts a slight restoring action tending normally to bring the model holding arm when released back to a neutral position.

The condyle guide plates 51 might be curved to conform to the horizontal walls of the condyle path, but for practical purposes a flat plate as illustrated will suffice, since it will not only accurately define the limit of the downward movement but will record accurately the angle to the horizontal plane which the protrusive movement assumes. In other words, it will define the correct position of the condyle at the two extremes and approximately, though not always exactly, the intermediate positions.

To define the limitations of extreme lateral movements, two sets of control devices are provided, one for each opposite lateral movement. Since these are similar in construction one side only need be described.

To provide the control which is exercised by the outside lateral walls of the condyle path toward which lateral movement takes place, there is provided at each opposite side of the casing a lateral limiting device in the form of an upright post 75 (see particularly Fig. 5) secured to the bottom of the casing and projecting upwardly through an aperture in the condyle plate 51. The upper end of the post is shaped to present to the end of the adjoining lateral branch 55 of the arm 19 a pin 77 having a surface approximating a knife-edged formation (see Fig. 1) which is arranged to contact with the edge of an adjustable plate 79 carried by the lateral branch 55.

The plate 79 is provided with a depending pivot lug 81 (see Figs. 5 and 6) whose cross sectional outline is a segment of a circle and is seated against a cooperating cylindrical groove presented by the downturned end of an intermediate bearing plate 83 and located between the adjustable plate 79 and the branch arm 55. The plate 79 is therefore capable of being turned upon its pivot lug from its normal or neutral position shown in Fig. 1, to another position such as that shown in Fig. 8, where its out-

er edge presented to the pin 77 is inclined to the axis of the arm 19 so that the latter may be moved laterally and rearwardly with the inclined edge of the adjustable plate in contact with the knife-edged face of the limiting pin. Preferably the plate 79 is adjustable about a center which, in the neutral position of the arm is that of central occlusion, substantially coincides with the edge of the pin 77 so that in the neutral position both opposite plates are in contact with their respective pins irrespective of the positions of adjustment.

Since the pin 77 is fixed in the casing and passes through an aperture in the plate 51, the latter may be adjustably tipped without affecting the position of the pin, or, in other words, the vertical control and the lateral control for the extreme lateral protrusive movement are independent of and not affected by each other, and the arm when brought back to neutral position will contact with the edge of the plate 79 whatever may be the adjusted position of the plate 51. Preferably also the knife-edged pins 77 lie in the same vertical plane as the axes of the adjustable plates 51.

The bearing plate 83 is held fixed on the branch arm by the stud pin 53 which permits movement of the adjustable plate in virtue of the arc-shaped slot 85 in the latter through which the pin 53 passes. The plate is further guided in its movement by the washer 87 (Figs. 5 and 6) located within the arc-shaped slot 89 formed in the plate, through which washer passes the clamping screw 91 threaded into the branch arm and having a thumb piece by which it can be turned down to clamp the plate in any position of adjustment. The bearing plate has the raised inner end 93 presenting an arc-shaped guide for the inner end of the plate and having a zero or reference mark from which the departure of the plate from its neutral setting may be noted and recorded through the aid of a series of graduations on the edge of the plate.

The adjustable stop plate, with its cooperating limiting pin on that side of the arm toward which lateral movement of the arm takes place, supplies the lateral control which in the natural jaw is afforded by the outer walls of the condyle path on that side toward which the movement of the jaw takes place. The adjustable plate 79 for the limiting pin 77 for the opposite side of the arm supplies the corresponding control which is afforded at the opposite condyle in the opposite movement of the natural jaw. The edges of the guide plates 79 might be shaped to provide an exact simulation of the guidance afforded by the lateral walls of the condyle path for any particular patient, but for practical purposes the straight edges shown will suffice since they not only

accurately define the limits of lateral movement but define the angle to the longitudinal plane in which the movement takes place and with approximate accuracy the intermediate positions of the jaw between the neutral position and its extreme position.

