

United States Patent

McVickers et al.

[15] 3,686,757

[45] Aug. 29, 1972

[54] **CONSTANT TENSION ORTHODONTIC APPLIANCE**

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[22] Filed: **Dec. 9, 1970**

[21] Appl. No.: **96,394**

[52] U.S. Cl. **32/14 D**

[51] Int. Cl. **A61c 7/00**

[58] Field of Search **32/14 A, 14 D**

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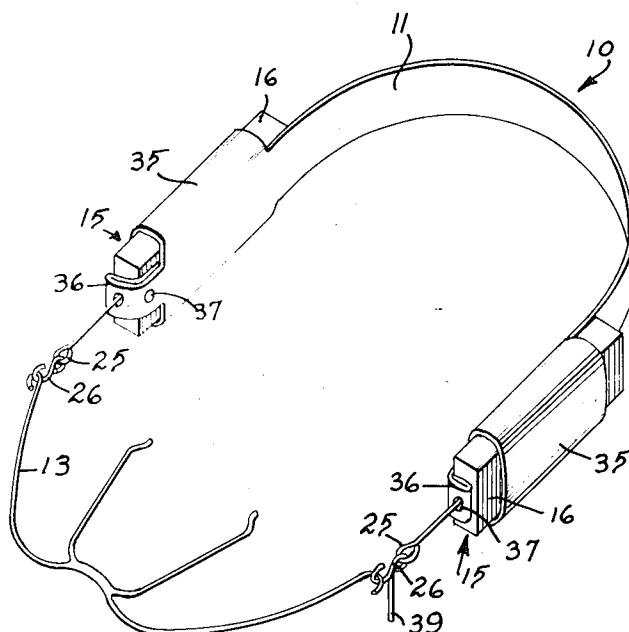
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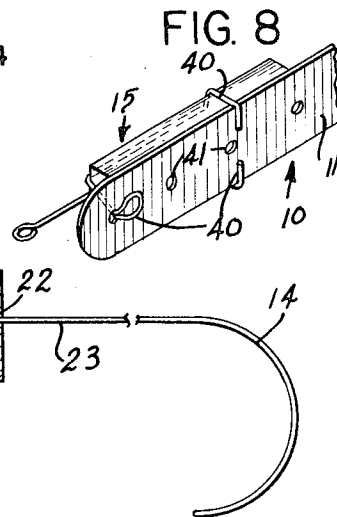
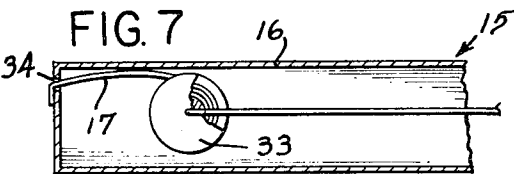
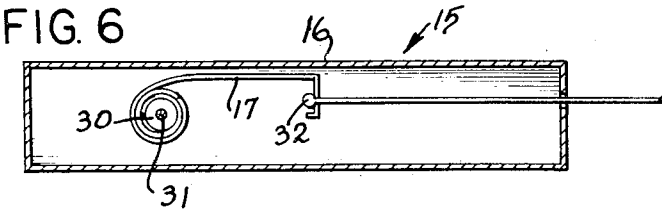
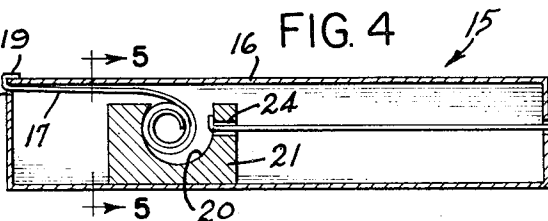
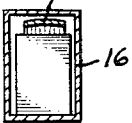
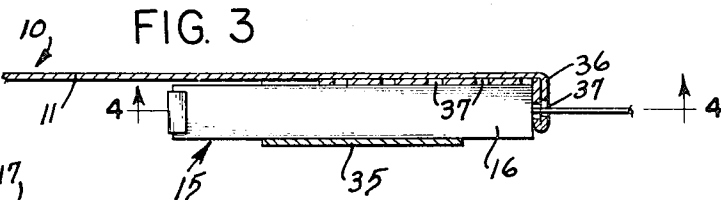
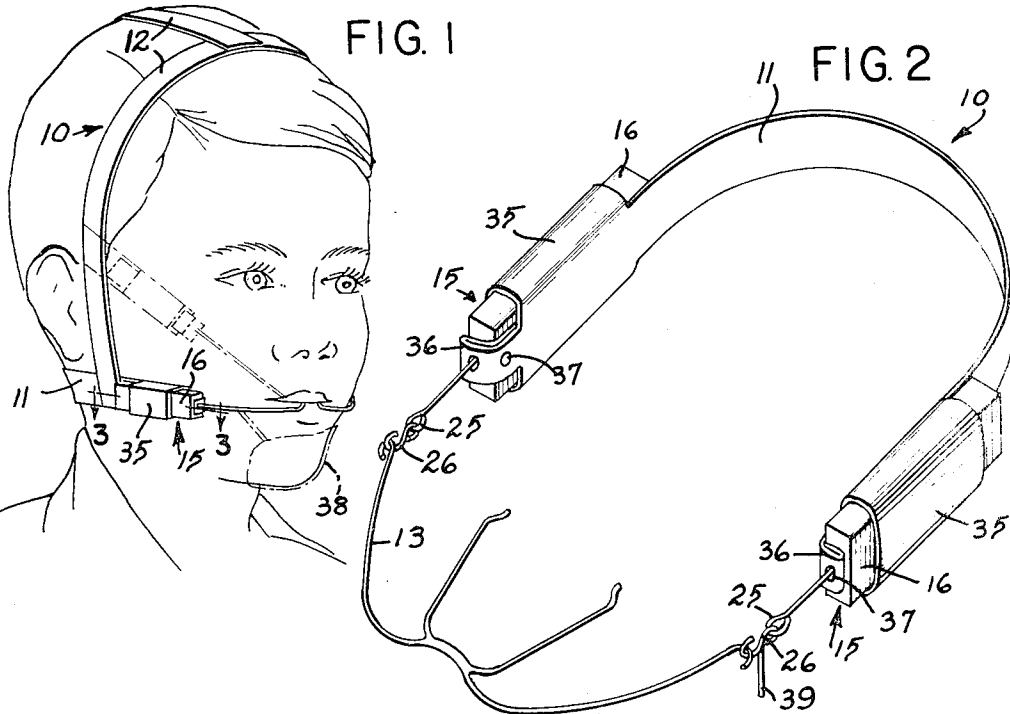
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[57] **ABSTRACT**

