

[54] **DENTAL ARTICULATOR**

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[51] **Int. Cl.**..... **A61c 17/04**

[58] **Field of Search**..... **32/32**

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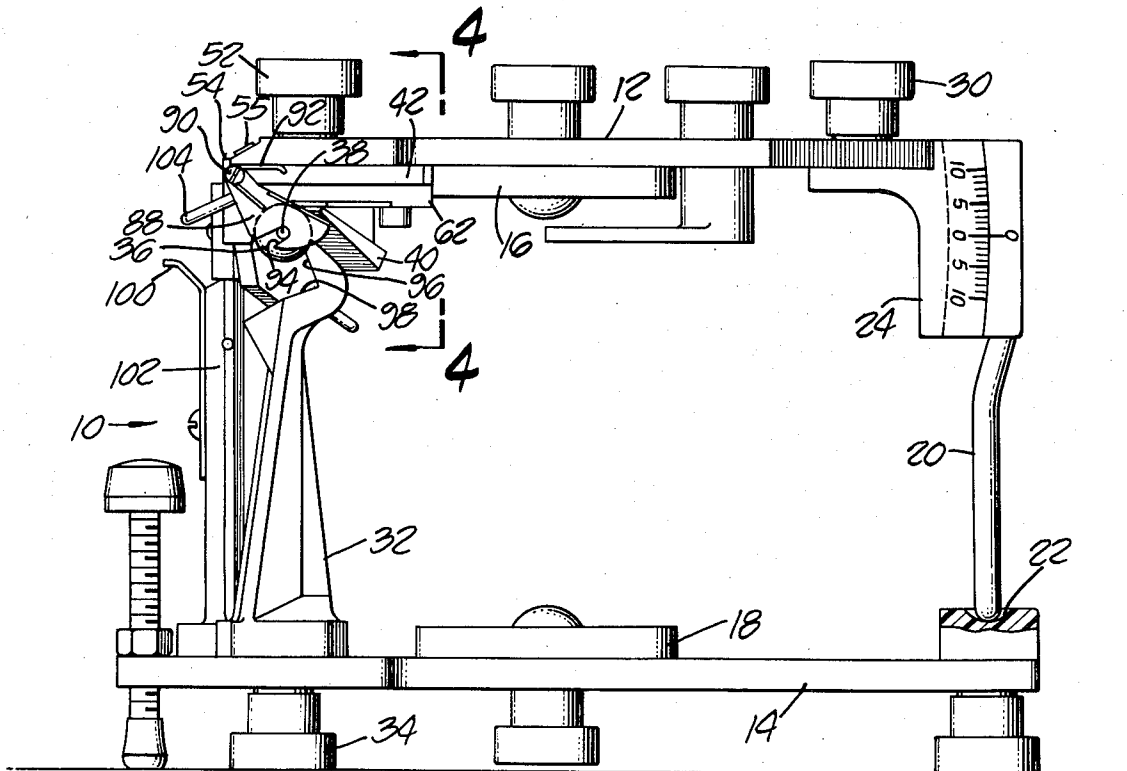