To give a definite guidance to the arm in its extreme lateral movement, a second differently located control device is employed for each opposite lateral movement of the arm to afford the control exercised by the inner interference of the condyle on that side opposite to that toward which the lateral movement takes place. This second limiting device, properly arranged, might be located on the same side of the arm as is the already described limiting device which governs the same lateral movement. Herein, however, it is located on the opposite side of the arm; that is to say, for movement in any one lateral direction the extreme movement is defined by one of the lateral limiting devices as described acting jointly with a second limiting device located on the opposite side of the arm. This device supplements the other in accurately defining the lateral bodily movement of the arm.

As one embodiment of this second pair of limiting devices I have herein shown the barrel-shaped casing 35 provided at each opposite side with laterally projecting pins 95 cooperatively related to a small upright plate 97 (see Figs. 1, 7 and 8), the latter being mounted to be turned at different angles of adjustment in a post 99 secured to the bottom of the casing 29. The plate may be held fixed in any selected position of adjustment by a set screw, the latter provided with the wing piece 101. Thus the plate 97 may be turned and held in some such position as is represented in Fig. 8, so that when the arm is moved laterally and forwardly the lateral path and extreme position of the arm will be defined jointly by the contact of the adjustable plate 79 with the limiting pin 77 and the contact of the pin 95 with the face of the plate 97. The adjustment of the plate 97 will depend on the amount of lateral shifting the jaw undergoes in reaching an extreme lateral position. This permits the model-carrying arm to simulate the natural movements of the jaw of the patient, the arm being bodily and laterally movable by its floating connection to the casing.

Similar results may be obtained if, instead of employing the plate 97, there is provided at each side of the upright ball engaging pin 39 the independently adjustable stop screws 103 which may be so adjusted as to limit the control of the sidewise swinging movement of the pin 39. Ordinarily one only of these limiting devices, either the plate 97 or the adjustable stop screw 103, need be employed in the same apparatus, but

both are herein shown for the purpose of illustration. The adjustment obtained through the plate 97 may be preferable for purposes of instruction since it offers the better visualization of the structural interferences of the jaw as they actually exist in the patient.

The ball which is normally allowed to slide vertically on the pin 39 provides for the opening and closing movements of the jaw. In certain instances, however, it is desirable that the closing action of the jaw be limited to a definite range and for this purpose the upper threaded end of the pin is provided with an adjustable nut 105 which can be so set as to limit the amount to which the jaws may close, or, in other words, the amount by which the upper model holder may be allowed to approach the lower holder. The nut 105, however, does not interfere with the opening action of the jaws.

To provide for limiting the protrusive movement of the model holder in each lateral direction, each adjustable plate 79 is provided with a forwardly projecting tang 107 (see Figs. 1 and 4) on which is mounted the sliding stop piece 109, the stop piece being retained on the plate by its underturned edges and limited in its outward movement by the upturned end 111 of the tang. The stop piece may be fastened in different positions on the tang by means of the clamping screw 113 threaded into the tang and passing through a slot in the stop piece. The rear end of the stop piece is provided with a stop shoulder 115 registering with the edge of the adjustable plate and so positioned with relation to the limiting pin 77 that it contacts therewith on the protrusive (or rearward) movement of the model-carrying arm, as represented in Fig. 8. By adjusting the stop piece to different positions on the plate the limit of the protrusive and lateral movement may be accurately defined. A series of graduations 117 is provided on the plate by which the position to which the stop piece is adjusted may be noted.

Any suitable means may be provided for restoring the jaw carrying arm from its protruding position to its normal position, such, for instance, as the two flexed spring members 119 secured to the side of the arm 19 and having their opposite ends bearing against the respective limiting pins 77.

The arm 19 may be provided with suitable devices such as the fixed upright stop piece 121 adapted to engage with the front face of each opposite branch arm 55 to limit the forward movement of the arm, or, in other words, to provide a stop corresponding to the fixed position of the natural jaw when retracted.

