Oct. 15, 1968 J. W. PEASE 3,405,590

TUNER FOR STRINGED MUSICAL INSTRUMENTS

Filed July 16, 1965 3 Sheets-Sheet 1

Fig. 3

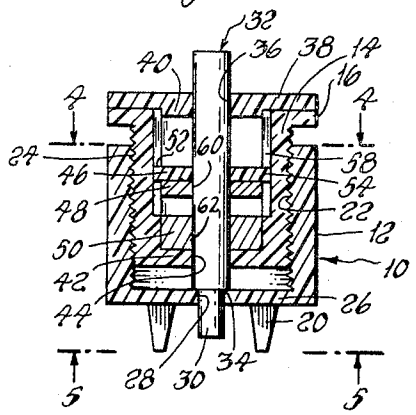
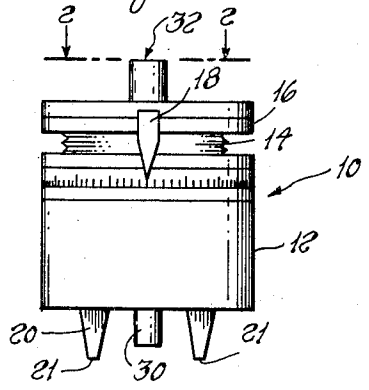


Fig. 1



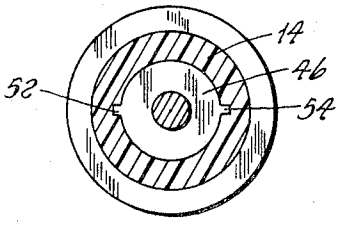


Fig. 4

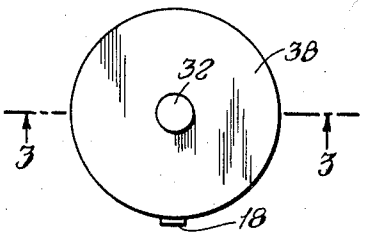


Fig. 2

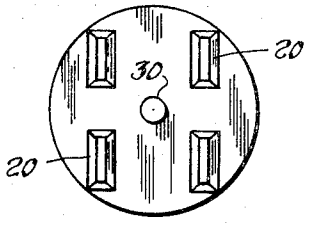


Fig. 5

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Fig. 6

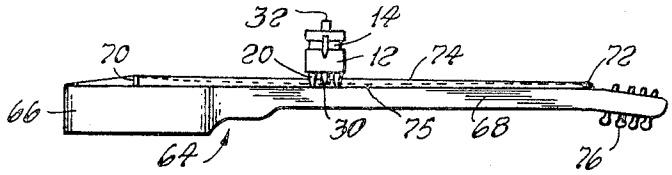
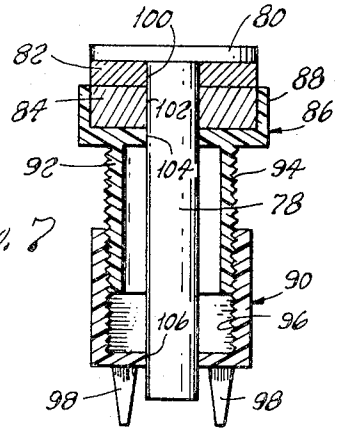


