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Brando

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(54) **DRUMHEAD TENSIONING DEVICE AND METHOD**

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Related U.S. Application Data

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(51) **Int. Cl.**[7] **G10D 13/08**

(52) **U.S. Cl.** .... **84/411 R**; 84/454; 84/419

(58) **Field of Search** .... 84/454, 458, 411 R, 84/419, 413

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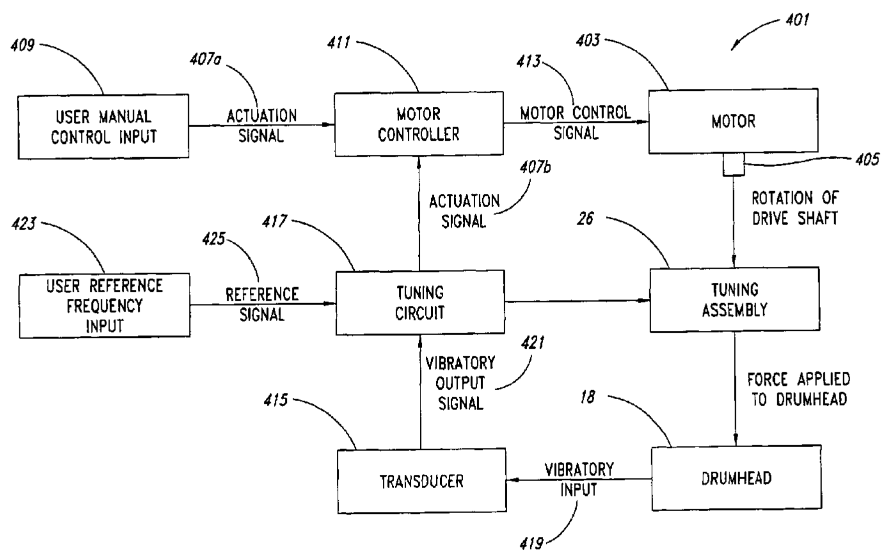
(57) **ABSTRACT**

In a tunable drum, a connector member in the drum is attached by linkages to a tuning ring, and is threadedly coupled by a tuning linkage to a retaining member fixed to the drum. Rotation of the tuning linkage with respect to the drum moves the connector member longitudinally and, as a result, adjusts the tension of the drumhead. In one embodiment, a motor is coupled to the tuning linkage such that an operator can manually adjust the tuning via a motor. In another embodiment, a transducer and tuning circuit can automatically provide control signals to the motor based on a difference between a desired frequency and a determined frequency.