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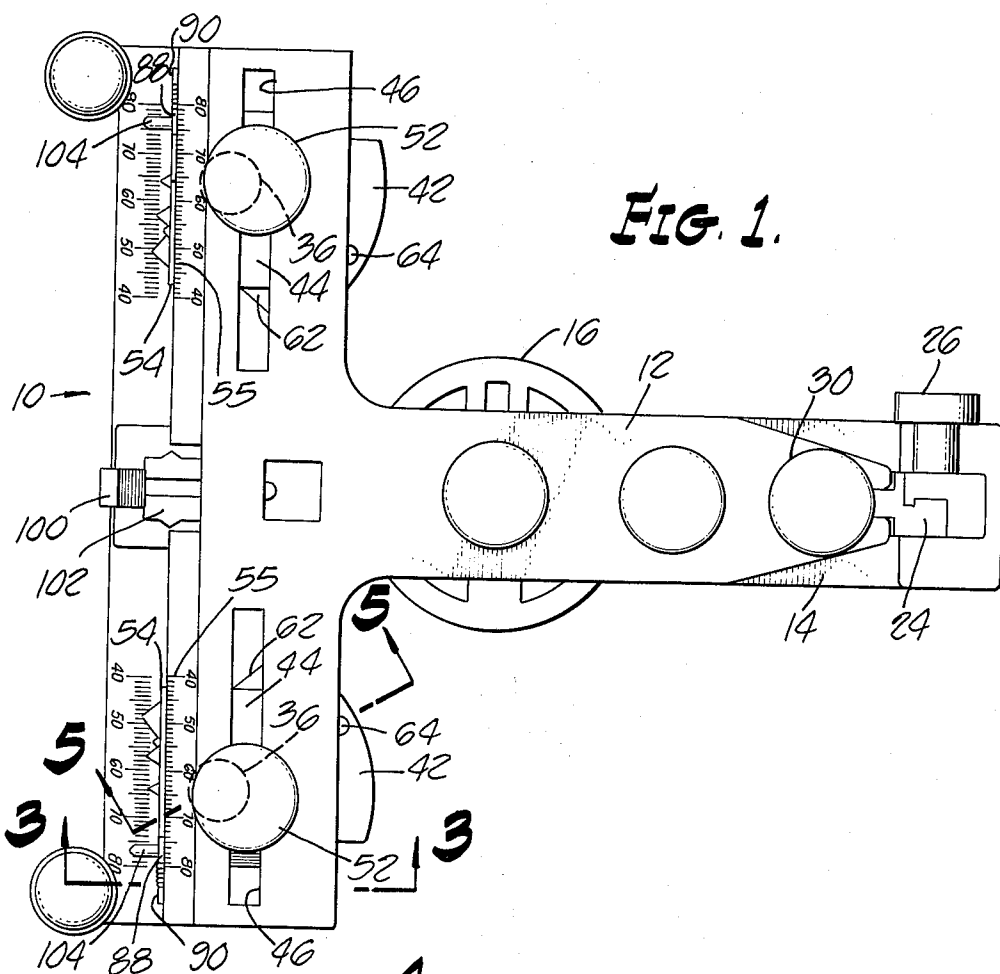
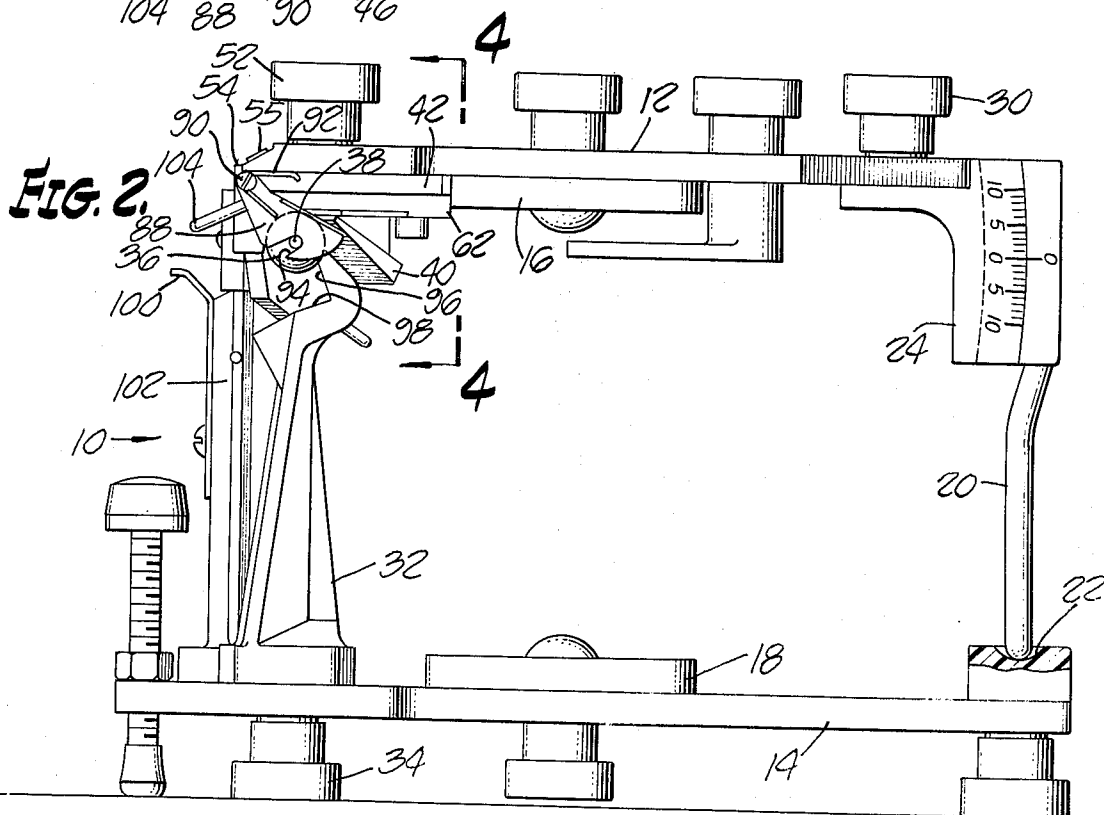
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ABSTRACT