In the use of the apparatus, the models having been prepared and transferred to the articulator, the extreme lateral position of

the model arm is then determined for both the right and left sides by the aid of suitable molds which have been taken from the natural jaw. With the model arm in one of its extreme lateral positions, the condyle plate 51 on that side of the instrument to which the arm has been moved is turned about its axis until it offers a supporting contact with the tip of the condyle pin or rest 53 and is there clamped. When the model holder is moved to the extreme lateral position thus defined from the neutral position of central occlusion, it will be guided in its vertical movement by the inclination of the condyle plate thus adjusted.

With the arm in the extreme lateral position above referred to, the adjustable plate 79 on the same side of the arm is then turned until its edge contacts with the knife-edged limiting pin 77. The clamp screw 91 is then turned to fix the plate in this position. At the same time the limiting device 109 is loosened and slid along the plate 79 until its shoulder 115 contacts with the pin 77, whereupon it is fastened tightly in that position.

At the same time the lateral guiding plate 97 on the opposite side of the arm is turned until its face touches the tip of the projecting pin 95, whereupon it is set tight by its set screw 101. Such a condition is indicated by the adjustment shown in Fig. 8. The model-carrying arm when moved from its neutral position to the extreme lateral position thus defined moves, with respect to its lateral displacement, as if in a groove, guided by the contact between the edge of the adjustable plate 79 and the knife-edge of the limiting pin 77 on the one hand and the pin 95 and the plate 97 on the other hand.

These adjustments having been completed, the arm is moved to its extreme lateral position on the opposite side and similar adjustments are made of the plates 51 and 79 for that side of the instrument and the vertical plate 97 for the opposite side.

If the adjusting screws 103 are employed instead of the plates 97, the adjustment will be similarly made; that is to say, when the arm is in its extreme lateral position on one side, the screw 103 on the opposite side of the arm will be turned until it touches the side of the pivoted, ball-engaging pin 39.

It will be observed that as the arm moves executing the extreme lateral protrusive movement on either side under the guidance of these two differently located guiding devices, the lateral guiding members which are carried by the arm for defining the extreme lateral movement in the opposite direction, namely, the plate 79 on the side opposite to that toward which the first named assumed movement takes place, and the pin 95 on the side of the arm toward which the movement takes place, move away from the pin

77 and the plate 97 respectively, so that the extreme lateral movement in either direction is without interference from the guiding devices utilized for defining the extreme lateral movement in the opposite direction.

It will be observed that when the model arm executes its protrusive lateral movement, it not only moves bodily forward but bodily laterally without a fixed center of rotation, thus simulating the action of the natural jaw where both condyles move independently of each other, both forwardly and laterally and usually dissimilarly in the extent of movement.

It is unnecessary that the models be placed in any exact location in the described form of articulator for the instrument may be placed in neutral position for any selected position of the models. The movements of the model-carrying arm are independent of any fixed center of rotation, so that it will reproduce the extreme lateral movements of the natural jaw with accuracy irrespective of the distance of the models from the ball 37 and irrespective of whether they are fixed on their arms slightly at one side or the other of the longitudinal plane passing through the ball. It is therefore unnecessary to take preliminary measurements of the relation between the patient's jaw and the condyles, as has heretofore been customary, for the purpose of accurately determining the fixed position which the models must occupy in the jaws of the articulator.

While I have herein shown and described for the purpose of illustration one specific embodiment of the invention, it is to be understood that the same is not limited to the mechanical details or to the form or relative arrangement of parts herein shown, but that extensive deviations may be made therefrom without departing from the spirit of the invention.

I claim:

1. In an articulator, the combination with a support, of a movable model-carrying arm having a floating connection to the support providing for a bodily movement of the arm in all directions, both vertically, laterally and longitudinally, without a fixed center of rotation, with devices for adjustably defining the opposite movements of the arm, including an adjustable guide for each opposite movement to define the inclination to the horizontal plane taken by the arm in that movement, lateral guiding devices comprising for each opposite lateral movement an independently adjustable device to provide lateral guidance corresponding to the outer interference at one condyle of the natural jaw and a differently located adjustable device to provide a guidance corresponding to the inner interference at the opposite condyle, and a device to limit the protrusive movement of the arm for each

opposite extreme lateral movement thereof. 2. In an articulator, the combination with a support, of a movable model-carrying arm having a floating connection to the support providing for a bodily movement of the arm in all directions, both vertically, laterally and longitudinally, without a fixed center of rotation, with devices for adjustably defining the opposite movements of the arm, including an adjustable guide for each opposite movement to define the inclination to the horizontal plane taken by the arm in that movement, and lateral guiding devices comprising for each opposite lateral movement an independently adjustable device to provide lateral guidance corresponding to the outer interference at one condyle of the natural jaw and a differently located adjustable device to provide a guidance corresponding to the inner interference at the opposite condyle.