Fig. 7



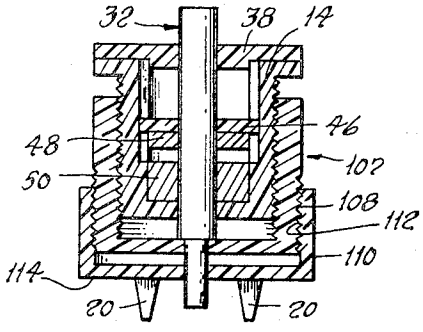


Fig. 8

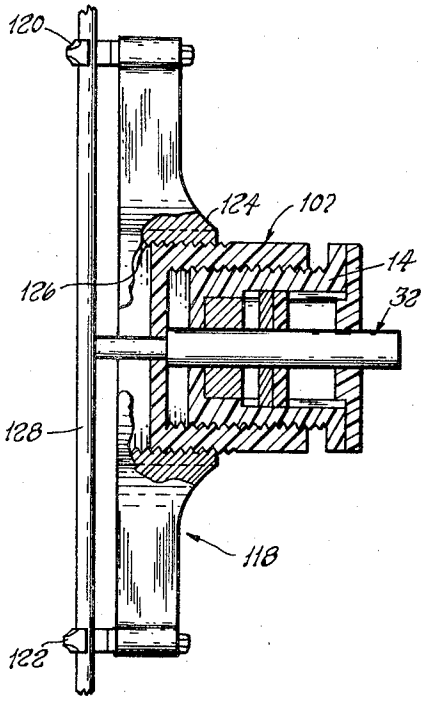


Fig. 9

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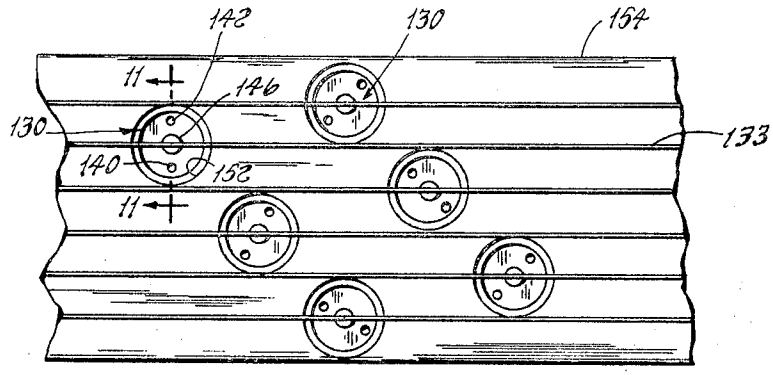


Fig. 10

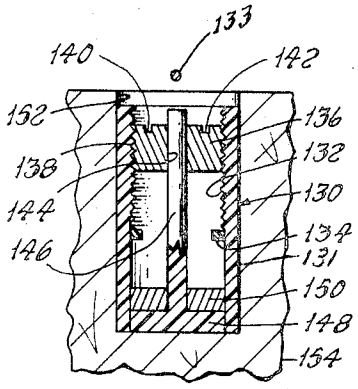


Fig. 11

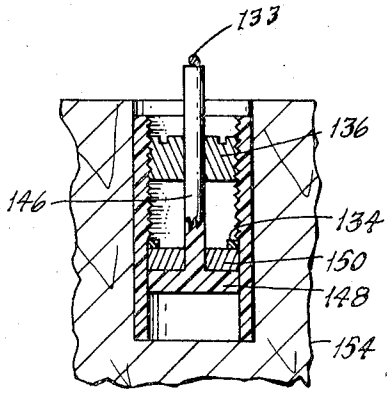


Fig. 12

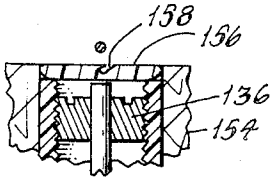


Fig. 13

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United States Patent Office

3,405,590

Patented Oct. 15, 1968

3,405,590

TUNER FOR STRINGED MUSICAL INSTRUMENTS

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Filed July 16, 1965, Ser. No. 472,597

12 Claims. (Cl. 84—458)

ABSTRACT OF THE DISCLOSURE

A housing positionable with respect to a tensioned string on a stringed musical instrument is provided with presettable means for exerting a predetermined deflecting force on a string and means for indicating when this deflecting force is less than an opposing force developed in the string by increasing tension, whereby the string may be tuned to a predetermined pitch.

This invention relates to an improved device and method for tuning stringed musical instruments by aid of the eye or touch instead of the ear.

Present methods of tuning include the pitch pipe and tuning fork each of which depend upon the ear of the tuner. As different tuner's ears vary in their capacity to detect the vanishing point of beats, in a tuning fork, it is impossible to tune all pianos, for example, precisely alike. Also in the conventional method of tuning a piano by tuning fork to middle C and tuning the remaining notes by ear in relation to the established C note, the result normally is decreased accuracy in the direction of the octaves remote from the middle C octave. This is due in part to the non-uniformity of scale of frequency change in the piano keyboard. Some notes on the exact frequency scale are half notes, others are less than or greater than half note changes. The human ear cannot detect frequency to such accuracy and hence a guess or compromise is required in tuning the piano. Thus, it is impossible by ear to tune two pianos exactly alike and it is also impossible for even an expert tuner to duplicate the same temperment in the same instrument retuned.

Other present known devices such as oscilloscope and audio frequency electrical meters are impractical for general use both from the standpoint of cost, experience in operation and application to the instrument.