29 Claims, 14 Drawing Sheets



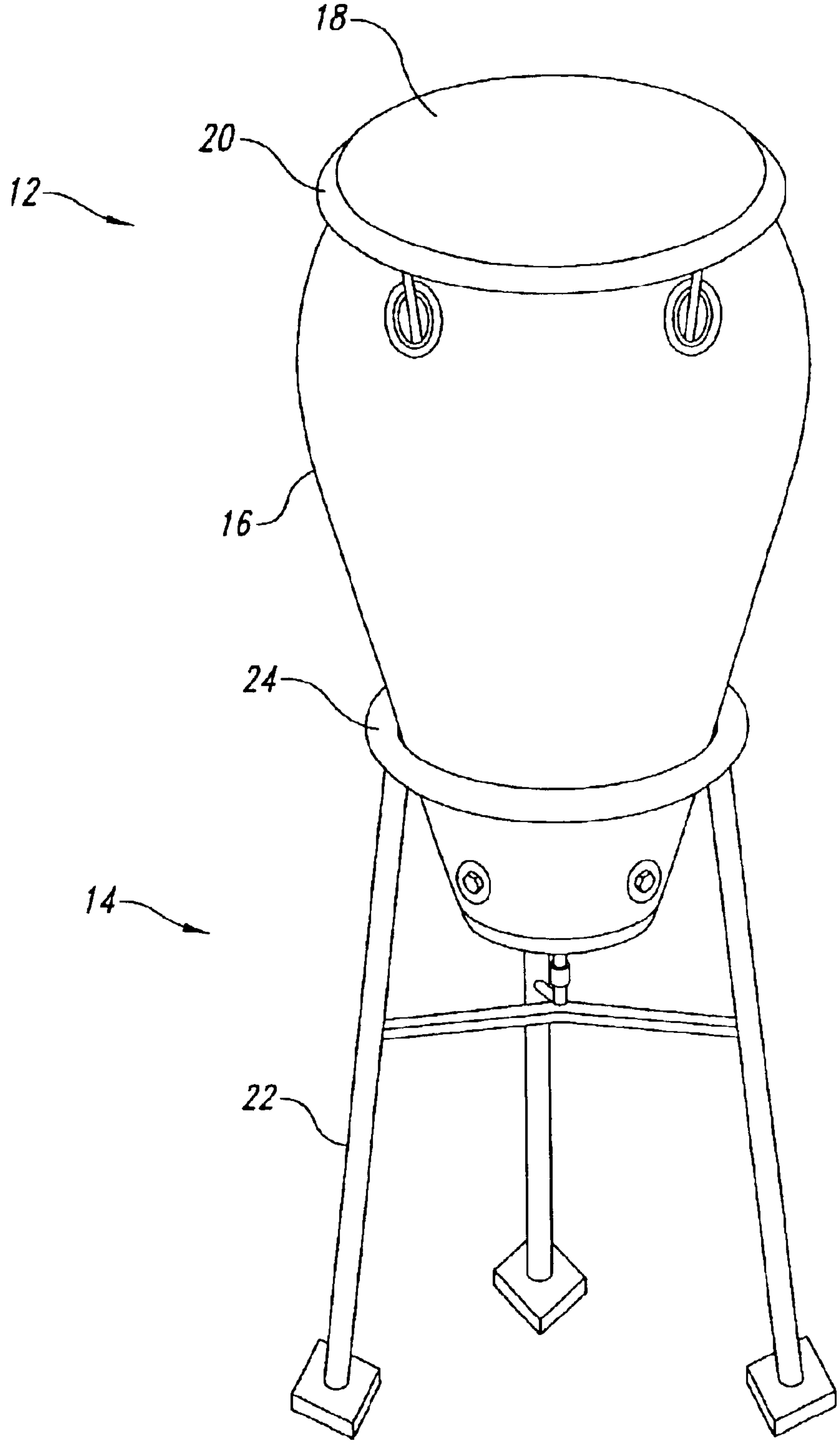


Fig. 1

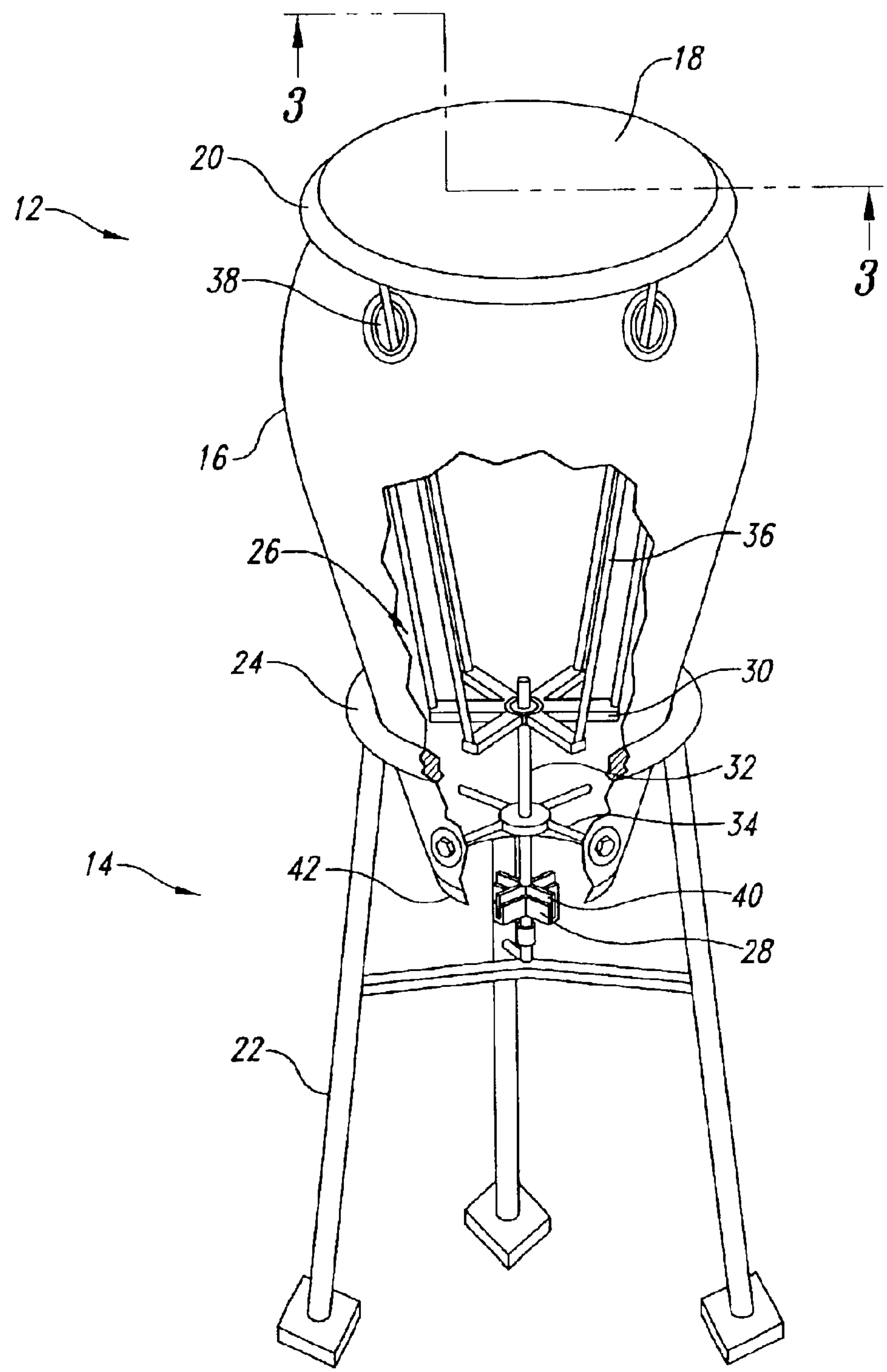


Fig. 2

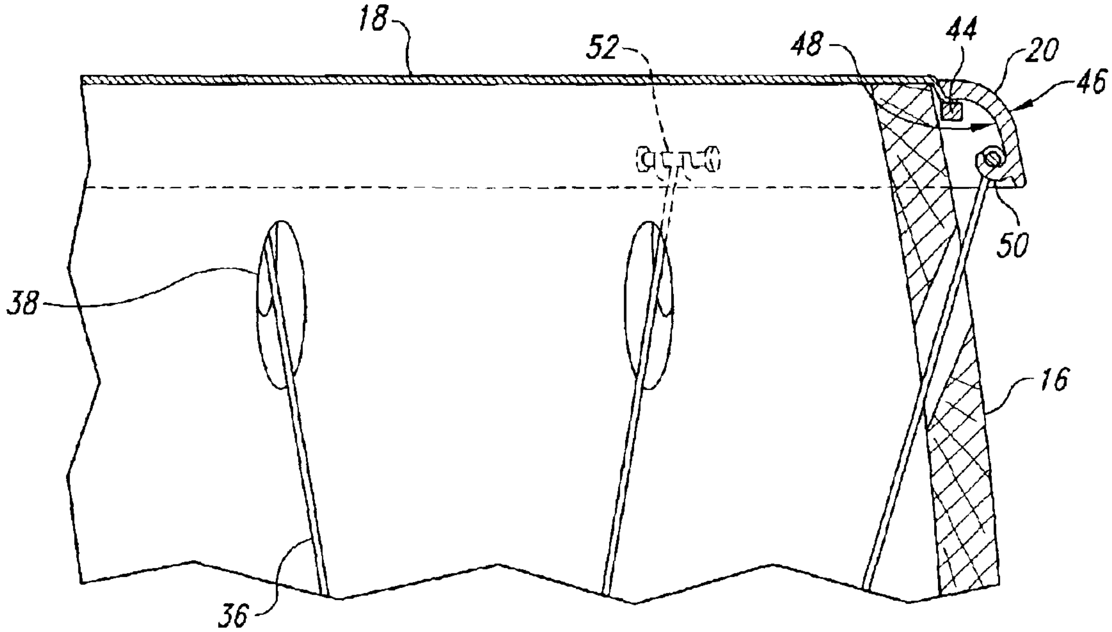


Fig. 3

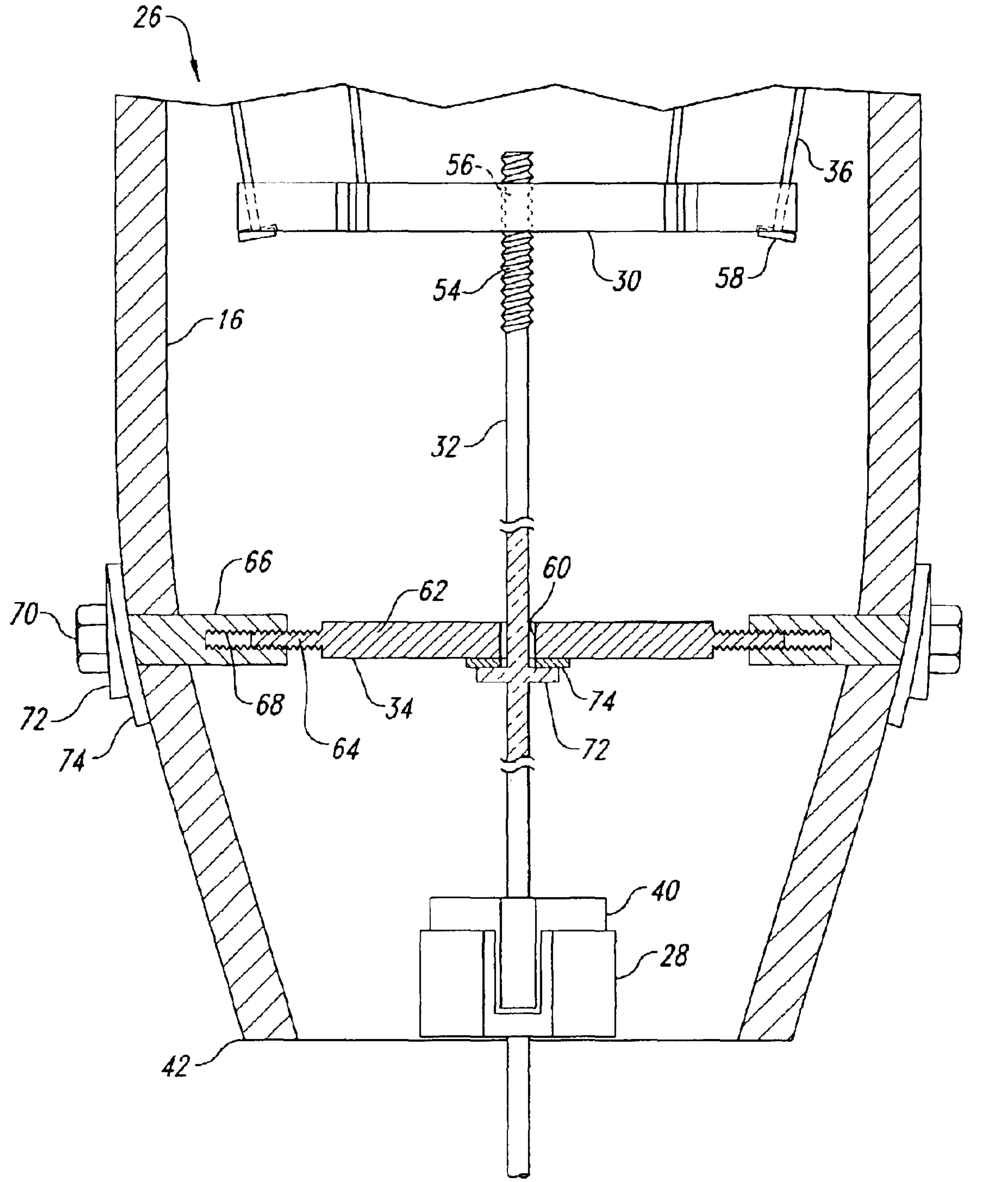


Fig. 4

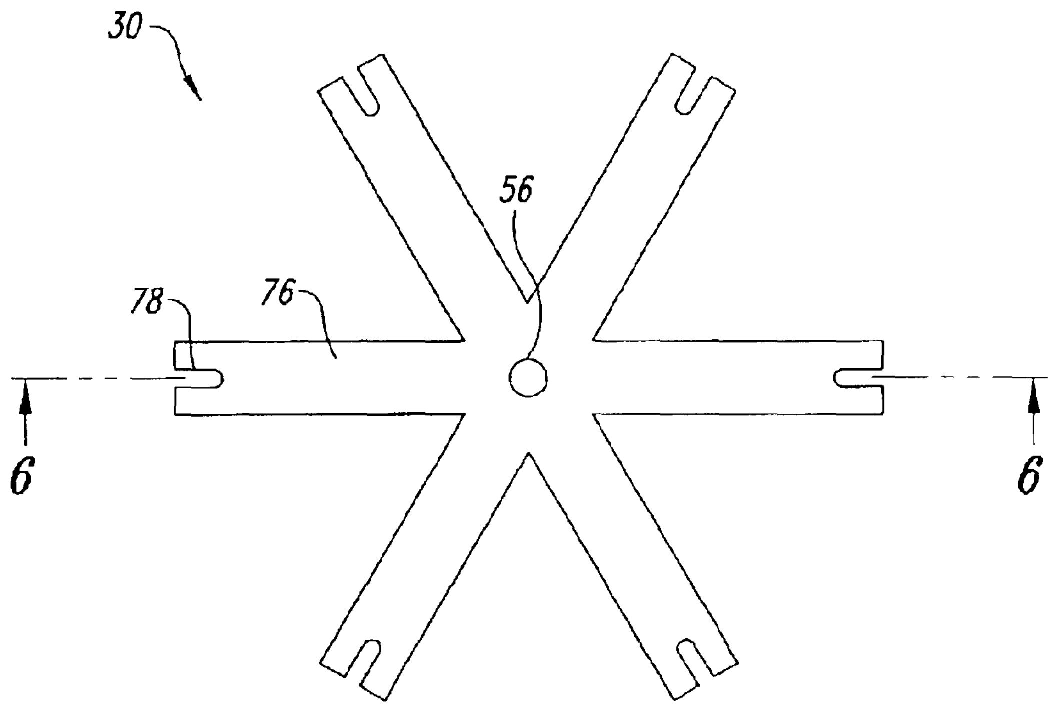


Fig. 5

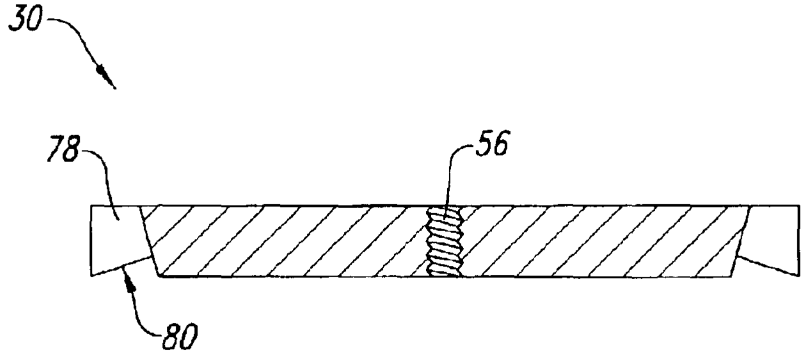


Fig. 6

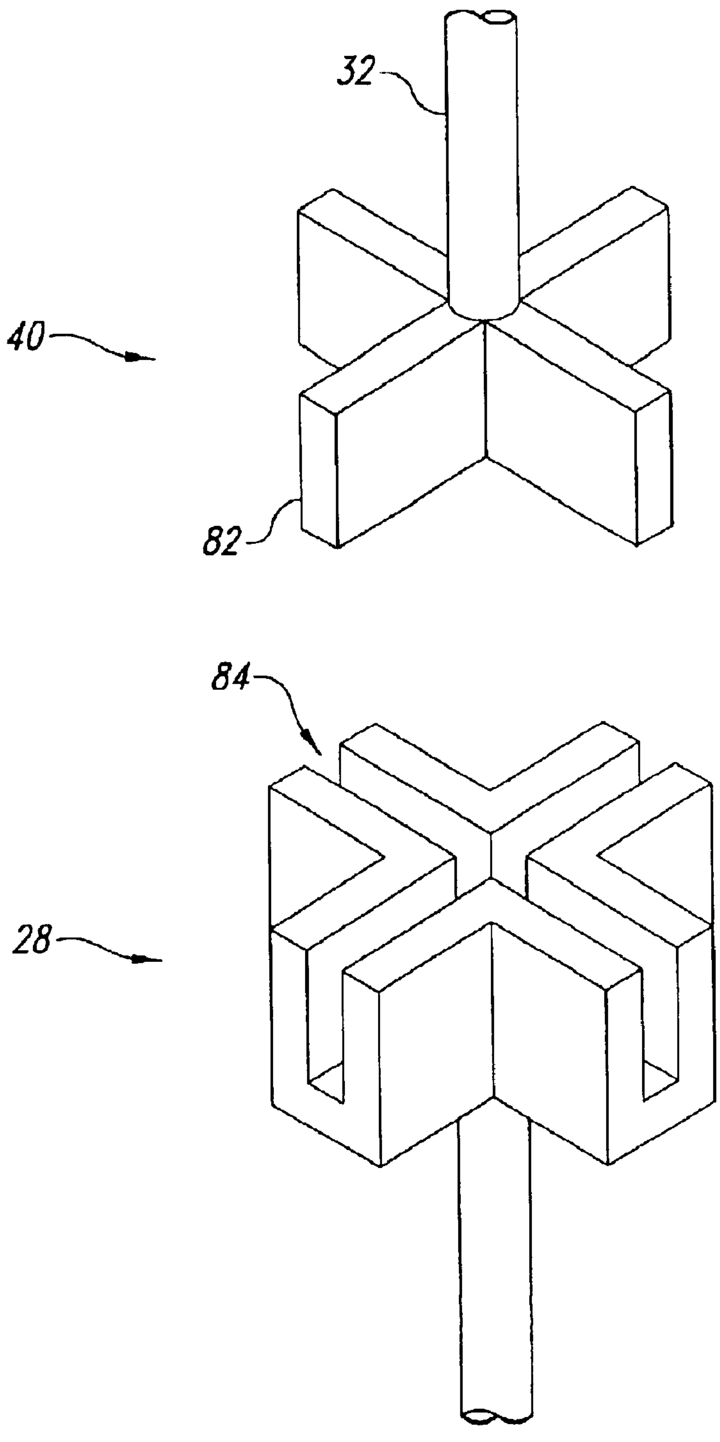


Fig. 7

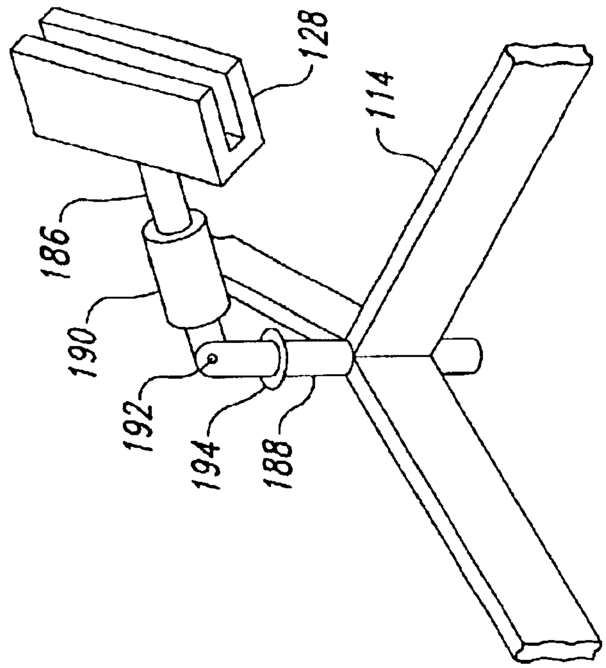


Fig. 9

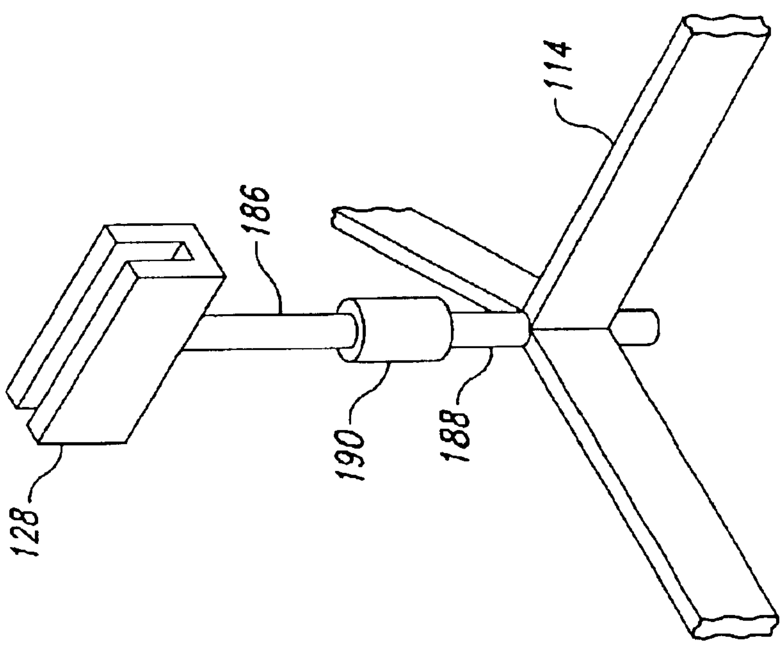