3. In an articulator, the combination with a support, of a movable model-carrying arm having a floating connection to the support providing for a bodily movement of the arm in all directions, with devices for adjustably defining the extreme lateral movements of the arm, including for each opposite lateral movement thereof an adjustable device to provide a guidance corresponding to the outer interference at one condyle of the natural jaw, and differently located adjustable devices to provide a guidance corresponding to the inner interference at the opposite condyle.

4. In an articulator, the combination with a support, of a movable model-carrying arm having a floating connection to the support providing for a bodily movement of the arm in all directions, with devices for adjustably defining the extreme lateral movements of the arm, including for each opposite lateral movement thereof a guide member and a bearing member, one on the support and the other on the arm and in contact when the arm is in a neutral position of central occlusion, the guide member being adjustable about the center substantially coinciding with the point of contact when the arm is neutral.

5. In an articulator, the combination with a support, of a movable model-carrying arm providing for a bodily movement in all directions, devices for adjustably defining the extreme movements of the arm, including adjustable guiding means for each opposite movement to define the inclination of the horizontal plane taken by the arm in that movement, two sets of lateral guiding devices for each opposite lateral movement, each set including a guide member and a bearing member, one for each side of the arm, one on the support and the other on the arm, and in contact when the arm is in neutral position, the guide member being

adjustable to provide a guidance corresponding to the outer interference at one condyle of the natural jaw, and a differently located adjustable device to provide for the opposite side of the arm a guidance corresponding to the inner interference at the opposite condyle, the two last named adjustable devices acting to define a laterally definite path of movement for the extreme lateral movement of the arm.

6. In an articulator, the combination with a support, of a movable model-carrying arm having a connection to the support providing for the bodily movement of the arm in all directions, devices for adjustably defining the vertical movement of the arm in its extreme movements and adjustable devices independent thereof for defining laterally the movement of the arm in each opposite lateral extreme movement.

7. In an articulator, the combination with a support, of a movable model-carrying arm having a connection to the support providing for a bodily movement of the arm in all directions, and adjustable devices for defining the extreme lateral movements of the arm including for each opposite lateral movement thereof a guide plate mounted on the arm and a bearing member on the support, the two being in contact in the neutral position of the arm, the guide plate being adjustable about a center substantially coinciding with the point of contact when the arm is neutral and providing when adjusted a lateral guidance for the arm.

8. In an articulator, the combination with a support, of a model-carrying arm, a ball on which the arm is mounted and relatively to which it has longitudinal movement, the ball being movable laterally on the support to provide bodily lateral movement of the arm and also movable vertically on the support to provide bodily vertical movement thereof, and devices for adjustably defining the extreme lateral movements of the arm in both opposite directions.

9. In an articulator, the combination with a support, of a model-carrying arm, a connection between the arm and support, including a part on which the arm is pivoted for relative movement thereto, said part being movable laterally on the support to provide bodily lateral movement of the arm in executing its extreme lateral movements, and devices for adjustably defining the extreme lateral movements of the arm in both opposite directions.