A dental articulator is disclosed which simulates the operation of human jaws for use in the manufacture of false teeth. An upper frame representing the upper jaw is mounted to a lower frame by a pair of ball and socket joints which may be adjusted to approximate a specific patient's jaw hinge. Each socket has three sides. Relative motion of the ball is allowed along two sides of the socket and away from the third side. The third side provides a reference position corresponding to the fully closed, occludent position of the upper and lower jaws. The two sides which determine the direction of allowed motion of the ball relative to the socket may be adjusted independently as to azimuth and elevation without disturbing the fixed reference position. Further, a lock arrangement is provided which locks each ball in the fixed reference position while allowing rotation of the upper frame and sockets about that position.

12 Claims, 9 Drawing Figures





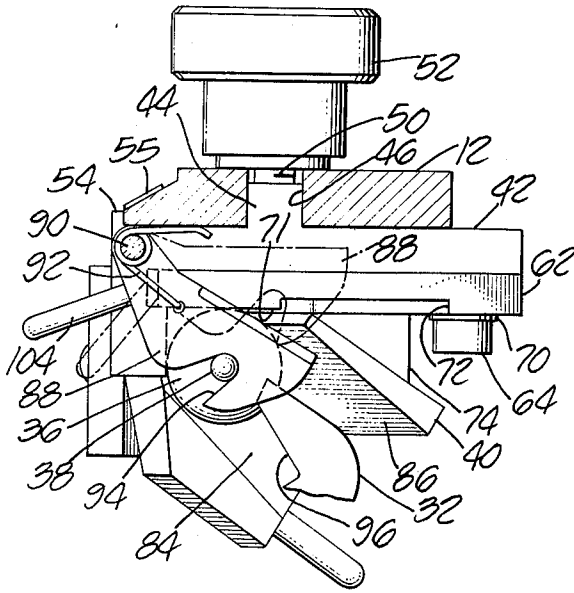


FIG. 3.

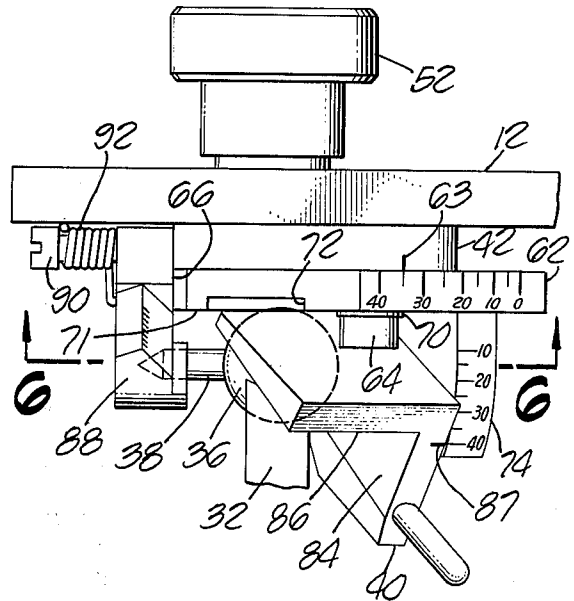


FIG. 4.

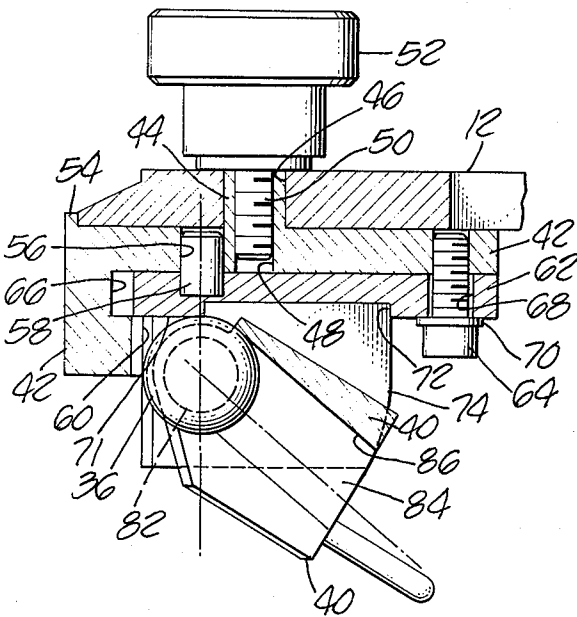


FIG. 5.

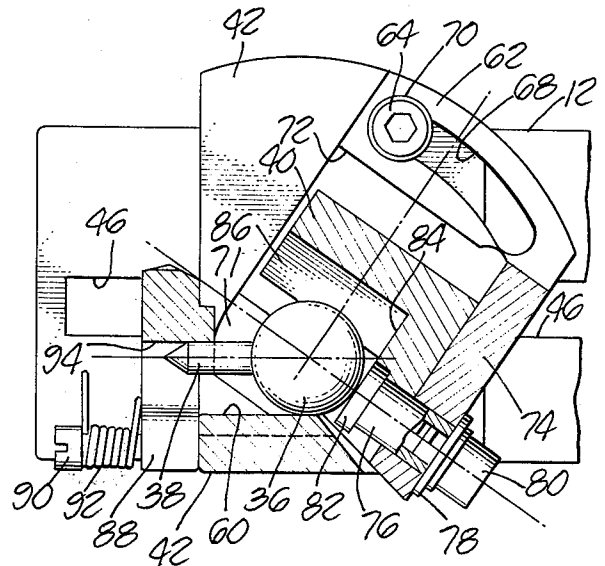


FIG. 6.

FIG. 7.

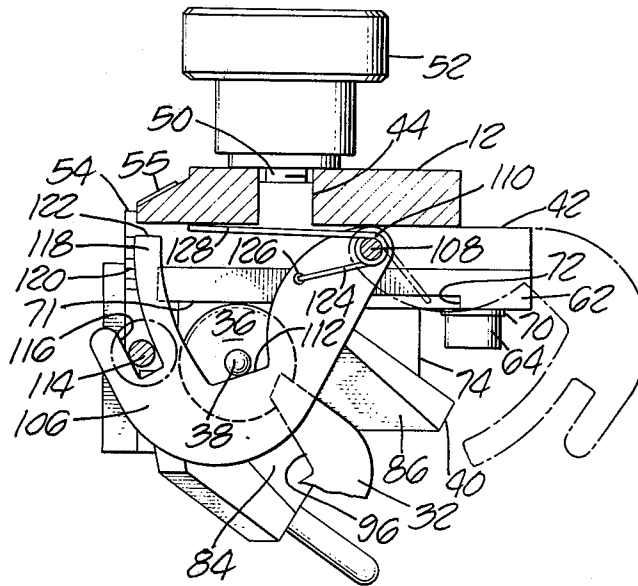


FIG. 8.