Fig. 8

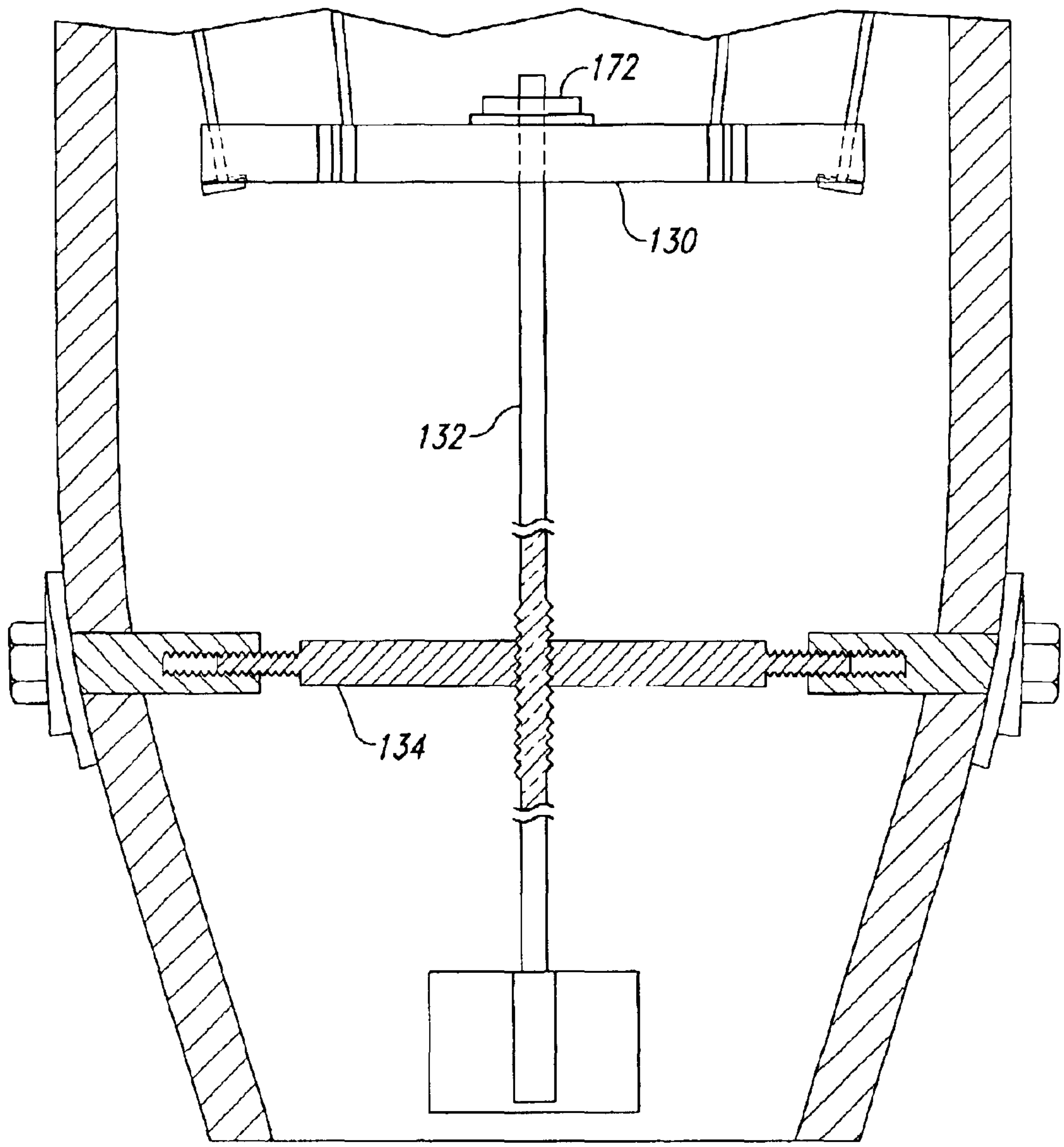


Fig. 10

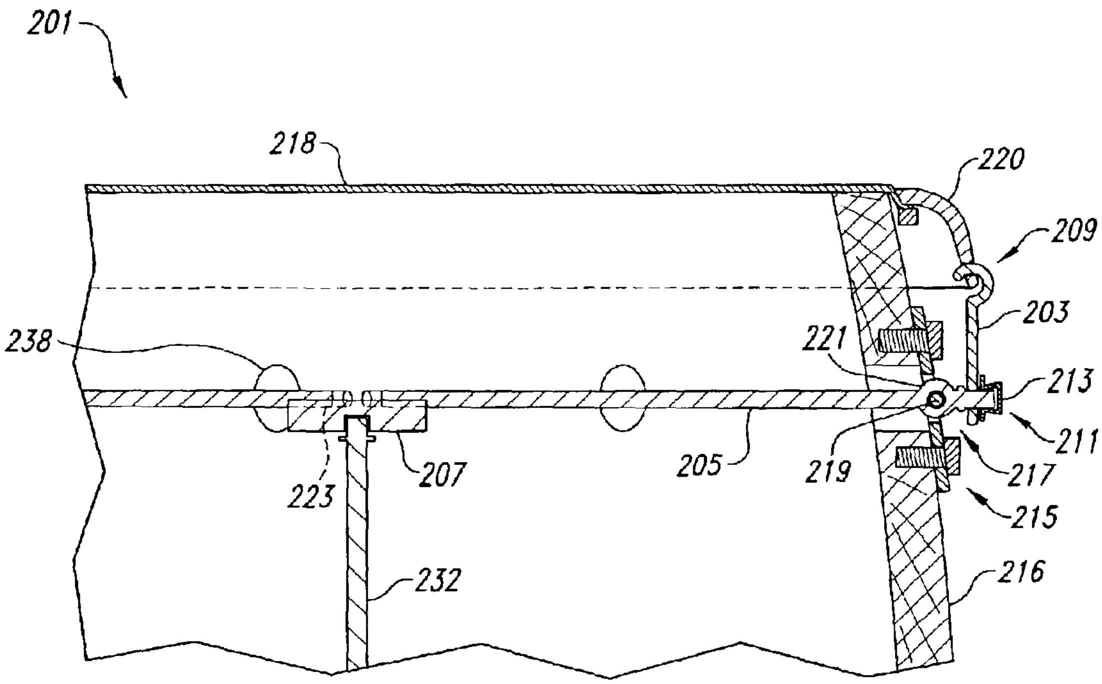

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Fig. 11

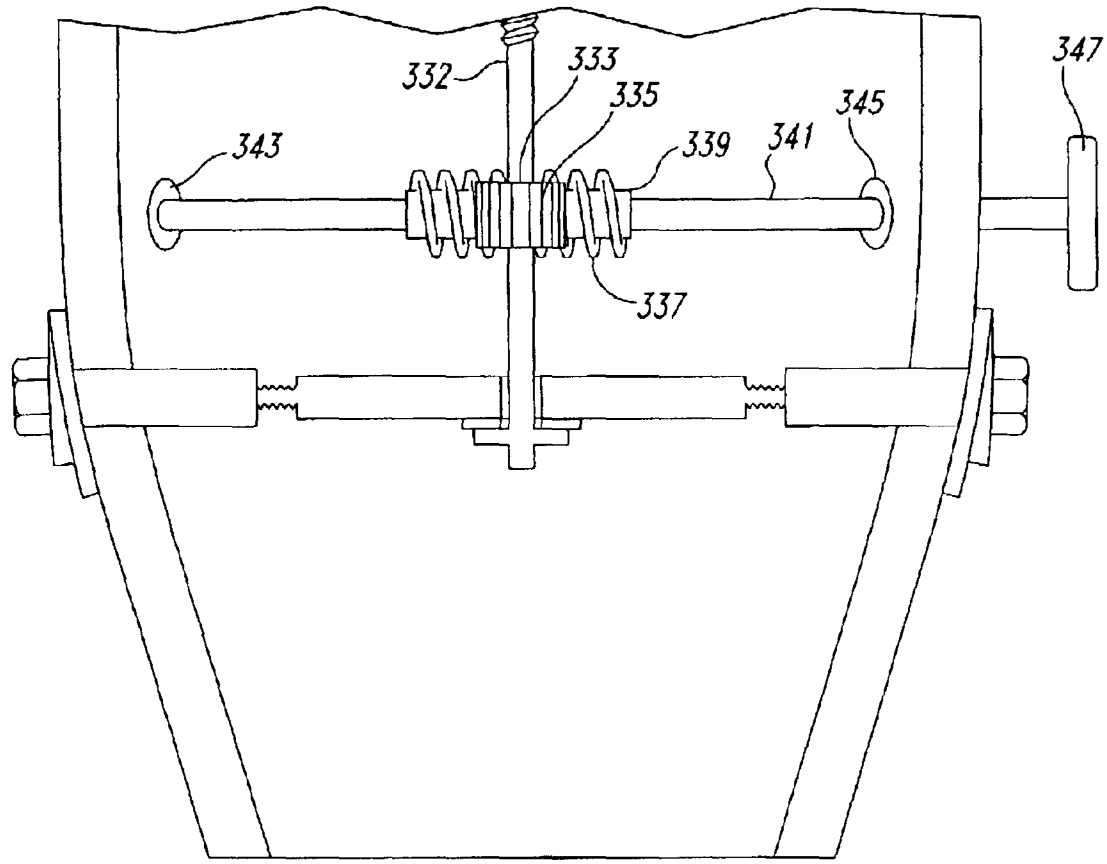

Fig. 12

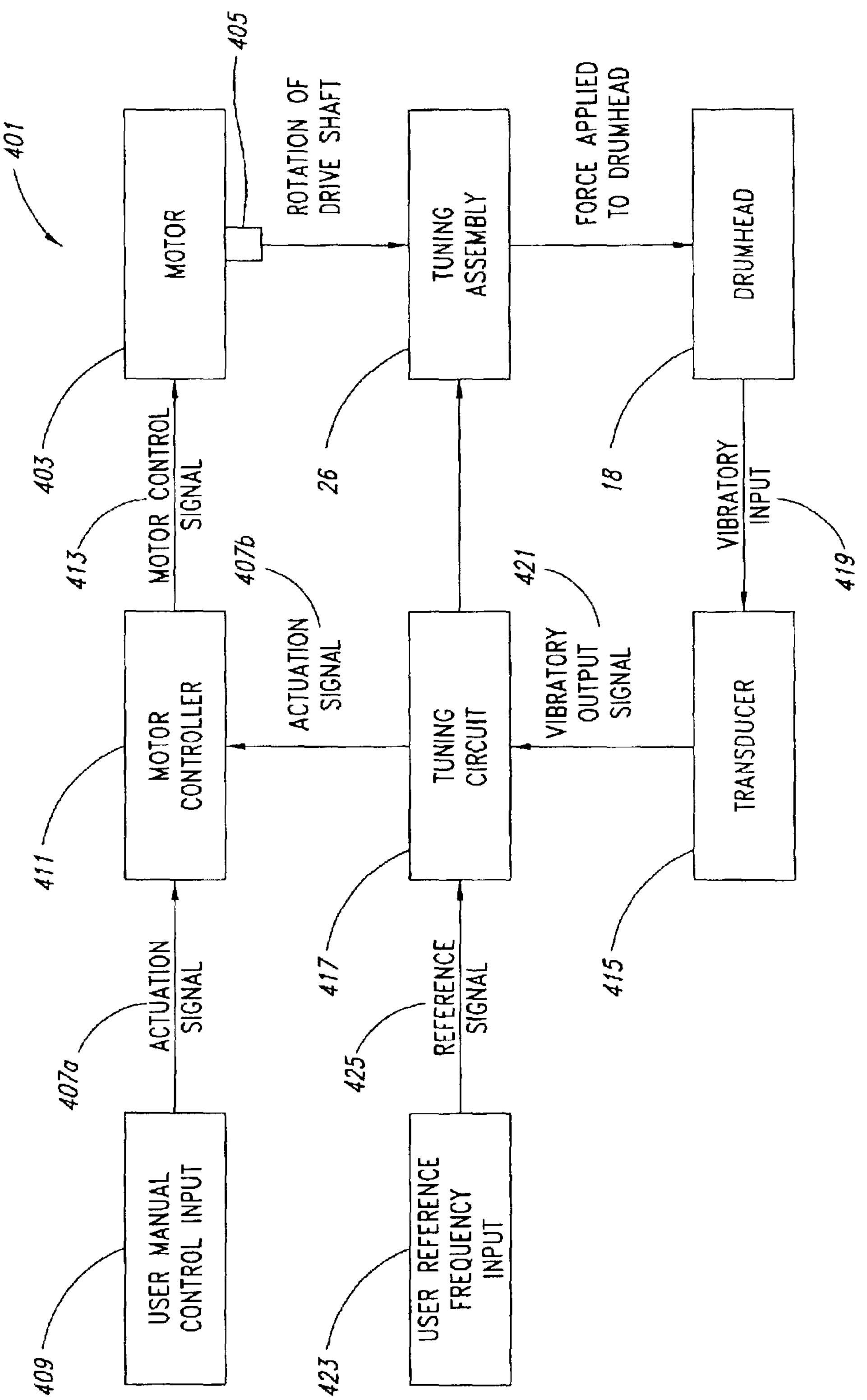
401
405
MOTOR
ROTATION OF DRIVE SHAFT
TUNING ASSEMBLY
FORCE APPLIED TO DRUMHEAD
DRUMHEAD
403
26
18
413
MOTOR CONTROL SIGNAL
407b
421
VIBRATORY INPUT
419
ACTUATION SIGNAL
VIBRATORY OUTPUT SIGNAL
MOTOR CONTROLLER