10. An articulator having a movable model-carrying member provided with a floating connection to its support permitting the bodily movement of the model in all three planes to correspond to the bodily movement of the natural jaw, with sets of independently adjustable guide members for each opposite movement of the member, each

set comprising a guide adjustable about a transverse axis and a bearing member connected to the model-carrying member movable over the guide to control the vertical movement of the member, or that accompanying the displacement of the same from the occlusal plane simulating the control exercised over the condyle by the horizontal plane or floor of the glenoid fossa, and independently adjustable means to control extreme lateral movement comprising separately adjustable limiting devices, each consisting of an adjustable guide to provide the guidance corresponding to the outer interference at the condyle on the side toward which the lateral movement takes place, and a differently located guiding device to provide the guidance corresponding to the inner interference at the opposite condyle thereby to definitely guide the bodily movement of the member from its position of central occlusion to its extreme lateral position in each opposite direction.

11. An articulator having a support, a model-carrying arm provided with a connection to the support permitting bodily movement of the arm in all directions, adjustable devices for defining the extreme movement of the arm comprising for each opposite movement a guide adjustable about a transverse axis and serving to define the inclination of the path of movement from the horizontal plane, an adjustable device for guiding the lateral movement comprising a bearing member and an adjustable guide, one on the support and the other on the arm, the point of contact of said members lying in the same vertical plane as the transverse axes of said first named guiding devices, and a second differently located adjustable lateral guiding device.

12. An articulator having a support, a movable model-carrying arm having a floating connection to the support providing for the bodily movement of the arm in all directions, and devices for adjustably defining the extreme lateral movements of the arm, including for each opposite lateral movement thereof an adjustable device to provide a guidance corresponding to the outer interference at one condyle of the natural jaw and a differently located adjustable device to provide a guidance corresponding to the inner interference at the opposite condyle, the lateral guiding device for each extreme lateral movement being such as to offer no interference to the opposite extreme lateral movement.

13. In an articulator, the combination with a support, of a rigid model-carrying arm, a ball on which the arm is mounted and relatively to which it has longitudinal movement, and the ball being movable vertically on the support to provide bodily vertical movement thereof and guiding devices to

guide said arm in its movement on and with said ball.

14. In an articulator, the combination with a support, of a rigid model-carrying arm, a ball on which the arm is mounted and relatively to which it has longitudinal movement, the ball being movable vertically on the support to provide bodily vertical movement thereof, and an adjustable device to limit the vertical movement of the ball.

15. In an articulator, the combination with a support, of a model-carrying arm, a connection on the support to which the arm is pivoted, said connection being movable laterally on the support to provide bodily lateral movement of the arm in executing its extreme lateral movements, and the connection being also movable vertically with relation to the support to provide for bodily vertical movement of the arm and guiding devices to guide said arm in its movement on and with said connection.

16. An articulator having a base, a movable, model-carrying arm having a floating connection to the base, the arm having a protrusive movement with relation to a system of guides adapted to define its extreme lateral position, the same comprising for movement in each opposite direction a plate pivotally mounted on the base for adjustment about an upright axis and presenting a bearing wall adapted to be engaged by a part carried by the arm, and a plate pivotally mounted on the arm for adjustment about an upright axis and adapted to engage a part on the base.

17. In an articulator, the combination with a support, of a movable, model-carrying arm having a floating connection to the support, adjustable devices defining the position of the arm vertically in each of its extreme opposite movements, and adjustable devices for defining the position of the arm laterally in each of its extreme opposite movements, the latter comprising a plurality of arm-positioning, differently located, lateral bearing members for defining the position of the arm on movement in one direction away from the position of central occlusion, and a corresponding set of such members for defining the position of the arm on movement in the opposite direction.

18. An articulator having a support, a model-carrying arm, the latter having a floating connection to said support to permit movement of the arm relatively to the support to correspond to the actual movement of the mandible, adjustable devices to define the vertical displacement of the arm for different protrusive positions thereof, and independently adjustable, lateral, guiding devices to reproduce for the lateral displacement of the arm in either direction the two differently located factors of interference embodied in the outer walls of one con-

dyle path and the inner walls of the opposite condyle path.

19. An articulator having a support, a model-carrying arm, the latter having a floating connection to said support to permit movement of the arm relatively to the support to correspond to the actual movement of the mandible, adjustable devices to define the vertical displacement of the arm for different protrusive positions thereof, and two sets of independently adjustable, lateral, guiding devices to reproduce for the lateral displacement of the arm in either direction the two differently located factors of interference embodied in the outer walls of one condyle path and the inner walls of the opposite condyle path, each set comprising an adjustable, segmental plate presenting a lateral bearing wall adapted to be engaged by a part on the arm and adjustable about an axis on the support, and a second, differently located, adjustable bearing member.