Apparatus to aid in the orthodontic or orthopedic correction of dental-facial malformations. The apparatus includes a harness connected to an orthodontic or orthopedic appliance and applies a predetermined constant force in a prescribed direction. The force applied to the appliance is substantially constant regardless of the vertical and lateral movement of the head of the wearer relative to the harness or as the desired displacement of the dental-facial structures occur.

7 Claims, 8 Drawing Figures





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CONSTANT TENSION ORTHODONTIC APPLIANCE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to surgical and dental appliances used to correct structural bone defects and relates particularly to an orthodontic appliance for aligning or realigning dental-facial structures relative to the structure of the upper or lower jaws.

2. Description of the Prior Art

Many people have been, and will continue to be, born with slight deformities of the oral cavity or mouth, particularly where teeth are too large or the jaws are not sufficiently large to accommodate the number of teeth that a person grows in his lifetime. The result has been that the teeth have been crowded together and misshapen which has detracted from the appearance of the person, has prevented proper cleaning and treatment, has induced cavities, has produced poor interaction between upper and lower teeth, and has produced many physical and emotional problems.

Heretofore some efforts have been made to align the teeth, particularly during the formative years of a person, by fabricating appliances to properly position the teeth relative to each other and their supporting structures by controlling the direction of growth and tooth alignment. In some instances it has been necessary to remove certain of the teeth to accommodate the movement required to attain proper alignment of the remaining teeth.