TUNING CIRCUIT
TRANSDUCER
411
417
415
407a
ACTUATION SIGNAL
425
REFERENCE SIGNAL
USER MANUAL CONTROL INPUT
USER REFERENCE FREQUENCY INPUT
409
423

Fig. 13

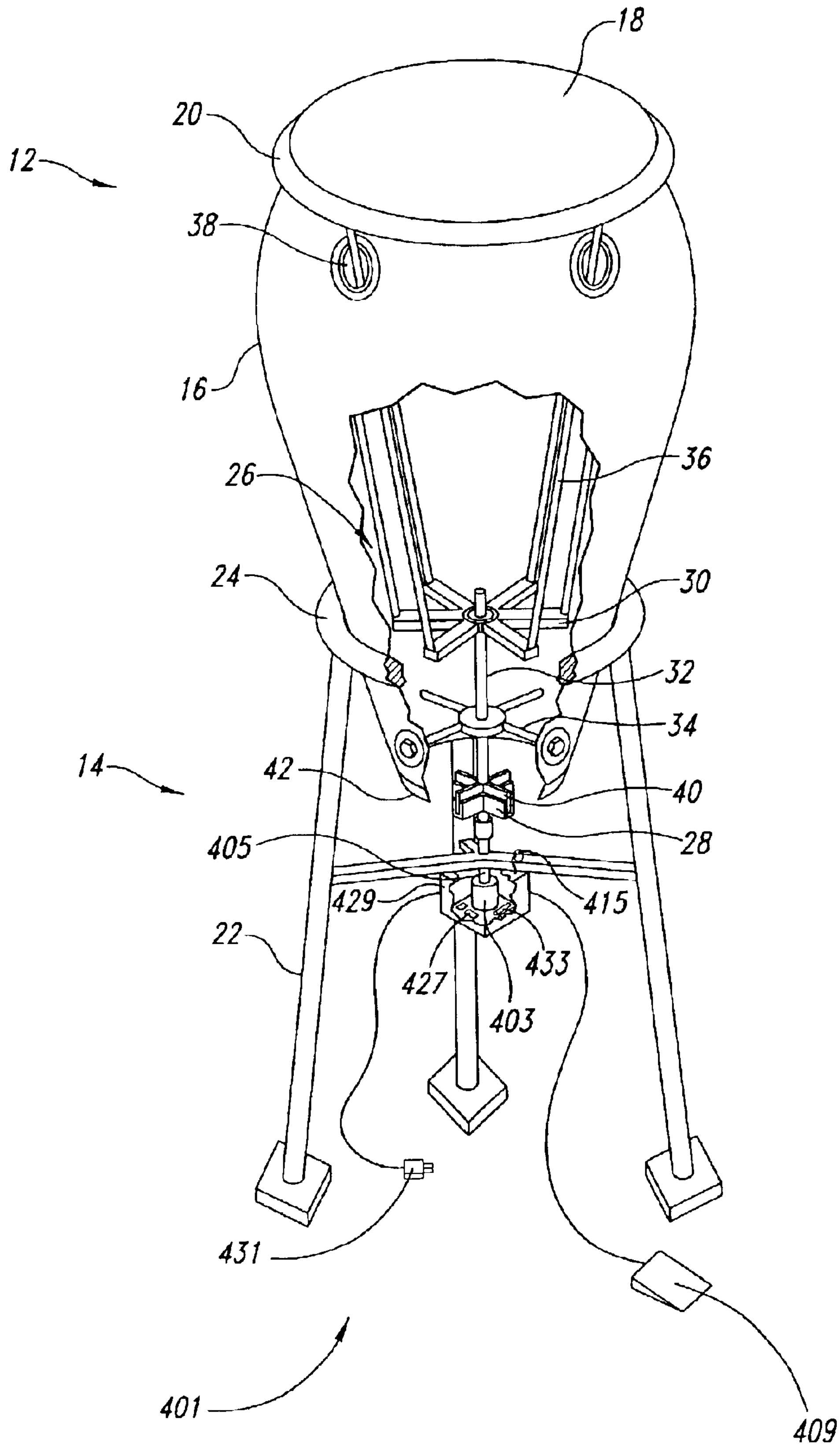
18
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Fig. 14

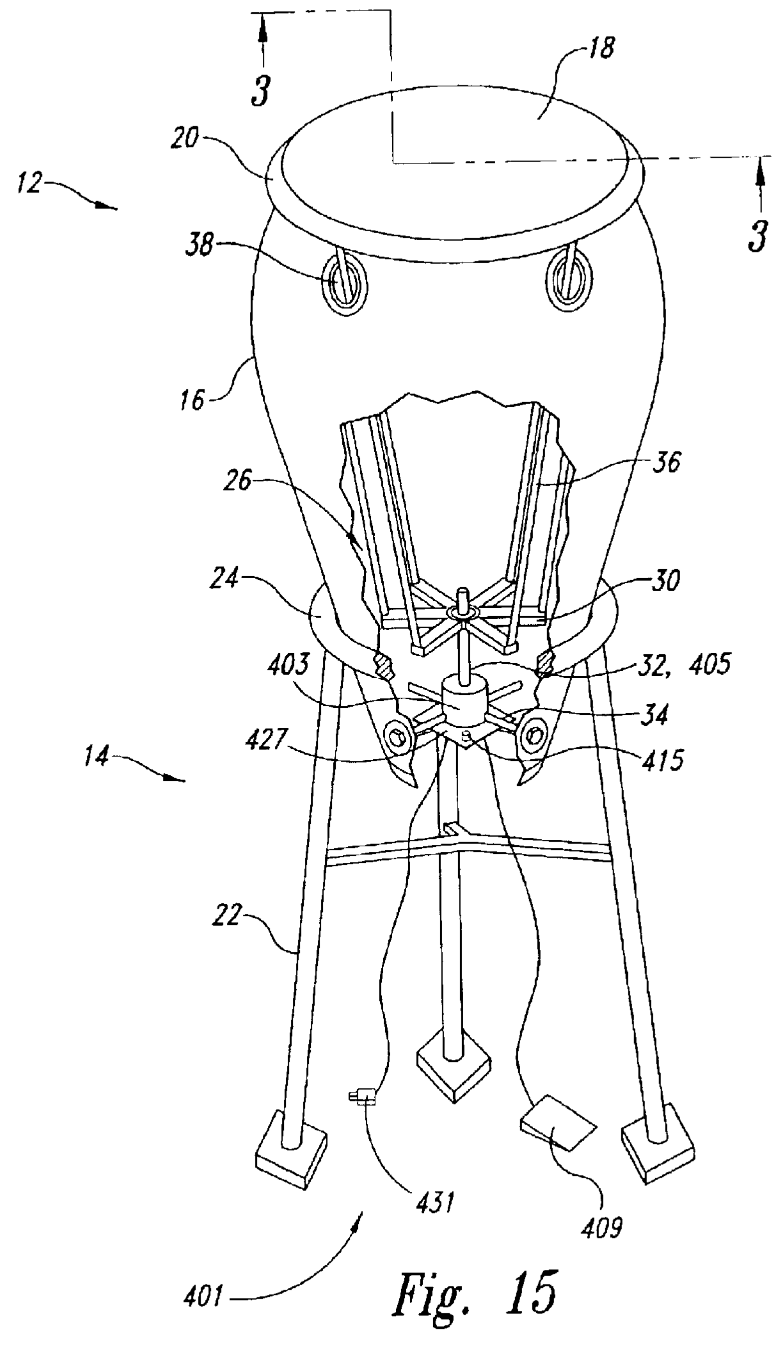
3
18
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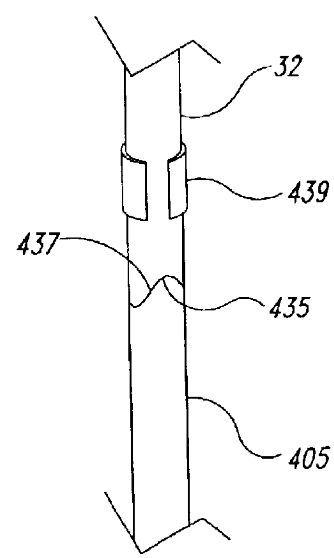
Fig. 15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435
405