The above defined problem has been recognized at least as early as 1864 as evidenced by the patent issued to C. R. Edwards No. 43,674. Since that date numerous attempts have been made, without success, to provide a simple, inexpensive and reliable musical string tuner of satisfactory accuracy, and not requiring a "musical ear."

Thus, a general object of the present invention is to provide a simple, inexpensive and reliable musical string tuner.

A further object is to provide an improved tuning device and method for stringed musical instruments by which not only experts but also unskilled persons can readily tune stringed musical instruments.

Another object is to provide a tuning device whereby a stringed instrument can be tuned with accuracy beyond that detectable by the human ear even by a person devoid of what is termed a "musical ear," wholly unskilled in the art of musical instrument tuning.

A further object is to provide a tuner for stringed instruments which will demonstrate to sight or touch the attainment of proper pitch in the string.

In general the present invention comprises means for deflecting a musical string a predetermined amount, means for directing a predetermined constant biasing force through said first means in the direction of the string, the biasing force being selected in relation to the deflected force developed in the deflected string at a tension corresponding to desired pitch of the string. Use of the present invention is dependent upon an initial proper tuning of the string to obtain a basis for adjusting the tuner device.

Other objects and advantages will appear from the following description of an example of the invention, and the novel features will be particularly pointed out in the appended claims, and from the drawings in which:

FIG. 1 is an elevational front view of an instrument embodying the invention,

FIG. 2 is a plan view of the device of FIG. 1,

FIG. 3 is an elevational view partly in cross section taken on line 3—3 of FIG. 2.

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3,

FIG. 5 is a bottom view of FIG. 1,

FIG. 6 is a perspective view showing application of the instrument of FIG. 1 to a banjo, the instrument being slightly enlarged in relation to the showing of the banjo to more clearly indicate details of the instrument in its application to the banjo,

FIG. 7 is an elevational view partly in cross section of a modified form of tuner incorporating the invention,

FIG. 8 is an elevational view partly in cross section of a further modified form of tuner incorporating the invention,

FIG. 9 is a view partly in cross section of a still further modification incorporating the invention,

FIG. 10 is a plan view of a built-in tuner incorporating the invention,

FIG. 11 is a view partly in cross section taken on line 10—10 of FIG. 10,

FIG. 12 is a cross sectional view of the device of FIG. 11 shown in operating position, and

FIG. 13 is a cross sectional view showing a portion of FIG. 11 with a snap cap insert used to cover the tuning unit when not in use.

Referring to FIGS. 1 to 5 of the drawing and initially to FIG. 1, the exemplary tuner shown therein and generally indicated by the numeral 10 includes a recessed housing 12 in which is threaded a plug 14 flanged as at 16 for rotation of the plug 14 within the housing 12. A measuring scale indicated is formed on the housing 12 and a pointer is fixed to the plug 14 to indicate the rotatable setting of the plug with respect to the housing. A verticle scale (not shown) may also be placed on the housing to indicate the number of complete turns of the plug in the housing. Spaced feet 20 shown in FIGS. 1 and 5 are formed projecting from the bottom of the housing 12 provide a means for measuring deflection of a string to be tuned as will be described hereinafter.

Referring to FIG. 3 the housing 12 is recessed and internally threaded as at 22 to receive the externally threaded portion 24 of the recessed plug 14. A bottom portion 26 of the housing 12 is centrally apertured as at 28 to receive a reduced cross section end 30 of a force transmitting member such as shaft 32.

The reduced cross section end 30 of shaft 32 forms a shoulder 34 limiting the downward movement of the shaft 32. The surface in housing bottom 26 formed by the aperture 28 forms one bearing surface for the shaft 32. The other bearing surface of shaft 32 is formed by an aperture 36 formed centrally in a plate 38 fixed to the top of the plug 14 by any suitable means such as cementing or by an annular boss 40 formed on the bottom of the plate for press fit into the central recess of plug 14. A bottom portion 42 of the plug 14 is centrally apertured as at 44 to pass the shaft 32.