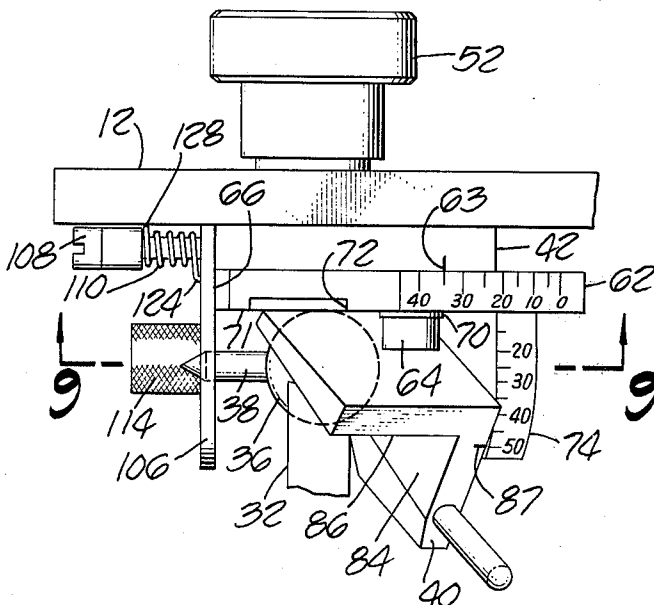
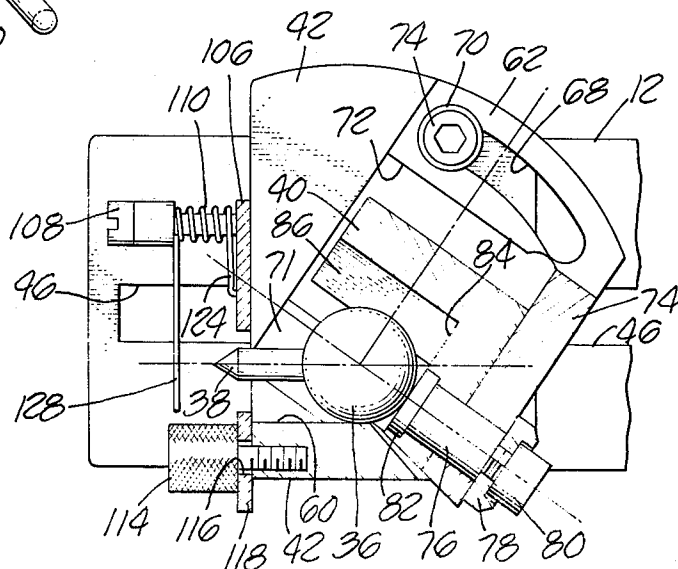


FIG. 9.



DENTAL ARTICULATOR

This invention relates to dental articulators. More specifically, this invention is directed to improved means for joining the upper and lower portions of an articulator.

Dental articulators are used to simulate the jaw and hinge mechanism of humans for use in the manufacture of false teeth and thereby provide a proper arrangement of the teeth according to a human's particular bite. To accomplish this, upper and lower frame units are generally employed to simulate the upper and lower jaws. Further, condyle ball and socket arrangements are employed in a great many of these devices which correspond to the actual jaw hinges of humans. Such a device is shown in my U.S. Pat. No. 3,206,852. To facilitate the description of the present invention, and to promote an understanding of articulators in general, my aforementioned patent is to be referenced for the present description. However, it will readily appear and be understood by those skilled in the art that the present invention can be incorporated with various other articulators.

The condyle ball and socket joints employed in dental articulators generally provide for significant lateral displacement to better reflect actual jaw movements. Consequently, the joints are not interlocking and will not support the upper frame when it is rotated to disengage the false teeth mounted on the articulator. As a result, it has been found useful to provide a secondary mechanism for holding the upper frame on the lower frame when the upper frame is pivoted from the engagement position. Further, the permitted relative lateral displacement of the condyle ball and sockets creates a second operational closed, occludent position when efforts are made to work on the subject teeth with both the upper and lower portions engaged.

An object of the present invention is to provide a positive constraint between the upper and lower portions of a dental articulator, both to keep the two frames together when the upper frame is pivoted from the occludent position and to prevent relative lateral displacement of one frame relative to the other while in the occludent position. Spring loaded hooks pivotally mounted to the upper frame are provided which engage the condyle balls of the lower frame. These hooks lock the sockets to the condyle balls in the occludent position while simultaneously allowing rotation of the upper frame about an axis passing through the center of each condyle ball. The hooks thereby prevent relative displacement or separation of the frames.