Fig. 16

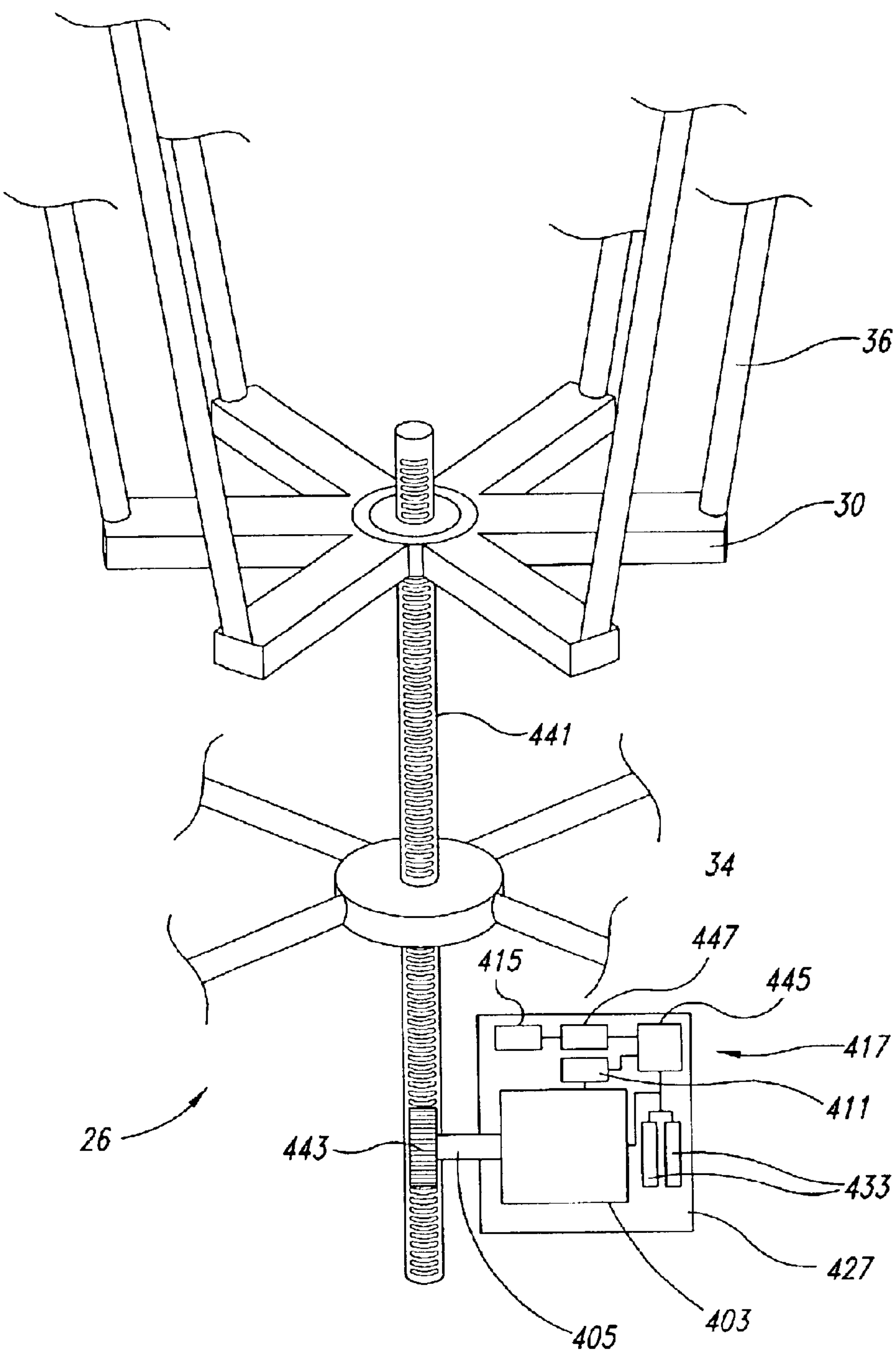

Fig. 17

DRUMHEAD TENSIONING DEVICE AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application a continuation-in-part of application Ser. No. 10/133,241, filed Apr. 26, 2002, now U.S. Pat. No. 6,667,432 which is a continuation-in-part of application Ser. No. 10/015,489, filed Dec. 12, 2001, now U.S. Pat. No. 6,441,286 which is a continuation-in-part of application Ser. No. 09/878,516, filed Jun. 8, 2001 (now issued U.S. Pat. No. 6,410,833).

TECHNICAL FIELD

The present invention is directed toward percussion drums and, in particular, to apparatus, systems and methods for adjusting the tension of a drumhead.

BACKGROUND OF THE INVENTION

Percussion drums have been used for hundreds, if not thousands, of years to produce sounds either alone or in combination with other musical instruments. A typical drum has a hollow body or shell over which a drumhead is stretched. A typical drumhead is circular and terminates at its outer boundary at a rigid or substantially rigid rim. When the drumhead is placed over the mouth of the shell, the rim is positioned slightly outside of the shell. A tensioning ring is positioned over the rim and is attached to the shell to retain the drumhead in tension across the mouth.

The tensioning ring is commonly attached to the shell by a number of threaded rods that extend between the tensioning ring and brackets on the outer surface of the shell. Threaded nuts are tightened on the threaded rods to move the tensioning ring toward the brackets, thus tightening the drumhead. A typical drum has six or more of such threaded rods. Accordingly, adjusting the tension in the drumhead typically requires the tightening of six or more separate nuts.

A number of tuning mechanisms have been developed in the past to make tuning the drumhead easier. Most of these mechanisms are incorporated into kettle drums, such as that illustrated in U.S. Pat. No. 4,831,912 to Allen et al. Other mechanisms, such as those illustrated in U.S. Pat. No. 4,244,265 to Tuttrup and U.S. Pat. No. 4,909,125 to Fece, have been developed for other types of drums.

None of the devices known to the inventor provide a simple and affordable drumhead tuner that is at the same time accurate and reliable. The mechanisms illustrated in Allen et al. and Fece, for example, are elaborate and likely expensive to manufacture. Accordingly, although they may be appropriate for expensive drums of the type illustrated therein, they may be inappropriate for simpler and/or less expensive types of drums.

Further, the mechanisms illustrated in Fece and Tuttrup are both subject to inadvertent adjustments that may accidentally modify the tone of the drum. The Fece device may be accidentally rotated, which would result in the drumhead tension changing. Similarly, the cables extending along the outside of the shell of the Tuttrup device could be displaced by the drummer or a drum stand, or the jackscrew inadvertently impinged, to accidentally change the tone of the drum.

It is therefore apparent that a need exists for a simple and inexpensive drum tuning device that is also accurate and reliable and not subject to inadvertent adjustments.

SUMMARY OF THE INVENTION

The present invention is directed toward a tunable drum for use with or without a drum stand. Embodiments of the

invention allow an individual to quickly and reliably tune the drum either manually, by operating a motor, or automatically by way of a tuning circuit.

In one particular embodiment, the drum incorporates a shell, a drumhead, a tuning ring, an adjustment or tuning assembly and a motor to drive the tuning assembly. The shell has opposing first and second ends with a first mouth at the first end and a second mouth at the second end. The drumhead covers the first mouth, and is retained against the shell by the tuning ring. The tuning ring is held against the drumhead by a number of cords, cables or other elongated linkages. The cables extend from the tuning ring to the adjustment assembly through holes in the shell. The motor selective drives turning assembly in response to actuation signals. A user or operator may manually operate the motor, or a feedback mechanism employing a tuning circuit may automatically operate the motor based on a difference between a desired vibrational frequency of the drumhead and a determined vibrational frequency of the drumhead.

In another embodiment, a stand for retaining and tuning a drum includes a number of legs, a drum engagement member coupled to the legs, the drum engagement member dimensioned to supportingly engage at least a portion of the drum, a second coupling movably supported by the legs and dimensioned to detachably engage a first coupling of the drum when the drum is supportingly engaged by the drum engagement member, and a motor having a drive shaft drivingly coupled to the second coupling, the motor selectively operable to move the second coupling with respect to the legs.

In still another embodiment, a tuning assembly for a drum includes a connector member sized and shaped to be positioned inside the drum, the connector member being attachable to the tuning ring by a plurality of linkages extending from the tuning ring into the drum such that longitudinal movement of the connector member with respect to the drum will change the tension of the drumhead, and a motor having a drive shaft coupled to the connector member, the motor selectively operable such that rotation of the drive shaft longitudinally moves the connector member with respect to the drum and, as a result, will adjust the tension of the drumhead.

In still another embodiment, in combination a drum and a stand for retaining the drum include a plurality of elongated links having first and second ends, the first end of each of the links being coupled to the tuning ring, the links extending from the tuning ring into the shell through a plurality of holes in the shell, a connector member positioned inside the shell, the second end of each of the links being coupled to the connector member, a first coupling received in the shell for movement with respect therewith and coupled to the connector for transmitting movement thereto, a motor mounted to the stand, the motor having a drive shaft, and a second coupling sized and dimensioned to drivingly engage the first coupling, the second coupling coupled to the drive shaft of the motor for being moved thereby.

In yet a further embodiment, a method for tuning a drumhead on a drum includes determining an operational state for a motor based at least in part on a frequency of vibration of the drumhead and operating the motor in the determined operational state to vary a tension of the drumhead. Determining an operational state for a motor based at least in part on a frequency of vibration of the drumhead may include selecting a first operational state corresponding to a rotation of a drive shaft of the motor in a first direction if the frequency of vibration of the drumhead is above a first reference frequency level, selecting a second operational state corresponding to a rotation of the drive shaft of the motor in a second direction if the frequency of vibration of the drumhead is below a second reference frequency level, and selecting a third operational state corresponding to no rotation of the drive shaft of the motor if the frequency of vibration of the drumhead is between the first and the second reference frequency levels.

In still a further aspect a method for facilitating the tuning of a drum comprises extending a plurality of linkages from a tuning ring at an end of the drum to a connector member positioned inside the drum such that axial movement of the connector member results in axial movement of the tuning ring, coupling the connector member to a motor, and operating the motor such that rotation of a drive shaft of the motor results in axial movement of the connector member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of a drum and a drum stand according to one particular embodiment of the present invention.

FIG. **2** is an isometric cutaway view of the drum and the drum stand of FIG. **1**, illustrating a tuning assembly according to this particular embodiment of the present invention.