Mounted on the shaft 32 by cement, press fit or other suitable means is an annular carrying member 46 on the lower side of which is fixed by cementing or other suitable means one element 48 of two associated magnetic

elements 48 and 50. Element 50 is supported on the bottom 42 of the plug 14 and cemented, press fit or otherwise fixed to the plug. Projections 52 and 54 are formed on the carrying member 46 as indicated in FIGS. 3 and 4 to be received in grooves 56 and 58 formed in the internal surface of the recessed plug 14 to key together the magnetic elements 48 and 50 and prevent relative rotation of the two. Both rotate in unison as the plug 14 is threaded in the housing 12. Magnetic elements 48 and 50 can be an armature and magnet or they can be two magnets depending upon the magnetic force desired and upon a factor of sensitivity to adjustment as will be explained hereinafter. Magnetic elements 48 and 50 are apertured as at 60 and 62 to accommodate the shaft 32.

In operation of the device as shown in FIGS. 1 to 5, the shaft 32 carrying the magnetic element 48 is vertically slidable in the housing 12 responsive to a force on either end of the shaft 32 or responsive to attraction of the magnetic elements 48 and 50. Downward movement of the shaft is limited by the shoulder 34 of shaft 32 engaging the bottom of housing 12.

In FIG. 6 is shown a banjo 64 having a body generally indicated at 66, including a neck portion 68, spaced bridge supports 70–72, for a string 74, and tuning keys such as key 76 connected to string 74. The opposite end of the string is anchored to the body of the banjo.

In applying the device of FIGS. 1 to 5 to the banjo to tune the string 74, the device is placed with the legs 20 straddling the string 74 and engaging the neck portion 68 of the banjo body. The lower end 30 of the shaft 32 engages and deflects the string 74 a predetermined amount, the vertical distance between a line through the bottom 21 of the feet 20 and the bottom end of the shaft 32 being designed less than the normal height of the string 74 from the neck 68 of the banjo when the string is under any playable tension. Since the string converges toward the neck of the instrument in the direction of the adjusting keys, selection of desired string deflection can be obtained to a limited extent by selecting the position along the instrument neck at which tuning will be effected. Once a particular spot or point is selected along the neck and the device set for that point returning must be made at that point.

As previously mentioned herein the initial setting of the tuner is dependent upon an original proper tuning of the string. To adjust the device from a tuned string the device is positioned over and deflecting the string as above described. The plug 14 is then rotated relative to the housing 12 until the top of shaft 32 pops upward. Precise adjustment can be obtained by screwing the plug outward until the shaft 32 remains down due to magnetic force overcoming the upward force of the deflected string on the shaft 32 and then screwing the plug inward until the shaft 32 pops outwardly. The device is then set for the particular tension then in the string. The adjusted position of the plug is indicated by the pointer 18 on the scale formed in or affixed to the outside of the housing 12. Also if desirable the scale may be eliminated and a marking made on the housing for the adjustment of a particular string. I have also found it convenient to affix a removable adhesive label to the housing for marking. Additional markings may be applied for the remaining strings of the instrument.

Having determined the settings of the device once from a properly tuned instrument one is then able to repeatedly retune the instrument from the settings derived from the properly tuned instrument.

In retuning the stringed instrument, the device is positioned to deflect the string at the selected tuning point and held in position by one hand. With the other hand the instrument key 76 is rotated in a direction to tighten the string. When the tension corresponding to the desired pitch is obtained the shaft 32 will pop upward. This may be sensed by sight or touch and may also be heard. In this manner a string may be tuned in a matter of seconds by an unskilled person with no ear for tone. Further the tuning is precise beyond the limits of the human ear to detect difference in tone. In view of the rapidity and facility of tuning the device is also quite useful when settings are developed for different keys such that one may retune for a different key in a matter of seconds. The device is preferably molded of plastic in mass production and is inexpensive, light in weight (a few ounces) and about two inches in length by about ¾" in diameter such that it can be readily carried on the person.

To better understand the operation of the device, an explanation of the functions of the several elements will now be made. Basically applicant's device provides a predetermined deflection of a string to be tuned, a predetermined force in the direction of the string for opposing the force in the string developed by the deflection and means for clearly indicating the development of a force in the string just barely overcoming the predetermined force directed against the string.