To adequately simulate a specific individual's jaw mechanism, adjustments to the condyle ball and socket arrangements must be made. To achieve these results, various devices have been employed. However, adjustments to these devices often cannot be accomplished in a manner which preserves a fixed occludent position of the condyle balls in each socket and at the same time allows for independent determination of the socket orientation relative to the upper frame. Thus the adjustments are difficult to accomplish and do not provide for easy transfer of measurements from the patient to the articulator.

Further objects of the present invention are to provide fixed occludent positions independent of the orientation of each socket and to allow for independent

adjustments of the socket orientation relative to the upper frame.

The present invention provides a socket to be employed with a condyle ball which maintains at all times a reference position fixed relative to the upper frame. At the same time, means are provided for mounting the socket about two perpendicular axes. The axes permit two independent degrees of freedom for orientation of the socket and yet are arranged to preserve the fixed reference position at all times. Further, the fixed reference position is coincident with the occludent position of the condyle ball in the socket.

Thus, a dental articulator joint is provided which is capable of being pivotally locked in the occludent position and which allows for simple and convenient adjustment of the socket orientation to approximate the patient's jaw hinge structure. Further objects and advantages will become readily apparent hereinafter.

DRAWINGS: IN THE DRAWINGS

FIG. 1 is a top view of the dental articulator illustrating the upper frame and the locations of the left and right-hand hinge assemblies.

FIG. 2 is a side view of the dental articulator illustrating the upper and lower frames in the normal occludent position.

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 1 illustrating the locking member in place and showing the unlocked position of the locking member in phantom.

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 2 illustrating the left-hand condyle and socket as viewed from the front of the articulator.

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 1 illustrating the placement of the ball in the socket in the occludent position.

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 4 illustrating a bottom view of the left-hand socket with the ball in the occludent position.

FIG. 7 is a cross-sectional view taken along line 3—3 of FIG. 1 illustrating a second locking mechanism in place. The unlocked position of the locking member is shown in phantom.

FIG. 8 is a cross-sectional view taken along line 4—4 of FIG. 2 illustrating the second locking mechanism embodiment.

FIG. 9 is a cross-sectional view taken along line 9—9 of FIG. 8 illustrating a bottom view of the second embodiment of the locking mechanism.

Turning now to the drawings, a dental articulator generally designated 10 is shown as basically comprising an upper frame 12 and a lower frame 14. Cast model teeth (not shown) are mounted between the upper frame 12 and lower frame 14 on mounts 16 and 18. Incisal pin guide 20 is positioned to stop the frames at the point where the cast model teeth meet. Mating hole 22 is provided to receive incisal pin guide 20. Provision is made for altering the operative makeup of pin guide 20, using a conventional interlocking slide clamp 24. Knob 26 is threaded and cooperates with clamp 24 to lock the device. Knob 30 is also provided to allow lateral adjustment of the pin guide 20. Knob 30 is threaded into the slide clamp 24 which when tightened becomes fixed to upper frame member 12.

The upper frame member 12 is supported in the back on two condyle posts 32. These posts are mounted to the lower frame member 14 and can be moved laterally by releasing knobs 35. In the way, each condyle post 32

may be positioned from the center of the articulator 10 a distance approximately equal to the distance of each hinge from the center of the patient's jaw. Located at the end of each condyle post 32 and rigidly fixed thereto are condyle balls 36. These condyle balls 36 are spherical and have pins 38 extending laterally outward and centered on an axis passing through the center of both condyle balls 36. Pins 38 are used for making the original adjustment of the position of the condyle posts 32 as procedurally described in the aforementioned Swanson patent, U.S. Pat. No. 3,206,852. The condyle posts 32 are designed to attach to the condyle balls 36 at a position offset toward the front of the articulator 10. This offset attachment is employed to avoid interference of the condyle post 32 with the upper frame 12 of the articulator when the frame 12 is rotated from the occludent position.

Each condyle ball 36 supports the upper frame 12 in a socket which is provided functionally with three sides. The condyle ball and socket arrangement form means for joining the upper and lower frames of the articulator. These joints are identical except that one is right handed and the other is left handed. Consequently, only the left-hand ball and socket joint as illustrated in FIGS. 3 through 9 will be described in detail. In the occludent position the mounting base 42 provides the posterior wall of the socket. The swivel mount 62 plus the angle member 40 provide the top wall of the socket, and member 40 provides the lateral wall. The angle member 40 is adjustable to allow a more accurate simulation of the various different patient's jaw mechanisms. The mounting base 42 is held fixed to the upper frame 12 by an extension 44 which protrudes upward into a slot 46. Extension 44 has a hole 48 to accommodate the threaded end 50 of a knob 52. Knob 52 may be tightened to draw the mounting base 42 against the upper frame member 12 to rigidly fix it in position over the condyle ball 36. A ridge 54 extends upward from the mounting base 42 along the back of frame member 12 to insure proper orientation of the mounting base 42 with respect to the frame member 12 and allow convenient reading of this position on scale 55. By insuring the positioning of the mounting base 42 on the upper frame 12 using the ridge 54 and knob 52, the socket assembly will be referenced to a plane parallel with the under surface or plane of the upper frame member 12. When the articulator is assembled and the condyle balls are in place in the mounting base as thus positioned, it will reflect the proper position for the upper set of cast model teeth to be mounted on the mount 16 on the upper frame member 12. In practice the cast model teeth are actually supported in proper position relative to the socket by relating them to the pins 38 on the two condyle balls which are in turn supported by the lower frame 14. Thus the proper spacial orientation and relationship is achieved among the cast model teeth, the upper frame 12, lower frame 14, mounting bases 42, swivel mounts 62, angle members 40 and condyle balls 36 in this the occludent position.