FIG. **3** is a sectional elevation view of an upper portion of the drum of FIG. **2**, seen along Section **3—3**.

FIG. **4** is an elevation view of a lower portion of the drum of FIG. **2** illustrating the tuning assembly engaged with a portion of the drum stand of FIG. **2**, shown with portions of the invention cut along a diametric section.

FIG. **5** is a plan view of a connector member in the form of a spider member of the tuning assembly of FIG. **4**.

FIG. **6** is a sectional elevation view of the spider member of FIG. **5**, seen along Section **6—6**.

FIG. **7** is an isometric view of a lower portion of the tuning assembly of FIG. **4** and an actuator from the drum stand of FIG. **4**.

FIG. **8** is an isometric view of an actuator of a drum stand according to another particular embodiment of the present invention, shown in an operative configuration.

FIG. **9** is an isometric view of the actuator of FIG. **8**, shown in an inoperative configuration.

FIG. **10** is an elevation view of a lower portion of a drum and a tuning assembly according to another embodiment of the present invention, shown with portions of the drum cut along a diametric section.

FIG. **11** is a sectional elevation view of an upper portion of a drum according to another embodiment of the present invention.

FIG. **12** is a sectional elevation view of a lower portion of a drum according to another embodiment of the present invention.

FIG. **13** is a functional block diagram of a drumhead tensioning device having a motor, motor controller, user manual control input, user reference frequency input, transducer, and tuning circuit, according to a further illustrated embodiment of the present invention.

FIG. **14** is an isometric view of a drum and a drum stand according to one particular embodiment of the present invention employing at least some of the elements of FIG. **13** where the motor is mounted to the drum stand.

FIG. **15** is an isometric view of a drum and a drum stand according to one particular embodiment of the present invention. employing at least some of the elements of FIG. **13** where the motor is mounted within the drum.

FIG. **16** is a partial front, top isometric view of a drive shaft, threaded rod and sleeve for securely coupling the threaded rod to the drive shaft.

FIG. **17** is a partial isometric view of an alternative tuning assembly according to one particular embodiment of the present invention for use with or without a motor.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

The present detailed description is generally directed toward systems, apparatus and methods for reliably and accurately tuning a drumhead, and for preventing accidental adjustments to the drumhead's tension. Several embodiments of the invention allow an individual to tune the drumhead through manual control of a motor and/or through automatic control of the motor to achieve a desired frequency of vibration.

Many specific details of certain embodiments of the invention are set forth in the following description and in FIGS. **1-17** to provide a thorough understanding of such embodiments. One skilled in the art, however, will understand that the present invention may have additional embodiments, or may be practiced without several of the details described in the following description.

FIG. **1** generally illustrates a drum **12** and drum stand **14** according to one embodiment of the present invention. The drum **12** generally has a shell **16**, a drumhead **18** and a tuning ring **20**. The shell **16** in the illustrated embodiment is in the form of a conga drum. The inventor appreciates, and one of ordinary skill in the art will understand, that the present invention can apply to a wide variety of drum types. For simplicity purposes, however, the following disclosure is directed toward the illustrated conga drum version of the present invention.

The illustrated drum stand **14** has three legs **22** supporting an upper ring **24** that encircles and retains the drum shell **16** when the drum **12** is in the drum stand. The upper ring **24** can be padded to protect the surface of the shell **16**, and can be coated with a surface treatment to prevent the shell from rotating with respect to the drum stand when the shell is fully seated therein.

FIG. **2** best illustrates a tuning assembly **26** within the drum **12** engaged with an actuator **28** on the drum stand **14**. The tuning assembly **26** incorporates a connector member such as spider member **30**, a threaded rod **32**, and a retaining member **34**. The connector member is denominated herein as a "spider" member **30** where the connector member has elongated arms, but may take other forms as discussed below. The spider member **30** is connected to the tuning ring **20** by a number of cables **36**. Each cable **36** is coupled to the tuning ring **20** at a location outside the shell **16**, extends through a hole **38** in the shell, and is coupled to the spider member **30** at a location inside the shell **16**. As discussed in more detail below, the threaded rod **32** passes through the retaining member **34** before terminating at a key **40** at its lower end. In the illustrated embodiment, the key **40** is positioned above a bottom rim **42** of the shell **16** so the drum **12** can be set on a flat surface without the key impinging upon the flat surface. The retaining member **34** is fixed to the shell **16**, as discussed in more detail below.

FIG. **3** illustrates the relationship between the drumhead **18**, the tuning ring **20** and the cables **36** in this particular embodiment. The drumhead **18** is generally circular, and terminates at its outer edge at an enlarged rim or bead **44**.

The bead **44** is positioned slightly outside the shell **16** when the drumhead **18** is properly fitted on the shell. The tuning ring **20** is complementary in shape to the shell **16** to fit over the shell and contact the enlarged bead **44** along its entire perimeter. Thus, urging the tuning ring **20** downward results in an increased tension in the drumhead **18**. An upper surface **46** of the tuning ring **20** is curved downward, and is smooth to allow an individual to comfortably play the drum. A lower surface **48** of the tuning ring **20** has a number of hairs of prongs **50** spaced about the perimeter of the tuning ring to align with the holes **38**. Each prong **50** projects inward from the lower surface **48** and upward when configured for use. The pair of prongs **50** thus creates a fastener to which an elongated rod **52** at the upper end of the cable **36** can be retained. The cable **36** can be wrapped around the elongated rod **52**, or can be attached by any other means generally understood in the art. As discussed above, the cables **36** extend downward from the tuning ring **20**, through the openings **38** in the shell **16** to the tuning assembly (not shown).

FIG. **4** illustrates the tuning assembly **26** according to the present embodiment. The spider member **30** is suspended between the cables **36** and the threaded rod **32**. A threaded distal end **54** of the threaded rod **32** engages a complementary threaded opening **56** in the spider member **30**. Rotation of the spider member **30** with respect to the threaded rod **32** thus results in relative axial movement between the spider member and the threaded rod. As discussed in more detail below, this relative axial movement ultimately results in changing the tension of the drumhead **18**. The lower ends of the cables **36** each terminate in an enlarged head **58**, that is retained by the spider member **30**.

The retaining member **34** of the illustrated embodiment is in the form of a cross with an aperture **60** at the intersection of four legs **62**. Each leg **62** terminates at its distal end in a threaded portion **64**. An elongated nut **66** having internal threads **68** extends through the shell **16** and threadedly engages the threaded portion **64** of each leg **62**. The outer end of the elongated nut **66** terminates in a bolt head **70**. In the illustrated embodiment, a washer **72** and a decorative plate **74** are positioned between the bolt head **70** and the shell **16**. The retaining member **34** is thus fixedly attached to the shell **16**. The inventor appreciates as would one of ordinary skill in the art that many different variations can be made to this particular structure without deviating from the spirit of the invention.

The threaded rod **32** extends from the spider **30** through the retaining member **34**, where an enlarged, annular shoulder **72** prevents the threaded rod from moving axially toward the upper end of the drum. A bearing **74** is positioned between the annular shoulder **72** and the retaining member **34** to allow the threaded rod **32** to rotate with respect to the retaining member with reduced friction. Because the threaded rod **32** is prevented by the retaining member **34** from moving axially upward, when the threaded rod is rotated with respect to the spider member **30** the spider member moves downward toward the retaining member.

The inventor and one of ordinary skill in the art would appreciate that many various structures can be used to move a connector member such as the spider member **30** axially with respect to the threaded rod **32**. For example, as illustrated in FIG. **10**, a threaded rod **132** can be threadedly engaged with a retaining member **134** and a shoulder **172** at the extreme distal end of the threaded rod can be seated above a connector or spider member **130** such that rotation of the threaded rod with respect to the retaining member causes the threaded rod, and with it the spider member, to move axially. The inventor appreciates that still further variations can be made without deviating from the spirit of the invention.

FIGS. **5** and **6** further illustrate the spider member **30** of the present embodiment. In the illustrated embodiment, six arms **76** project outward, corresponding to the six cables (not shown). For situations where more or fewer cables are used, the spider member **30** would have a different number of arms **76** to correspond with the number of cables in such a situation. The arms **76** are spaced radially at roughly equal angles with respect to the other arms to evenly distribute the forces that the cables **36** exert on the spider member **30**. Each arm **76** terminates at its distal end in a groove **78**. The groove **78** is sufficiently wide to receive the length of a cable **36** (not shown), but sufficiently narrow to prevent the head **58** (not shown) at the lower end of the cable from passing through the spider member **30**. As illustrated in FIG. **6**, a bottom surface **80** is tapered to compensate for the angle of the cable **36** as it extends upward from the spider member **30** and outward toward the tuning rim **20** (not shown). The inventor appreciates that other variations or shapes can be used for the spider member **30** without deviating from the spirit of the present invention. For example, a disk-shaped plate with detents distributed about its perimeter could be used. Likewise, the spider member **30** need not be flat, but instead could be curved downward to provide additional strength and/or to obviate the need for the tapered bottom surface **80**.

FIG. **7** better illustrates the key **40**, and the actuator **28** of this particular embodiment. The key **40** is fixedly attached to the extreme bottom end of the threaded rod **32**. In the illustrated embodiment, the key is in the shape of a Greek cross, although it is appreciated that any number of regular or irregular shapes (other than a circle) can be substituted therefore. The key **40** incorporates four engagement members **82** to faclitate rotating the threaded rod **32**. The engagement members **82** are sized to allow an individual to manually rotate the threaded rod **32** in addition to allowing the individual to rotate the threaded rod using the drum stand. Accordingly, configurations for the key **40** that facilitate both manual and assisted rotation would be optimal.

The actuator **28** has a number of channels **84** therein configured to complement the engagement members **82** on the key **40**. The channels **84** are open to the top to allow the key **40** to be lowered into the actuator **28** from above when the drum is placed in the stand. The actuator **28** is fixed to the drum stand **14** to prevent relative rotation between the actuator and the stand.

FIGS. **8** and **9** illustrate the operative and inoperative configurations, respectively, of another embodiment the actuator of **128**. The actuator **128** is connected to the stand **114** by an upper linkage **186** and a lower linkage **188**. A locking member **190** is positioned between the upper and lower linkages **186**/**188** to retain the linkages in axial alignment. In this configuration, i.e., the operating configuration, the actuator **128** is upright and positioned to receive the key (not shown) for tuning the drum.

In FIG. **9**, the actuator **128** is in the inoperative configuration. In this configuration, the locking member **190** has moved from the locked position to the unlocked position, allowing the upper linkage **186** to move with respect to the lower linkage **188**. In the illustrated embodiment, the upper linkage **186** is pivotally connected at a hinge **192** to the lower linkage **188**. The locking member **190** is a sliding collar that, when moved upward, exposes the hinge **192** to allow the actuator **128** to move into the inoperative configuration. When the actuator **128** is moved into the operative configuration, the locking member **190** is able to slide downward over the hinge **192** until it contacts a raised section **194**. When the locking member **192** has slid downward until it contacts the raised section **194**, the locking member prevents the upper linkage **186** from pivoting with respect to the lower linkage **188**, retaining the actuator **128** in the operative configuration. The inventor appreciates that other configurations can be used to perform the above function, and thus various alterations and modifications to this illustrated structure would not deviate from the spirit of the present invention.

FIG. **11** illustrates a tuning assembly **201** according to another embodiment of the present invention. In the illustrated embodiment a drumhead **218** is retained against a shell **216** by a tuning ring **220**. The tuning assembly of this particular embodiment incorporates a fastener **203**, a plurality of linkages **205**, a connector member **207**, and a threaded rod **232**. The parts of the drum and tuning assembly are that are not discussed in detail below are similar or identical to the corresponding parts discussed above. Accordingly, the applicant does not describe these features again.