20. An articulator having a support, a model-carrying arm, the latter having a floating connection to said support to permit movement of the arm relatively to the support to correspond to the actual movements of the mandible, adjustable devices to define the vertical displacement of the arm for different protrusive positions thereof, the same including a plate adjustably mounted on the support about a transverse, horizontal axis and a bearing member on the arm engaging the same, and independently adjustable, lateral guiding devices to reproduce for the lateral displacement of the arm in either direction the two differently located factors of interference embodied in the outer walls of one condyle path and the inner walls of the opposite condyle path, the same including a lateral bearing member adjustable about an upright axis substantially intersecting the axis of adjustment of said guide plate, a part carried by the arm and adapted to contact with said guide member along its axial line of adjustment when the arm is in the position of central occlusion, and a second, differently located, adjustable, lateral, guide member.

21. An articulator having a support, a model-carrying arm, a floating connection including an upright post mounted on the support, a longitudinal opening in the arm permitting the longitudinal, protrusive movement of the arm relatively to the post, adjustable devices to define the vertical displacement of the arm for different protrusive positions thereof, and devices to define the extreme lateral positions of the arm, the same comprising for each extreme lateral position an adjustable bearing plate located adjacent the post and a second adjustable bearing plate located at a different position lengthwise the arm.

22. An articulator having a support, a

- model-carrying arm, the latter having a floating connection to said support, adjustable devices to define the vertical displacement of the carrier for different positions of the arm, the same including a guide plate adjustably mounted on the support about a transverse, horizontal axis and a bearing member on the arm engaging the same, and means to define the position of the arm laterally for extreme movements thereof in opposite directions, the same comprising engageable bearing walls, one carried by the guide plate and the other on the arm, one of said bearing walls being presented by an adjustable, segmental plate for adjustment about an axis which, when the arm is in its position of central occlusion, substantially intersects the point of engagement between the bearing walls on said arm and said segmental plate and also intersects the axis of said guide plate, the segmental plate having an arc-shaped slot engaged by a clamping screw.
23. An articulator having a support, a model-carrying arm, the latter having a floating connection to said support, adjustable devices to define the vertical displacement of the arm in its extreme opposite movements, and adjustable devices to define the position of the arm laterally in each of its extreme opposite positions, the same comprising, for movement in one direction, two contacting elements, one carried by the arm and the other by the support, one of said members comprising a segmental plate adjustable about an upright axis and presenting an arm-positioning, lateral bearing wall, and a second set of differently located, contacting elements, one carried by the arm and the other by the support and including an adjustable, lateral bearing member adapted to supplement the action of said first bearing wall, said articulator having also corresponding contacting elements to govern movement of the arm in the opposite direction.
24. A dental articulator having a jaw arm mounted for mandibular movement, independently adjustable guide members for the opposite lateral movements of the arm each comprising a guide adjustable about a transverse axis and a rest connected to the arm movable over the guide to control the vertical movement of the member or that simulating the control exercised over the condyle by the horizontal plane or floor of the glenoid fossa, and means adjustable independently of said members and of each other to limit the range of the extreme lateral movement of said arm in both opposite directions.
25. A dental articulator having a movable jaw carrying arm mounted for mandibular movement, independently adjustable guide devices for each opposite lateral movement of the arm and adapted to control the vertical movement of the arm or that simulating the control exercised over the condyle by the horizontal plane or floor of the glenoid fossa, means to adjustably limit the forward and backward movement of the arm, and independently adjustable devices for limiting the extent of the lateral movement of the arm in both opposite directions.
26. An articulator having a jaw arm mounted for mandibular movement with independently adjustable guiding devices for controlling the vertical movement of the arm and simulating the control exercised over the condyle by the horizontal plane or floor of the glenoid fossa, and means to limit the extent of the lateral movement of the arm in both directions, said means being adjustable independently of each other and of said guiding devices.
27. In a dental articulator, the combination with a support of a movable model carrying arm having longitudinal, lateral and vertical movements, devices for adjustably defining the lateral movements of the arm including an adjustable guide for each opposite lateral movement to define the inclination to the horizontal plane taken by the arm in that movement, lateral guiding devices comprising for each opposite lateral movement an independently adjustable device to provide lateral guidance, and a device for adjustably limiting the protrusive movement of the arm for each opposite extreme lateral movement thereof.
28. A dental articulator having a movable model carrying arm, adjustable condyle guiding means therefor to adjustably define the inclination to the horizontal plane taken by the arm in its movement, a lateral guiding member pivoted for adjustment about an upright axis to provide lateral guidance for the arm, and an adjustable stop member for adjustably limiting the protrusive movement of the arm for each opposite extreme lateral movement thereof.
29. In a dental articulator, the combination with a support, of a movable model carrying arm, devices for adjustably defining the lateral movements of the arm including an adjustable guide for each opposite lateral movement to define the inclination to the horizontal plane taken by the arm in that movement and lateral guiding devices comprising for each opposite lateral movement an independently adjustable device to provide lateral guidance, and a ball and socket connection for the arm, the arm being mounted to permit of its longitudinal movement with relation to the ball and socket connection.
30. In a dental articulator, the combination with a support, of a movable model carrying arm, devices for adjustably defining the lateral movements of the arm includ-