Means are provided for effecting a first degree of freedom for the socket about an axis normal to the plane of the upper frame member 12. One device for providing this degree of freedom includes a hole 56 located in the mounting base 42, a pin 58 located on hole 56, and a swivel mount 62 which is allowed to pivot about pin 58. The swivel mount 62 is caused to pivot about an axis coincident with an axis which passes

through the center of the condyle balls 36 when it is in the occludent position. This coincident relationship is achieved by having the pin 58 located at a normal distance from the surface 60 of the mounting base 42 which is equal to the radius of the condyle ball 36. The center line of hole 56 is normal to the mounting base 42 to cause the swivel mount 62 to pivot in the plane of the upper frame member 12. Reference mark 63 is positioned on the mounting base 42 at a convenient point. Markings are then placed on the swivel mount 62 as shown in FIG. 4. Conveniently, the zero mark will be located with the swivel mount 62 oriented so that the angle member 40 is positioned along a line perpendicular to a center line passing through both condyle balls 36. The remaining marks then indicate the degree of rotation of the swivel mount 62 relative to the mounting base 42 from the zero position.

Swivel mount 62 is held against mounting base 42 by set screw 64 and slot 66. The body of the swivel mount 62 is designed to fit into slot 66 with sufficient tolerance to allow free pivotal movement about pin 58. Set screw 64 is threaded into mounting base 42 and rides in slot 68 located on swivel mount 62. The slot 68 is slightly smaller than the collar 70 on set screw 64. By tightening set screw 64 into mounting base 42, the swivel mount 62 is restrained from rotating about pin 58. Swivel mount 62 has surface 71 which provides a bearing surface for condyle ball 36 when it is in the occludent position and this surface may be flat or slightly inclined. Slot 72 is provided to accommodate angle member 40.

Means are provided for effecting a second degree of freedom for the socket about an axis parallel to the plane of the upper frame member 12. To accomplish this, a mounting plate 74 is extended vertically from swivel mount 62.

A swivel 76 is located in mounting plate 74 so that the center line of swivel 76 passes through the center of condyle ball 36 when it is in the occludent position. This is accomplished by having the center line of swivel 76 located at a normal distance from surface 71 equal to the radius of the condyle ball 36. Swivel 76 is held in place by washer 78 and set screw 80. Swivel 76 is also pivotally located through angle member 40. A swivel head 82 is positioned in a countersunk portion of angle 40 to make the swivel flush with the vertical inner surface 84 of the angle member 40. Vertical surface 84 is perpendicular to surface 86 of the angle member 40 and is located at a normal distance from the center line of pin 58 equal to the radius of condyle ball 36. The normal distance from surface 86 to the center line of swivel 76 is also equal to the radius of the condyle ball 36.

Thus, a second axis is provided which is mounted on the first axis about which the swivel mount 62 pivots. This second axis allows depressions of the angle member 40 from the plane of the upper frame member 12. The angle through which angle member 40 is depressed may be measured by marking a convenient point 87 on the angle member 40. A scale indicating degrees of depression as shown in FIG. 4 may then be placed on the mounting plate 74. The orientation of the socket as provided by the angle member 40 may then be easily determined by referencing markers 63 and 87.

The condyle ball 36 in its most rearward or occludent position touches the mounting base 42 on surface 60, the swivel mount 62 on surface 71, the angle member

40 on surface 86 and the swivel 76 on head 82 which is flush with surface 84. These contacts define the occludent position of each condyle ball in its socket. Because of the orientation of the axes through pin 58 and swivel 76, displacement of angle member 40 does not effect this occludent position. Further, pin 58 is located perpendicular to the plane of the mounting bracket 74 which allows a rotation of swivel mount 62 without affecting the vertical disposition of the angle member 40. Also, the sockets for the two condyle balls 36 are the reverse of each other in order that surfaces 84 are each interior of the condyle balls 36. The interior orientation of these surfaces 84 acts to prevent slide movement of the upper frame 12 on the condyle balls 36. As a result, a condyle ball and socket arrangement is provided which presents an occludent position and at the same time allows two degrees of freedom for orientation of the socket about that fixed occludent position.

To lock the upper frame member 12 in the occludent position on the lower frame member 14, means are provided on the upper frame member 12 which engage pins 38 and allow only rotation of the upper frame member 12 and socket on the condyle balls 36. One device for accomplishing this function includes two locks 88 which are pivoted about screws 90. Each screw 90 is fixed into base mount 42 and is located behind both surfaces 60 and 71 in order that condyle balls 36 will be held against surfaces 60 and 71. Spring 92 is also located on screw 90 and acts to bias lock 88 against pin 38. Each lock 88 has a notch 94 for accommodating pin 38. Notch 94 has an outer locking surface which is approximately perpendicular to a line drawn through the centers of screw 90 and pin 38. This prevents a component of force which would cause lock 88 to rotate into an unlocked position. Locks 88 thus prevent the upper frame 12 from moving relative to the lower frame 14 in a manner which would cause angle member 40 to slide over condyle ball 36. However, upper frame 12 is allowed to rotate about a center line coincident with the center lines of pins 38.