The fastener **203** is coupled between the tuning ring **220** and the linkage **205**. In the illustrated embodiment, an upper end **209** of the fastener **203** is curved and extends through a complementary opening in the tuning ring **220**. Similarly, a lower end **211** of the fastener **203** has an opening engaged with the linkage **205**. The exact manner of attaching the fastener **203** to the tuning ring **220** and/or to the linkage **205** can vary dramatically without deviating from the spirit of the present invention. A cap or similar structure can be captively engaged with the linkage **205** to prevent the fastener **203** from disengaging from the linkage.

The linkage **205** is pivotally mounted to the shell **216** by a bracket **215**. The bracket is mounted to the shell **216** by screws or other suitable fasteners. The bracket **215** has a central opening **217** that aligns with openings **238** in the shell **216**. A rod **219** extends generally laterally across the opening **217** in the bracket **215**, and serves as a fulcrum about which the linkage **205** can pivot during operation. The rod **219** can be integral with the bracket **215**, or can be affixed or otherwise engaged therewith in any suitable manner.

The linkage **205** is contoured to pivot about the rod **219** during operation. In the illustrated embodiment, a ring **221** is formed along the length of the linkage **205**, and encircles the rod **219**. Because as discussed below the linkage **205** will be urged upward during operation, the upper portion of the ring **221** can be slotted or removed to facilitate engagement of the linkage **205** with the rod **219**. The linkage **205** projects a relatively short distance outside of the shell **216**, and projects inwardly toward a center line of the shell. Because the length of the portion internal to the drum is significantly greater than the length external to the drum, the force necessary to move the internal end of the linkage **205** is substantially lower than the resultant force generated by the external portion of the linkage.

Each of the linkages **205** engages the connector member **207**. In a manner similar to the described above, the connector member moves longitudinally during operation in order to tune the drum. Consequently, the linkages **205** are coupled to the connector member **207** in a manner that allows for relative rotation between the two. In the illustrated embodiment, the linkage **205** rests in a complementary recess **223** that retains the linkage in the proper radial alignment during operation. The inventor appreciates that the linkages can be coupled to the connector member in a wide variety of ways without deviating from the spirit of the present invention.

The threaded rod **232** is engaged to rotate with respect to the connector member **207**. In the illustrated embodiment, the threaded rod **232** is seated within an annular depression centrally located in the bottom of the connector member **207**. A lower portion of the threaded rod (not shown) can be engaged with a structural member as discussed above to threadly move in a longitudinal direction with respect to the shell **216**. When the threaded rod **232** moves longitudinally, the connector member **207** moves as well. The inventor appreciates, however, that the threaded rod **232** can instead by threadly engaged with the connector member **207** such that rotation of the threaded rod results in translation of the connector member. Consequently, the relative movements of the threaded rod **232** and the connector member **207** function similar or identical to those described above.

During operation, the user can rotate the threaded rod **232** to move the threaded rod and the connector member **207** longitudinally within the shell **216**. When the connector member **207** moves up or down as oriented in FIG. **11**, the external portion of the linkage **205** moves in the opposite direction. As a result, when the connector member **207** moves upward the external portion of the linkage **205** moves downward and the drumhead **218** is tightened. Because the length of the portion of the linkage **205** internal to the drum is substantially greater than the length of the linkage external to the drum, the amount of force required to move the connector member is substantially less than the resulting force exerted by the linkage **205** on the fastener **203** and, in turn, drumhead **218**.

Embodiments of the present invention have numerous advantages over devices of the prior art. For example, because the key is manipulable both by hand and with the drum stand, the invention allows an individual to conveniently tune the invention both with and without the drum stand, and allows an individual to easily remove the drum from the drum stand to prevent accidental changes to the tension of the drumhead. To further prevent accidental changes, the cables extending from the tuning ring to the tuning assembly of the present invention extend almost entirely inside the drum shell. Thus, the drummer's hands, knees or the drum stand will not accidentally contact the cables, putting them in further tension and accidentally altering the tone of the drum.

Still further, because the actuator of the present invention is movable between operative and inoperative configurations, the drum can be left in the drum stand between uses and during use without the risk of accidentally changing the tension in the drumhead. Instead, the user merely moves the actuator into the inoperative position and uses the drum without worry that the tension of the drumhead will accidentally be changed.

Still further, because the tuning assembly is retained entirely within the boundaries of the shell, the drum can be set on the ground or otherwise carried and utilized without structural members getting in the way.

FIG. **12** illustrates another embodiment of the present invention. In the illustrated embodiment, threaded rod **332** is engaged to rotate with respect to the drum, as discussed above. The threaded rod **332** has a worm gear **333** fixed to it to rotate with the threaded rod during operation. The worm gear **333** has teeth **335** spaced around it, as is generally understood in the art. The teeth **335** on the worm gear **333** are enmeshed with a complementary thread **337** on a screw member **339**.

The screw member **339** is oriented perpendicular to the worm gear **333**, such that rotation of the screw member **339** results in rotation of the worm gear **333**. The screw member **339** is fixed to a shaft **341** that extends across the internal cavity of the drum. One end of the shaft **341** is rotatably coupled to a bushing **343** in the shell of the drum, and the other end of the shaft extends through a similar bushing **345** on an opposing side of the shell. The shaft **341** projects beyond the shell, outside of the drum, and terminates in a handle **347**.

During operation, the user can manually rotate the handle **347** to tune the drumhead. When rotated, the handle **347** causes the shaft **341** to rotate. When the shaft **341** rotates, the screw member **339** also rotates which, as discussed above, causes the worm gear **333** to rotate. When the worm gear **333** rotates, the threaded rod **332** rotates with it. As discussed above, when the threaded rot **332** rotates, the tension in the drumhead changes. Thus, when the handle **347** is turned, the drum is tuned.

FIGS. **13**-**17** show alternative embodiments of the present invention. In particular, FIGS. **13**-**16** show embodiments employing a motor, while FIG. **17** shows a tuning assembly **26** which may be driven by the illustrated motor, or may be driven manually as previously discussed. These alternatives will now be discussed with reference to the particular FIGS. **13**-**17**.

FIG. **13** shows a motorized drum tuning system **401** for tensioning the drumhead **18** via the tuning assembly **26**. The motorized drum tuning system **401** employs a motor **403** such as a servo motor having a drive shaft **405**. The motor **403** is generally responsive to actuation signals **407***a*, **407***b* to turn the drive shaft **405** either clockwise or counterclockwise, or to stop or not turn the drive shaft **405**. Thus, the motor **403** may have three operating states, clockwise rotation, counterclockwise rotation, and no rotation. As discussed in detail below, the drive shaft **405** of the motor **403** is coupled to, or is some embodiments forms a part of, the tuning assembly **26** to adjust the tension in the drumhead **18**, for example by driving elements of the tuning assembly **26** such as the connector member (e.g., spider member **30**, **130** and/or threaded rod **32**, **132** (FIGS. **2**, **4** and **10**), connector member **207** and/or threaded rod **232** (FIG. **11**), or threaded rod **332** and/or worm gear **333** (FIG. **12**)).

The motorized drum tuning system **401** may optionally include a manual control input **409**, allowing a user or operator to manually control the operation of the motor **403**. The manual control input **409** can take the form of a switch or transducer having three switching states, corresponding to respective ones of the operating states of the motor **403**. For example, the manual control input **409** may take the form of a "touch-sensitive" transducer, such as transducers that are responsive to skin or body characteristics for instance temperature (e.g., infrared sensitive), resistivity, and/or chemistry. Also for example, the manual control input **409** may take the form of a touch-sensitive transducer responsive to an electrical ground supplied by the a user touching the transducer **409**. Some suitable touch-sensitive transducers are commercially available from Technical Solutions of Silvan, East of Melbourne, Australia.

The motorized drum turning system **401** may also optionally include a motor controller **411** for converting actuation signals **407***a*, **407***b* into motor control signals **413** suitable for controlling the operation of the motor **403**. The structure and operation of motor controllers is generally known in the art of motor control.

The motorized drum tuning system **401** may also optionally include a transducer **415** and tuning circuit **417** for allowing the user or operator to automatically tension the drumhead **18** to tune the drum **12**. The transducer **415** detects the vibration of the drumhead **18** as a vibratory input **419** and provides a vibratory output signal **421** to the tuning circuit **417** which is proportional to the frequency of vibration of the drumhead **18**. The transducer **415** can take any of a variety of forms, for example a microphone to acoustically detect vibrations of the drumhead, a laser or other light source and receiver to optically detect vibrations of the drumhead, or a piezoelectric or other suitable tactile sensor to tactilely detect drumhead vibrations.

The tuning circuit **417** receives the vibratory output signal **421** at an input and compares the frequency of vibration of the drumhead **18** to at least one reference level representing a desired frequency of vibration of the drumhead **18**. The desired frequency may be supplied by the user or operator via a user reference frequency input **423** as a reference signal **425**, or may be predefined in the turning circuit **417**. The user reference frequency input **423** may allow the user to enter any desired frequency or frequency range, or may allow the user to select between a number of predefined frequencies or frequency ranges. The user reference frequency input **423** may take the form of a switch, or may take the form of a sampler to acoustically sample a sound created by another drum or instrument. The tuning circuit **417** supplies an actuation signal **407***b* either directly to the motor **403**, or indirectly via the motor controller **411**.

The tuning circuit **417** may be implemented as a set of discrete electrical/electronic components and/or may be implemented as an integrated circuit such as a microprocessor, digital signal processor ("DPS"), or application specific integrated circuit ("ASIC"). U.S. Pat. No. 6,291,755 to Hine et al., U.S. Pat. No. 6,066,790 to Freeland et al., U.S. Pat. No. 5,936,179 to Merrick et al., U.S. Pat. No. 5,877,444 to Hine et al., and U.S. Pat. No. 5,777,248 to Campbell disclose various tuning circuits for stringed instruments. In operation, the tuning circuit **417** compares the determined vibratory frequency of drumhead **18** with a desired vibratory frequency. If the determined vibratory frequency of drumhead **18** is approximately equal to the desired vibratory frequency, the drum **12** is in tune, and no adjustment is necessary. If the determined vibratory frequency of drumhead **18** is not approximately equal to the desired vibratory frequency, the drum **12** is not in tune, and an adjustment is necessary. The tuning circuit **417** may employ a range around the desired vibratory frequency for determining whether the drum **12** is in tune. For example, the turning circuit **417** may compare the determined vibratory frequency to an upper and a lower reference frequency level, the upper and lower reference frequency levels being set some defined amount above, and below the desired frequency, respectively. The reference frequency levels should be set so as to prevent the feedback mechanism from unnecessarily oscillating about the desired frequency. The respective distances between the desired frequency and the upper and lower reference frequency levels may be not be equal in some embodiments, and may be equal in other embodiments.

FIG. **14** shows one illustrated embodiment of the motorized drum tuning system **401**. The motor **403** and a printed circuit board **427** incorporating the tuning circuit **417** are enclosed in a housing **429**, which is mounted to the drum stand **14**. Power is provided via a common electrical cord and plug **431**, or via batteries **433**. The user manual control input **409** takes the form of a foot actuated pedal. The transducer **415** takes the form of a microphone mounted on the drum stand **14**. Alternatively, the transducer **415** may be mounted on the housing **429**. The drive shaft **405** of the motor **403** extends out of the housing **429** and is fixed to the actuator **28** to rotatably drive the actuator **28** in clockwise and counterclockwise directions. The actuator **28** selectively engages the key **40**, for example when the drum **12** is received in the drum stand **14** to serve as a selectively detachable coupling. Operation of the motor **403** turns the actuator **28** and key **40** to selectively adjust the tension in the drumhead **18**.