Certain appliances have required the application of extraoral forces to certain pressure points on the jaws or within the mouth of the user. These forces have been applied in predetermined directions, usually through the application of a head gear, or harness, which could be worn intermittently, usually while a person was sleeping or while spending time at home out of the public view. The force has been obtained from resilient members including rubber bands, elastic straps, or coiled springs, and has been transmitted to the appliance through the use of J-hooks, a chin cup, or a face bow. The required magnitude of the force has been obtained by various means which adjusted the preload in the elastic members. These adjustments have had to be performed by the orthodontist with the device in place on the patient, with corresponding demands upon the time of both. The adjustment procedure has been complicated since the vertical and lateral positions of the head have affected the extension of the elastic member, with a resulting effect upon the magnitude of the force. Normal movements of the patient's head while wearing the device have likewise resulted in varying force magnitudes which have imposed painful constraints upon the patient's freedom of movement.

In a similar manner, the desired movement of the dental-facial structures as they have responded to treatment has resulted in a decrease in the applied force as the elastic members have relaxed in taking up the slack. This has resulted in the need for visits to the orthodontist's office for adjustments of the elastic, frequently as often as every three weeks, with subsequent demands upon their time.

In many cases the movement of the dental-facial structures have been slight. However, the tendency of

many of the elastic materials to relax their force after a period of continual stress has likewise resulted in the necessity of frequent adjustments to restore the force to the desired level. The patient often adapts to the reduced force experienced between adjustments, and later experiences pain and discomfort as the required force is restored by an adjustment.

Uncooperative patients have adjusted certain of these devices themselves to relax the force to a level which was not beneficial to their treatment. This unknown variable has been a severe handicap to the orthodontist as he has attempted to diagnose the reasons for their lack of response to treatment.

Many of these devices have also proven to be unsanitary, and for other reasons have not been satisfactory.

SUMMARY OF THE INVENTION

The present invention is an orthodontic appliance including a harness fitted to the head or neck of a person and connected to conventional J-hooks, face bow or chin cup by a force-applying negator extension member adapted to apply a constant predetermined force to the corrective appliance at all times including when the head of the wearer is moved either from side to side or up and down and as the desired movement of the dental-facial structure occurs, and in which a prescribed force can be applied and such force will remain constant throughout the life of the apparatus without adjustments of any kind.

It is an object of the invention to provide an orthodontic or orthopedic appliance for correcting dental-facial abnormalities which can be used intermittently, and when used, which will apply a constant force to the corrective appliance regardless of movement of the head in any direction or as the dental-facial structure moves in response to the treatment.

It is another object of the invention to provide an orthodontic appliance which will exert a constant force of a prescribed magnitude for the life of the apparatus, which can be fabricated without the patient being present, which will not respond to attempted adjustments by the patient, and which may be easily fitted to patients of various size and age groups.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective illustrating one application of the invention as applied to a person.

FIG. 2 is a perspective of an appliance per se.

FIG. 3 is an enlarged section on the line 3—3 of FIG. 1.

FIG. 4 is an enlarged section on the line 4—4 of FIG. 3.

FIG. 5 is a section on the line 5—5 of FIG. 4.

FIG. 6 is a section similar to FIG. 4 of a modified form of the invention.

FIG. 7 is a section similar to FIG. 4 of a further modified form of the invention.

FIG. 8 is a perspective of the appliance showing a modified mounting means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With continued reference to the drawing, a harness or anchor 10 is provided including a neck band 11

which may be used by itself, as illustrated in FIG. 2, or may be connected to one or more head bands 12, as illustrated in FIG. 1. The harness 10 is of conventional construction and is arranged to provide a force in a prescribed direction depending upon the situation and the requirements of a specific individual. The harness illustrated in full lines in FIG. 1 normally is used for a straight rearward pressure on either the upper or lower teeth, while the structure shown in phantom in FIG. 1 is used to apply an upward and rearward pressure on the upper teeth. The neck band 11, illustrated in FIG. 2, normally would be placed slightly lower than the neck band in FIG. 1 to apply a rearward and downward pressure on the teeth of the lower jaw.

The neck band 11, whether used independently or in combination with the head bands 12, preferably is adjustable to accommodate persons of different sizes and ages although, if desired, such neck band could be of fixed length with a plurality of different lengths being provided to accommodate different head sizes. A conventional face bow 13 (FIG. 2) or a pair of J-hooks 14 (FIG. 4) normally are adjustably attached to the harness 10 and such face bow or J-hooks are removably attached to an appliance fixed to the teeth in such a manner that the appliance will be worn continuously while the harness normally is applied intermittently for a specified period of time each day, usually while the person is sleeping. Also shown in phantom in FIG. 1 is a conventional chin cup 38 used in the correction of certain abnormalities of the facial structure.