When the upper frame 12 is rotated from the engagement position, each mounting base 42 will come into contact with condyle posts 32 on surfaces 96 and 98. A spring 100 is provided on post 102 and acts against upper frame 12 to lessen the impact of mounting base 42 on condyle posts 32 when the frame 12 is rotated from engagement. When it is desired to move the upper frame 12 into other positions where one or the other condyle balls 36 are not in contact with surface 60 of mounting 42, locks 88 can be pivoted from engagement with pins 36 by depressing lever 104 as shown in phantom in FIG. 3.

An alternate embodiment of the locking mechanism is illustrated in FIGS. 7 through 9. Two locks 106 are provided to lock the upper frame member 14 in the occludent position. One lock 106 cooperates with each pin 38 to fix the condyle balls 36 in their respective sockets. Each lock 106 is pivotally mounted to the mounting base 42 by a screw 108 and is spring loaded to rotate from engagement with the pin 38 by spring 110. The lock 106 includes a locking surface 112 which receives the pin 38. The locking surface 112 is angled with respect to the surface 71 in order that the upper frame 12 cannot move backward on the lower frame 14. The upper frame 12 is also precluded from moving forward by the interference of the condyle ball 36 with the surface 60. Because the condyle ball is constrained

to remain in the socket by the lock 106, the upper frame 12 can be rotated about the axis of the pins 38 to gain access to the teeth.

The lock 106 may be locked by means of knurled screw 114 which is threaded into the mounting base 42. The knurled screw 114 cooperates with slot 116 located on the lock 106 to fix the position on the lock 106. One side of the slot 116 excludes upward along the side of the mounting base 42 to form an extended end 118 of the lock 106. A scale 120 is provided on the mounting base 42 so that it may be adjacent the extended end 118. The scale may be established to reference the position of the lock 106 by means of a scribe mark or the end surface 122 of the extended end 118. The scale 120 may be established to provide indication of intermediate positions of the lock 106. By positioning the lock 106 in intermediate positions relative to the mounting base 42, lateral movement of the upper frame relative to the lower frame 14 may be allowed. Each mark in the scale 120 may therefore represent one millimeter of relative lateral movement of the upper and lower frames. Naturally, the relationship of the scale 120 to the lateral movement will vary with changes in the orientation of the sockets.

When it is desired that the upper frame 12 and the lower frame 14 be separated, the knurled screw 114 is released. This allows the lock 106 to disengage from the pin 38 and come to rest against the upper frame 12. The spring 110 is wound about the mounting screw 108. A first end 124 of the spring 110 is positioned in hole 126 located in the lock 106. A second end 128 of the spring 110 extends outward from the screw 108 to interfere with the upper frame 12. Thus, the spring can be made to force the lock 106 away from the condyle pin 38 to allow easy removal of the upper frame 12.

Thus, the dental articulator contemplated by this invention provides for an easy and simple means for retaining the upper frame 12 in a fixed pivotal relationship with the lower frame 14 using locks 88. Further, the dental articulator herein described provides a flexible, easily operated condyle ball and socket arrangement which provides a fixed base point or occludent position for the condyle ball 36 to rest relative to the upper frame 12 defined by surfaces 60 and 71 and swivel head 82.

Having fully described the invention as set forth in a preferred embodiment, it is to be understood that the invention is not limited to said embodiment, but rather is of the full scope of the appended claims.

I claim:

1. A dental articulator comprising:
 - a lower frame;
 - an upper frame;
 - a pair of condyle means positioned on said lower frame;
 - a pair of socket means for receiving each of said condyle means respectively, each of said socket means having three functional sides said first side being slidably mounted to said upper frame; means for constraining said first side to remain in a plane co-extensive with the plane of said first functional side associated with the second of said pair of socket means, said second and said third functional sides being mutually perpendicular; means for constraining said second and third functional sides to pivot relative to said upper frame about a first axis which is perpendicular to the plane of said upper frame

and about a second axis which pivots about the first axis with said second and said third sides of which is perpendicular to the first axis, each of said sets of three functional sides further defining an occludent position fixed relative to said upper frame for said condyle means.

2. The device is claim 1, wherein said dental articulator further comprises:

means for selectively constraining said upper frame to pivot about the fixed occludent position.

3. The device of claim 2, wherein said constraining means includes:

pins rigidly fixed to said condyle means, the center line of said pins being coincident with a center line passing through the occludent position associated with each socket means; and

two locking members pivotally mounted to said upper frame, said locking members including engaging means for pivotally locking said upper frame to said pins.