Referring to FIG. 3, the predeterdemined biasing force is obtained by rotating the plug 14 to adjustably space the magnetic elements. Threading the plug outwardly brings the magnetic elements closer together and increases the biasing force. Threading the plug inwardly produces the opposite result. This selected biasing force is transmitted by the force transmitting shaft 32 initially to the bottom 26 of the housing 12 through the shoulder 34 of the shaft. However, as the force of the string in its deflected position indicated at 75 in FIG. 6 is gradually increased by turning the instrument key 76, force is transmitted to the shaft 32 through its end 30 in engagement with the string. As the tension in the string is increased a point is reached where the force of the string just barely overcomes the biasing force of the magnetic elements. At this point a breakdown of holding force of the magnetic elements occurs by a micro movement of the shaft 32 upwardly carrying with it the magnetic element 48. This micro movement of the magnetic element 48 away from the element 50 causes a decrease in the biasing force of the elements and thereby further increases the overcoming force of the string such that the shaft 32 pops upwardly giving a positive indication of proper, i.e. desired, tension on the string. The function of the projections 52 and 54 on the carrier 46 and the cooperating grooves 56 and 58 in the plug 14, as previously mentioned, is to key the magnetic elements together to prevent relative rotation of the two. Relative rotation of the magnetic elements could cause variation in force if there were any misalignment of the two or irregularity of surfaces due to the manufacturing tolerances.

Referring now to FIG. 7 there is shown a device also incorporating the subject invention. The device of FIG. 7 differs from the device of FIGS. 1–5 in elimination of the means for adjusting the biasing force and substituting means for adjusting the degree of string deflection.

Thus, the device of FIG. 7 comprises a shaft 78, a carrier 80 fixed to the shaft, a magnetic element 82 cemented or otherwise fixed to the carrier, a plug 86 having a flanged portion 88 forming a recess to receive a second magnetic element 84 and a housing 90. The plug 86 is formed with a lower tubular portion 92 externally threaded as at 94 and the housing 90 is internally threaded as at 96 to receive the tubular portion 92 of the plug 86. Spaced feet 98 are formed on the housing 90 in the same manner as in the device of FIGS. 1 to 5 and for the same purpose as previously described hereinabove. The elements 82 and 84 and the plug 86 and housing 90 are each centrally apertured as indicated respectively at 100, 102, 104 and 106 to pass the shaft 78.

In operation of the device of FIG. 7 downward movement of the shaft 78 is limited by engagement of magnetic element 82 with magnetic element 84. A predetermined biasing force is provided by attraction of the magnetic elements 82 and 84 each for the other. Selective variation of deflection of the string is obtained by adjust-

ably rotating the plug **86** in the housing **90**. The device is applied to the stringed instrument in the same manner as previously described hereinbefore such that when the tension in string **74** is increased to a point just overcoming the biasing force of the magnetic elements the shaft **78** pops upwardly.

Referring to FIG. 8 the device shown therein and also incorporating the invention is the same as shown in FIGS. 1 to 5 except for the provision of means to provide adjustment of string deflection.

Thus, the device of FIG. 8 includes the plug **14** and the elements plate **38**, shaft **32**, carrier **46** and magnetic elements **48** and **50**. The housing **107** is also the same as housing **12** except that the legs **20** are omitted from the bottom of the housing and the housing is formed with external threads **108**. Deflection adjustability is obtained by providing a recessed cap **110** internally threaded as at **112** to receive the externally threaded housing **107** and the legs **20** are fixed to the bottom **114** of the cap **110**. The bottom **112** of the cap **110** is apertured as at **116** to pass the stepped end **30** of shaft **32**.

In operation of the device of FIG. 8 the cap **110** may be turned on the housing **107** to provide a desired setting for degree of deflection of the string. Once set for desired deflection, operation of the device is the same as described above for the device of FIGS. 1 to 5. Adjustability of deflection is advantageous where a tuner may be used on any of several musical instruments some of which may have strings relatively high from the instrument body and others of which may have relatively low hung strings.

In FIG. 9 is shown a further modification of tuner incorporating the invention and useful with instruments where there is no adjacent body portion from which to measure string deflection, and wherein the tuner is supported on the string itself. It is useful for example as a tuner for pianos or harps.

The device of FIG. 9 is the same as the device of FIG. 8 except that the cap **110** is replaced by a frame **118** provided with a pair of spaced string engaging devices, anvils **120** and **122**, for mounting the frame on the string. As shown in FIG. 9 the device **120** and **122** may be hook shaped members adapted to pull the string toward the tuner and the central portion of the frame is formed of an enlarged section **124** apertured and threaded as at **126** to threadedly receive the housing **107**.