In order to connect the face bow 13, J-hooks 14 or chin cup 38 to the harness 10 so that a predetermined constant force is applied to both sides of the appliance at all times regardless of relative movement between the head of the user and the harness 10, or as the structures being corrected move in response to treatment, a constant tension device 15 is provided having a housing 16 in which a constant tension negator extension member 17 is mounted. The negator extension member is a coil of approximately one-half inch diameter of flat, flexible high-carbon spring steel or stainless steel having a thickness on the order of .003 inches and a width on the order of 0.250 inches, although these dimensions may vary along with the diameter of the coil and the properties of the material being used to obtain the various constant forces desired.

The negator extension member is characterized by properties which permit it to exert a constant force through a theoretically infinite deflection. This property exists since each incremental length of the negator has an inherent natural radius of curvature equal to the approximate radius of the coil. As the negator is pulled in an action which tends to uncoil it, the radius of curvature is forced to become infinite, that is, the material is pulled out straight. Each subsequent increment of movement will straighten out a like increment of material, requiring that a given increment of work be expended to straighten out the increment of material against its natural tendency to remain coiled. This amount of work is independent of the amount of material previously pulled from the coil, and thus the negator exerts a constant pull against a force which tends to unwind its coil.

As illustrated in FIG. 4, the free end of the negator extension member 17 extends through an opening 18 at

one end of the housing 16 and the free end is bent back upon itself to form a hook 19 which engages one surface of the housing 16. The coil of the negator extension member is received within a cavity 20 of a slide member 21 which can move lengthwise within the housing 16. The end of the housing remote from the hook 19 has an opening 22 through which an operating rod or wire 23 is freely movable. The inner end of the operating rod extends through an opening 24 in the slide member 21 and into the cavity 20 where the end of the operating rod is upset or bent over to anchor the end of such rod. It is contemplated that the slide member 21 could be omitted and the end of the operating rod bent into the shape of the slide member forming a contiguous element which would serve the function of both slide member and operating rod.

The operating rod 23 may constitute one end of a J-hook 14, as illustrated in FIG. 4, or, as illustrated in FIG. 2, the operating rod may terminate in an eye 25 which is connected to an S-hook 26 which in turn is connected to the face bow 13. When the operating rod 23 is moved to the right, as illustrated in FIG. 4, the slide member 21 also will be moved to the right and the negator extension member 17 will be extended from the coil. When the pull on the operating rod is relieved, the predetermined tension of the negator extension member will return the slide member 21 to the left.

With reference to FIG. 6, a modified form of the tension-applying member is provided in which the negator extension member 17 is coiled about a drum 30 which is freely rotatably mounted on a shaft 31 supported by opposite sides of the housing 16, as illustrated, or to the harness 10 or the face bow 13 (not shown). In this modification the free end of the negator extension member 17 extends in the reverse direction from the modification shown in FIG. 4 and the hook 19 at the free end of the negator extension member is provided with an opening 32 for the reception of the operating rod 23. It will be apparent that an outward pull on the operating rod will apply a direct force to the negator extension member 17 and cause such member to be unwound from the coil.

With reference to FIG. 7, a further modified form is provided in which the negator extension member 17 is mounted on a reel 33 which is freely movable lengthwise of the housing 16. In this modification the free end of the negator extension member 17 extends rearwardly and passes through an opening 34 in the rear wall of the housing 16 and the free end is bent downwardly to anchor the negator extension member 17 to such rear wall. The inner end of the operating rod 23 rotatably supports the reel 33 so that when an outward pull is applied to the operating rod, the reel will move through the housing and uncoil the negator extension member from such reel.

In order to mount the housing 16 on the neck band 11, a loop 35 which may be of any desired material is attached to opposite ends of the neck band and such loop is of a size to slidably receive the housing 16. To prevent longitudinal movement of the housing, a tab or flap 36 is connected to the end of the neck band and extends outwardly beyond the loop 35. The tab 36 has at least one opening 37 arranged so that when the tab is bent to a position overlying the end of the housing the opening 37 will be generally in alignment with the

opening 22 through which the operating rod 23 extends. In this position the operating rod will extend through the opening 37 and the tab will prevent forward movement of such housing.