4. A dental articulator comprising:

a lower frame;

an upper frame;

a pair of condyle means positioned on said lower frame;

a pair of socket means for receiving each of said condyle means respectively, each of said socket means being defined by three functional sides, said first side being slidably mounted to said upper frame and being constrained to remain in a plane co-extensive with the plane of said first functional side associated with the second of said pair of socket means, said second and said third functional sides being mutually perpendicular and being constrained to pivot relative to said upper frame about a first axis which is perpendicular to the plane of said upper frame and about a second axis which pivots about the first axis with said second and said third sides and which is perpendicular to the first axis, each of said sets of three functional sides further defining an occludent position fixed relative to said upper frame for said condyle means wherein each of said socket means includes;

a back member slidably mounted on said upper frame, said back member having said first functional side;

an angle member having said second and said third functional sides; and

means for orienting said angle member with respect to said upper frame, said orientation means including a pivotal mount, said pivotal mount being pivotally located on said back member and having an access normal to the plane of the upper frame, a shaft, said shaft being fixed to said pivotal mount and having a center line which is perpendicular to and intersects the access of said pivotal mount, said angle member being pivotally mounted to said shaft.

5. A dental articulator comprising:

a lower frame,

an upper frame,

means for joining said upper frame and said lower frame whereby a fixed occludent position is provided between said upper frame and said lower frame, means for selectively altering the orientation of said joining means to permit relative displacements of said upper frame on said lower

frame about two axes, the first of said axis being perpendicular to the plane of said upper frame, and the second of said axes being perpendicular to said first axis, without disturbing the fixed occludent position, and means for selectively constraining said upper frame to pivot about the fixed occludent position.

6. The device of claim 5, wherein said constraining means includes:

pins rigidly fixed to said lower frame, said pins being centered on a center line passing through both joining means, and

two locking members pivotally mounted to said upper frame, said locking members being pivotally lockable to said pins.

7. The device of claim 5, wherein said means for joining said upper frame and said lower frame include a pair of condyle means and a pair of sockets, each of said sockets being positioned to accept one of said condyle means respectively, and including a back member fixed to said frame and an angle member attached to said back member by said orientation means.

8. A dental articulator comprising:

a lower frame,

an upper frame,

a means for joining said upper frame and said lower frame, whereby a fixed occludent position is provided between said upper frame and said lower frame,

a means for selectively altering the orientation of said joining means to permit relative displacements of said upper frame on said lower frame in a range of directions without disturbing the fixed occludent position, and

means for selectively constraining said upper frame to pivot about occludent position, wherein said orientation means includes;

a pair of pivotal mounts located on said back member and having a pair of first axes normal to the plane of said upper frame, and

a pair of swivels located on said first pivotal mounts respectively, and having second axes perpendicular to said pivotal mounts respectively, each of said angle members being pivotally mounted to one of said swivels respectively.

9. A dental articulator having a lower frame,

an upper frame,

and means for joining the upper and lower frames whereby a fixed occludent position is provided between the upper and lower frames, wherein the improvement comprises:

means for selectively altering the orientation of each socket to permit relative displacement of the upper frame on the lower frame about two axes, the first of said axes being perpendicular to the plane of said upper frame, and the second of said axes being perpendicular to said first axes, without disturbing the fixed occludent position, and

means for selectively constraining the upper frame to pivot about the fixed occludent position.

10. A dental articulator comprising:

a lower frame,

an upper frame,

a pair of spherical condyle balls mounted to said lower frame,

a pair of pins, each one of said pair of pins being rigidly fixed to said spherical condyle balls respec-

tively, said pins being oriented to have center lines coincident with a line passing through the centers of both of said condyle spheres,

- a pair of hooks pivotally mounted to said upper frame, each one of said hooks being associated with one of said pins respectively to selectively constrain said upper frame to rotate about a line passing through the centers of said spherical condyle balls, and
- a pair of sockets mounted on said upper frame to cooperate with said spherical condyle balls, said sockets being left and right handed respectively, each of said sockets comprising, a back member fixed to said frame, said back member having a surface which receives said condyle ball, a swivel mount pivotally mounted to said back member and having a first axis normal to the plane of said upper frame, a mounting plate fixed to said swivel mount and perpendicular thereto, an angle member pivotally fixed to said mounting plate about a second axis perpendicular to the first axis, said angle member having two interior surfaces for receiving said condyle ball, said two interior surfaces being mutually perpendicular and being constrained by the first and the second axes to remain tangential to said spherical condyle ball when said spherical condyle ball is positioned against said surface of said back member.

11. A condyle ball and socket joint comprising:
a pair of condyle balls;

a pair of sockets capable of receiving said condyle balls; said sockets being left and right handed respectively, each of said sockets comprising, a mounting base, said mounting base having a first surface to receive said condyle ball, a swivel mount, said swivel mount being pivotally mounted to said mounting base about a first axis which is parallel to said first surface, said swivel mount having a second surface to receive said condyle ball, an angle member, said angle member being pivotally mounted to said swivel mount about a second axis perpendicular to said first axis, said angle member having a third and fourth surface to receive said condyle ball; said first, second, third and fourth surfaces forming a fixed position for said condyle ball irrespective of the positions of said swivel mount and said angle member about the first and second axis;

a pair of pins, each one of said pins being rigidly fixed to one of said condyle balls; and

locks fixed relative to said sockets, said locks being capable of engaging said pins to retain said condyle balls fixed relative to the fixed position formed by said first, second, third and fourth surfaces.

12. The device of claim 11 wherein said locks can be selectively positioned to give specific degrees of movement of each said condyle ball relative to each said socket.

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