FIG. **15** shows another illustrated embodiment of the motorized drum tuning system **401**. The motor **403** and printed circuit board **427** are received in the shell **16** of the drum **12**. The transducer **415** may take the form of a microphone mounted on the printed circuit board **427**. The transducer **415** may also take the form of a light source and receiver pair, mounted to the printed circuit board **427** so as to provide a clear optical path between the light source, the drumhead **18** and the light receiver. Thus, the light source may direct light to the drumhead **18**, which reflects the light to the light receiver for detecting vibrations of the drumhead via time delay or phase shift methodologies. A reflective material may be employed on the inside surface of or as part of the drumhead **18** to increase the reflectance thereof. The transducer **415** may further take the form of a piezoelectric or other tactile sensor attached to inside surface of the drumhead **18**. Alternatively, where the transducer **415** is a microphone, the transducer **415** may be mounted elsewhere, such as on the drum stand **14** or shell **16**. In the embodiment of FIG. **15**, the drive shaft **405** has a threaded end, and thus the drive shaft **405** serves as the threaded rod **32, 132, 232**.

FIG. **16** shows a structure for coupling the drive shaft **405** to the threaded rod **32, 132, 232**. The drive shaft **405** and threaded rod **32, 132, 232** have complimentary mating end portions **435, 437**. A sleeve **439**, may positioned over the mating end portions **435, 437** to secure the coupling. (FIG. **16** shows sleeve **439** in a non-secured position to better illustrate the mating end portions **435, 437**.) The coupling structure **435, 437, 439** of FIG. **16** may be employed with the embodiments of FIGS. **14** and/or **15**.

FIG. **17** shows an alternative embodiment of the tuning assembly **26**, which may be incorporated in the manual or motorized embodiments generally described above. FIG. **17** also illustrates the printed circuit board **427** in further detail.

The alternative embodiment of the tuning assembly **26** illustrated in FIG. **17** employs a linear rail or rack **441** to translate the connector member (e.g., spider member **30, 130**, connector **207**). The rail **441** includes a number of teeth for being drivingly engaged by a number of teeth on one or more gears **443** driven by the drive shaft **405** of the motor **403**. The rack **441** may be employed with the other embodiments discussed above to realize the translation of the various actuating elements of those embodiments, such as the connector member **207** (FIG. **11**).

The printed circuit board **427** includes the tuning circuit **417** implemented using a DSP **445** and a random access memory ("RAM") **447**. The printed circuit board **427** also includes the motor controller **411**. The motor **403** and the transducer **415** may also be mounted to the printed circuit board **427** to create a unitary package, allowing easy installation in the housing **429** (FIG. **14**) or drum **12**. The unitary package may allow for simple pre-market and/or aftermarket installation.

The inventor appreciates that the illustrated configuration is indeed merely illustrative. One of ordinary skill in the art, after reviewing the present disclosure, will appreciate that there are many equivalent means of transferring rotational movement from a first shaft to a second, unaligned shaft. In addition, the gear ratio between the two shafts can be adjusted to increase or decrease the torque transfer from the first shaft to the second shaft.

All of the above U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet, are incorporated herein by reference, in their entirety.

From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

What is claimed is:

1. A drum, comprising:

a shell having a first mouth at a first end and a second mouth at a second end, the second end being opposite the first end along a radial axis of the shell;

a drumhead covering the first mouth, the drumhead having a rim about its outer edge, the rim being positioned outside the shell;

a tuning ring positioned over the drumhead, the tuning ring having an opening therein shaped to receive the first end of the shell and to prevent the rim from passing through the tuning ring;

a plurality of elongated links having first and second ends, the first end of each of the links being coupled to the tuning ring, the links extending from the tuning ring into the shell through a plurality of holes in the shell;

a connector member positioned inside the shell, the second end of each of the links being coupled to the connector member;

a retaining member positioned within the shell on the side of the connector member toward the second end of the shell, the retaining member being coupled to the shell to remain longitudinally fixed with respect to the radial axis of the shell;

a tuning linkage threadedly coupled between the retaining member and the connector member such that rotation of the tuning linkage moves the connector member longitudinally with respect to the radial axis and, as a result, adjusts the tension of the drumbead; and

a motor having a drive shaft selectively operable to rotatably drive the tuning linkage with respect to the retaining member to tune the drumbead.

2. The drum of claim **1**, further comprising:

a user operable switch communicatively coupled to provide an actuation signal to the motor.

3. The drum of claim **1**, further comprising:

a user operable switch communicatively coupled to provide an actuation signal to the motor, the user operable switch having at least three states including a first state in which the actuation signal causes the motor to rotate the drive shaft in a clockwise direction, a second state in which the actuation signal causes the motor to rotate the drive shaft in a counterclockwise direction and a third state in which the actuation signal causes the motor to not rotate the drive shaft.

4. The drum of claim **1**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumbead; and a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency.

5. The drum of claim **1**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumbead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and

a motor controller having an input coupled to the output of the turning circuit to receive the actuation signal and having an output coupled to the motor to provide a motor control signal corresponding to the actuation signal.

6. The drum of claim **1**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumbead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and

a user operable reference frequency input coupled to the tuning circuit to select the reference frequency for the tuning circuit.

7. The drum of claim **1**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply a first actuation signal at a first time, the first actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and

a user operable switch communicatively coupled to provide a second actuation signal at a second time, the user operable switch having at least three states including a first state in which the actuation signal causes the motor to rotate the drive shaft in a clockwise direction, a second state in which the actuation signal causes the motor to rotate the drive shaft in a counterclockwise direction and a third state in which the actuation signal causes the motor to not rotate the drive shaft; and

a motor controller having an input coupled to the output of the turning circuit and to the user operable switch to receive the first actuation signal at the first time and the second actuation signal at the second time, the motor controller further having an output coupled to the motor to provide a series of motor control signals respectively corresponding to the first and the second actuation signals.

8. The drum of claim **1** wherein the motor is mounted at least partially within the shell.

9. A stand for retaining a drum and tuning a drumhead on the drum, the drum having a first coupling that is movable to adjust the tension of the drumhead, the stand comprising:

a number of legs;

a drum engagement member coupled to the legs, the drum engagement member dimensioned to supportingly engage at least a portion of the drum;

a second coupling movably supported by the legs and dimensioned to detachably engage the first coupling of the drum when the drum is supportingly engaged by the drum engagement member; and

a motor having a drive shaft drivingly coupled to the second coupling, the motor selectively operable to move the second coupling with respect to the legs.

10. The stand of claim **9** wherein the motor is selectively operable to move the second coupling with respect to the legs by rotatably driving the second coupling about a radial axis of the drum.

11. The stand of claim **9** wherein the motor is selectively operable to move the second coupling with respect to the legs by rotatably driving the second coupling about a radial axis of the drum and wherein the second coupling is selectively movable between an operative position in which the second coupling will engage the first coupling when the drum is retained by the stand, and an inoperative position in which the second coupling will not engage the first coupling when the drum is retained by the stand.

12. The stand of claim **9** wherein the second coupling projects upward when in an operative position such that lowering the drum into the stand when the second coupling is in the operative position will result in engagement between the first and second couplings.

13. The stand of claim **9** wherein the second coupling is pivotable between an operative position and an inoperative position.

14. The stand of claim **9**, further comprising:

a user operable switch communicatively coupled to provide an actuation signal to the motor.

15. The stand of claim **9**, further comprising:

a user operable switch in the form of a foot pedal communicatively coupled to provide an actuation signal to the motor.

16. The stand of claim **9**, further comprising:

a transducer positioned to detect vibration of the drumhead when the drum is retained by the stand, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead; and

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency.

17. The stand of claim **9**, further comprising:

a transducer positioned to detect vibration of the drumhead when the drum is retained by the stand, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and a user operable reference frequency input coupled to the tuning circuit to select the reference frequency for the tuning circuit.

18. A tuning assembly for a drum having a drumhead retained thereon by a tuning ring, the tuning assembly comprising:

a connector member sized and shaped to be positioned inside the drum, the connector member being attachable to the tuning ring by a plurality of linkages extending from the tuning ring into the drum such that longitudinal movement of the connector member with respect to the drum will change the tension of the drumhead; and

a motor having a drive shaft coupled to the connector member, the motor selectively operable such that rotation of the drive shaft longitudinally moves the connector member with respect to the drum and, as a result, will adjust the tension of the drumbead.

19. The tuning assembly of claim **18** wherein the drive shaft is directly connected to the connector member to rotate the connector member therewith.

20. The tuning assembly of claim **18**, further comprising:

a tuning linkage coupled to the drive shaft for rotation therewith and threadedly coupled to the connector member such that rotation of the tuning linkage longitudinally moves the connector member with respect to the drum.

21. The tuning assembly of claim **18**, further comprising:

a tuning linkage mounted for longitudinal translation with respect to a radial axis of the drum and fixed to the connector member to translate the connector member therewith; and

a gear coupled to the drive shaft to rotate therewith, the gear capable of drivingly engaging a portion of the tuning linkage to transmit rotation of the drive shaft to the tuning linkage.

22. The tuning assembly of claim **18** wherein the motor is sized and shaped to be received at least partially inside the drum.

23. The tuning assembly of claim **18** wherein the motor is mounted to a stand configured to support the drum.

24. The tuning assembly of claim **18**, further comprising:

a tuning linkage coupled to transmit movement to the connector member; and

a stand configured to support the drum and to which the motor is mounted, wherein the stand has a detachable coupling to selectively couple the motor to the tuning linkage when the drum is supported by the stand.

25. In combination a drum and a stand for retaining the drum, the drum having a shell and a drumhead retained thereon by a tuning ring, the combination comprising:

a plurality of elongated links having first and second ends, the first end of each of the links being coupled to the tuning ring, the links extending from the tuning ring into the shell through a plurality of holes in the shell;

a connector member positioned inside the shell, the second end of each of the links being coupled to the connector member;

a first coupling received in the shell for movement with respect therewith and coupled to the connector for transmitting movement thereto;

a motor mounted to the stand, the motor having a drive shaft; and

a second coupling sized and dimensioned to drivingly engage the first coupling, the second coupling coupled to the drive shaft of the motor for being moved thereby.

26. The combination of claim **25**, further comprising:

a user operable switch communicatively coupled to provide an actuation signal to the motor.

27. The combination of claim **25**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead; and

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency.

28. The combination of claim **25**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and

a motor controller having an input coupled to the output of the turning circuit to receive the actuation signal and having an output coupled to the motor to provide a motor control signal corresponding to the actuation signal.

29. The combination of claim **25**, further comprising:

a transducer positionable to detect vibration of the drumhead, the transducer producing a vibratory output signal corresponding to at least a frequency of vibration of the drumhead;

a tuning circuit having an input coupled to the transducer to receive the vibratory output signal from the transducer and having an output to supply an actuation signal proportional to a difference between a frequency of the vibratory input signal and a reference frequency; and

a user operable reference frequency input coupled to the tuning circuit to select the reference frequency for the tuning circuit.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,812,392 B2
DATED : November 2, 2004
INVENTOR(S) : Marlon Brando

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 12,
Lines 45, 48 and 67, "drumbead" should read as -- drumhead --.

Column 13,
Lines 10 and 27, "drumbead" should read as -- drumhead --.

Column 15,
Line 18, "drumbead" should read as -- drumhead --.

Signed and Sealed this

Thirtieth Day of August, 2005

JON W. DUDAS
Director of the United States Patent and Trademark Office