As illustrated in FIGS. 2 and 3, the apparatus for mounting the housing on the harness may be adjustable by providing an elongated tab 36 having a plurality of openings 37 generally along the center of the same. With this construction the tab 36 can be bent back upon itself preferably with two adjacent openings 37 in alignment with each other and in alignment with the opening 22 in the end of the housing 16. To adjust the position of the housing relative to the tab 36, it is necessary only to remove the operating rod from the openings 37, align any two adjacent openings and then extend the operating rod through such aligned openings.

An alternative means of adjustably mounting the housing on the harness is illustrated in FIG. 8. Instead of the loop 35 and tab 36, the harness 10 has a plurality of openings 41 through which is threaded a retainer 40 which grasps the constant tension device 15. Adjustment is obtained by selecting the proper opening 41 and threading the retainer through it. The constant tension device 15 is then placed within the retainer 40.

In the operation of the device, the desired harness 10 is selected in accordance with the desired function which the harness is to serve. Thereafter a prescribed tension-applying member 15, having a negator extension member 17 with the required tension, is mounted on the harness at each side of the person's head. Normally the prescribed tension will be equal on each side, but in cases where a rotation is desired, they may be unequal.

When the device is to be used with a face bow 13, the operating rod of the tension-applying members is provided with an eye 25 which can be connected by the S-hook 26 to opposite ends of the face bow. A handle 39 on the eye 25, or the S-hook 26, may be provided to aid in this manipulation. When the device is to be used with J-hooks, the operating rod may be connected by the S-hooks to J-hooks or the J-hooks may be integrally fixed to the operating rod. Preferably the operating rod 23 is extended so that a portion of the negator extension member is uncoiled when the face bow or J-hooks are secured to the corrective appliance. In this position the movement of the head toward one side will cause the negator extension member to be recoiled on that side and the negator extension member on the opposite side will be extended. However, the tension applied by the negator extension members on both sides will remain constant. When the head is moved so that a person is facing upwardly, both negator extension members will be extended simultaneously without changing the applied tension. Conversely, when the head is moved to face downwardly, both negator extension members will be retracted again without altering the tension. Similarly, as the dental-facial features move in response

to treatment, the negator extension members will recoil without changing the applied tension.

With the present apparatus an orthodontist can prescribe a predetermined tension in a predetermined direction and the apparatus can be fabricated without the need for the presence of the patient. The force applied by the apparatus is constant and cannot be adjusted by the patient.

We claim:

1. In an orthodontic appliance having a harness for mounting on the head of a patient and a corrective tractive apparatus applied to a selected portion of the dental-facial frame of the patient, the improvement comprising a constant-force negator extension member located on each side of the patient's head, each of said members including a coil having an outer end, said coil having properties which permit it to exert a constant force when in use, means for supporting said coil, means connecting said outer end to one of said harness and apparatus, and means connecting said coil supporting means to the other of said harness and apparatus.

2. The structure of claim 1 in which said means for supporting said coil includes a housing, said coil being mounted within said housing.

3. The structure of claim 2 including a slide member slidably mounted within said housing, said slide member having a cavity for receiving said coil, said means connecting said outer end of said coil to one of said harness and apparatus including an operating rod means, and means for connecting said operating rod means to said slide member.

4. The structure of claim 2 including a drum rotatably mounted within said housing, and said coil being mounted on said drum.

5. The structure of claim 2 in which said means for supporting said coil includes reel means freely carried within said housing.

6. An orthodontic appliance for applying a predetermined constant tension to a selected portion of a dental-facial frame of a patient comprising a harness for mounting on the upper portion of the patient, a corrective tractive apparatus selectively applied to the dental-facial frame of the patient, constant-force means connected to said harness at each side of the patient's head, said constant-force means including a housing, a negator extension member mounted within said housing, said negator extension member including a coil formed to a predetermined radius of curvature and having properties which permit it to exert a constant force at all times, operating rod means connected to said corrective tractive apparatus and extending into said housing, and means connecting one end of said operating rod means to said negator extension member for extending and retracting said coil in response to relative movement between said harness and said apparatus.

7. The structure of claim 6 in which said constant force means is adjustably connected to said harness.

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