ing an adjustable guide for each opposite lateral movement to define the inclination to the horizontal plane taken by the arm in that movement and lateral guiding devices comprising for each opposite lateral movement an independently adjustable device to provide lateral guidance, and a pivotal connection for the arm to permit the arm to swing laterally, the same comprising a slot formed longitudinally in the arm and a fulcrum member mounted on the support and engaging the walls of the slot, the arm being mounted to permit of its longitudinal movement with relation to said fulcrum member.

31. A dental articulator having a movable model holding arm with suitable guiding devices for guiding it in its lateral movements, and a connection for the arm permitting lateral, longitudinal and vertical movements of the arm held model, the same including a pivotal connection to the arm to permit the arm to swing laterally, the same comprising a slot formed longitudinally in the arm and a fulcrum member mounted on the support and engaging the walls of the slot, the arm being mounted to permit a longitudinal, mandibular movement with relation to the fulcrum member.

32. A dental articulator comprising a fixed lower model holder, a model-holding arm cooperatively and movably related thereto and located above the fixed holder, a connection permitting free movement of the arm and providing for longitudinal, lateral and vertical movements thereof, the same comprising a ball having a post by which it is connected to the fixed holder, and a socket connected to the arm having a slot arranged longitudinally the arm through which said post passes.

33. A dental articulator comprising upper

and lower model holding arms, the upper one being mounted for free longitudinal, lateral and vertical movement, guiding devices for guiding and positioning the arm in its opposite lateral movements, a hinged connection between the model holding end of the movable arm and said guiding devices, and means for fastening the arm against movement at said hinged connection where- by the models may at will be separated without interference with the positioning of the arm by said guiding devices, or the model holding end of the arm may be held in rigid relation with the guiding and positioning of the end of the arm.

34. A dental articulator having a movable model-carrying arm, adjustable condyle guides therefor, a lateral guiding member pivoted for adjustment about an upright axis at each side of the arm, and an adjustable stop piece carried by said member for determining the limit of lateral movement.

35. A dental articulator having a support, a movable model carrying arm, devices for adjustably defining the lateral movements of the arm, including an adjustable guide for each opposite side to define the inclination to the horizontal plane taken by the arm, and connections between the arm and the support to provide for free movement, the same comprising a fulcruming member carried by the support and comprising also an opening in the arm, the walls of which engage the opposite sides of the fulcruming member, the said opening extending lengthwise the arm to permit longitudinal movement of the arm and model carried thereby with relation to the fulcruming member.

In testimony whereof, I have signed my name to this specification.

GEORGE P. PHILLIPS.