The tuner of FIG. 9 provides for adjustments of both biasing force and string deflection. In operation after the tuner is set for deflection and biasing force from a properly tuned string the tuner is attached to a string to be tuned, indicated at **128** and the tension in the string is increased by the string adjusting element (not shown) of the instrument being tuned (not shown) until the shaft **32** pops as described for the device of FIGS. 1 to 5.

Initial adjustment of the tuner from a properly tuned string involves positioning the tuner on the string as shown in FIG. 9, adjusting the housing **107** in the frame to provide a degree of deflection in the string and adjusting the plug **14** in the housing **107** to the point at which the tension in the string just pops the shaft **32**. No exact degree of deflection is required for the initial setting of deflection. If the deflection is small the resultant setting of the plug for popping of the shaft **32** will be a setting corresponding to a light force bias. If the deflection setting is greater the resultant setting of the plug will be that for a stronger force bias. Either combination of settings will produce the same result for a given desired tension in the string. That is the string will pop the shaft **32** at the same tension for either combination of settings.

The provision of magnetic elements for producing a biasing force is particularly useful because the elements provide a substantially static force and a rapid breakaway.

It is presently preferred to make the present tuner with the exception of the magnetic elements of molded plastic parts of minim static friction, such as Delrin. However, non-magnetic metals can be used.

A tuning device according to this invention may also be incorporated into a musical instrument as a built-in tuner. Thus, referring to FIGS. 10, 11 and 12 and initially to FIGS. 11 and 12 there is shown a tuning unit **130** incorporating this invention and comprising a sleeve **131** internally threaded as at **132** adjacent its upper end and provided between its ends with an internal annular rib **134** or other suitable stop means. Threaded into the sleeve **131** is provided a cylindrical magnet **136** externally threaded as at **138** and recessed in its upper exposed face as at **140** and **142** to accommodate a spanner wrench (not shown) to rotate the magnet **136** within the sleeve **131**. If desirable an intermediate sleeve (not shown) can be fixed on the magnet by cement or other suitable means and the free periphery of the intermediate sleeve (not shown) threaded instead of forming threads on the exterior of the magnet.

The magnet **136** is centrally apertured as at **144** to pass a force transmitting shaft **146** the other end of which is fixed, as by integral forming, press fit or other suitable means to a carrier **148** to which is cemented or otherwise fixed an armature **150**. "Armature" as used here means a piece of ferromagnetic material which is attracted by a magnet. Of course a second magnet could be used instead of an armature, as explained on column 3 beginning at line 9. The armature can also be pressed fit or integrally fixed to the shaft without a carrier. Either the magnet **136** or sleeve **130** or both may be employed to guide the shaft **146** and its attached elements **148** and **150**. In the example shown in FIGS. 11 and 12 both are used.

The sleeve **131** and its enclosed elements are fixed as by cementing or other suitable means in a cylindrical recess **152** formed in the neck section **154** of the instrument body, each tuning unit **130** being positioned under an associated string, as for example string **133** of the instrument as indicated in the plan view of FIG. 10. The shaft **146** when in extended position as shown in FIG. 12 holds its associated string in deflected position away from the neck of the instrument. The extent of deflection is constant and limited by engagement of the armature **150** with the fixed rib **134**. The deflection force which must be overcome to pop the shaft **146** downward away from the string is adjusted by adjusting the threaded position of the magnet **136** in the sleeve **131**.

Each tuning unit may be preadjusted at the factory for each instrument such that no adjustment is required by the purchaser of the instrument. In such case the player of the instrument may retune the instrument by loosening the strings and turning the face of the instrument neck downward to allow gravity to position each armature against its associated rib. It will stay in this position by the magnetic force then developed between the armature and magnet. Thereafter the player simply tightens each string until the shaft of the associate tuning unit pops downward. The associated string is then in desired tune.

The tuning units can also be adjusted by the player by first having his instrument properly tuned and adjusting each magnet such that the shaft pops downward by setting the string on the end of the shaft **146**. The string can be moved sideways or lifted to allow the shaft to move to its extended position.

For normal use of the instrument between tunings (see FIG. 13), I provide a cap **156** to cover the top of each tuning unit **130**. The cap **156** is formed to snap into the top portion of the instrument recess **152**. A slot **158** is formed in the cap to insert a tool to lift the cap. The end of the spanner wrench (not shown) can be dimensioned to perform this function.

It will thus be apparent that applicant has provided an automatic tuner which can be in a form usable with any of several instruments or can be built into a particular instrument. It should also be apparent that the tuner eliminates the requirements of judgment and "musical ear"

associated with conventional tuners. Neither is required since the present device provides a positive action which can be seen, heard or felt and provides this indication simply responsive to tightening a string until the action occurs.

I claim:

1. A tuner for stringed musical instruments of the type having a body, at least one string to be tuned, spaced supports suspending the string and means for adjusting the tension in the string comprising:
(a) means for deflecting a portion of the string a given amount between spaced points therealong and applying a limited deflection force in a direction normal to the string,
(b) said means including a housing, means fixing the position of the housing in relation to the string, a force transmitting member slidable in said housing in a direction normal to the string to engage and deflect said string, biasing means connected between said housing and said member to apply a predetermined limited force to said member in a direction normal to the string,
(c) means for indicating when said predetermined limited force is less than an opposing force developed in said string by operation of said means for adjusting the tension in the string, whereby said string can be tuned to a predetermined pitch, and
(d) said biasing means including a holding magnet and associated magnetic element connected one to the housing and the other to the slidable force transmitting member.

2. A tuner according to claim 1 including,
(a) means for adjustably spacing said magnetic element and magnet to selectively vary the biasing force on the string.

3. A tuner for stringed instruments of the type having a body, at least one string to be tuned, spaced supports suspending the string and means for adjusting the tension in the string comprising:
(a) an elongated sectionalized housing having a tubular section with spaced projecting legs at one end to engage the body of the instrument and an internally threaded portion at the opposite end and having a recessed plug section externally threaded to be received in the threaded end of said tubular section.
(b) a force transmitting shaft centrally positioned longitudinally on said housing, said recessed plug being centrally apertured to pass said shaft,
(c) said tubular housing section being formed with a bottom apertured to pass one end of said shaft.
(d) said one of said shaft being formed with a shoulder to utilize said bottom as a stop means limiting the movement of said shaft in the direction of said housing legs,
(e) biasing members including a holding magnet and aligned associated magnetic element fixed one to said shaft and the other to said plug to bias said shaft in the direction of said housing legs,
(f) said housing plug being rotatable with respect to said housing tubular section to vary the proximity of said magnet and magnetic element to thereby vary said biasing force.

4. A tuner according to claim 3,
(a) a carrier member fixed to said shaft for supporting said one biasing member,
(b) said plug recess being formed with at least one groove parallel to the longitudinal axis of said housing and said carrier member fixed to said shaft being formed with a projecting tab slidable in said groove to prevent relative rotation of said biasing members,

5. A tuner according to claim 3,
(a) said plug being formed with a flange adjacent its open end with a marker on said flange,
(b) the outer periphery of said tubular section of said housing being marked with a scale for cooperation with said flange marker to indicate the adjusted position of said plug in said housing.

6. A tuner according to claim 5,
(a) a carrier member fixed to said shaft for supporting said one biasing member,
(b) said plug recess being formed with at least one groove parallel to the longitudinal axis of said housing and said carrier member fixed to said shaft being formed with a projecting tab slidable in said groove to prevent relative rotation of said biasing members.

7. A tuner according to claim 5,
(a) said plug being provided with a centrally apertured closure member for its open end to serve as a slidable bearing support for said shaft, the aperture in said plug bottom forming a second bearing support.

8. A tuner for stringed musical instruments comprising:
(a) a frame having on one side thereof a pair of spaced apart extensions each provided with an inwardly facing string engaging anvil on the end thereof,
(b) said frame having an apertured and internally threaded central portion between said extensions,
(c) a first recessed closed bottom cylindrical plug externally threaded to be adjustably received in said threaded aperture of said frame and also internally threaded about said recess,
(d) a second recessed closed bottom cylindrical plug externally threaded and dimensioned to be screwed into said first plug,
(e) the closed bottoms of said plugs being formed with aligned apertures, the aperture in said first plug being smaller than the aperture in said second plug,
(f) a stepped shaft received through said plug apertures and abutting the closed portion of said first plug as a stop for said shaft,
(g) cylindrical magnetic elements fixed one in said second plug and the other on said shaft, said shaft passing through both,
(h) said first plug being rotatably adjustable in said frame to vary the projection of said shaft from said frame beyond a straight line through said frame anvils supporting the string and hence to vary the deflection in the string,
(i) said second plug being rotatably adjustable in said first plug to vary the spaced association of said magnetic elements and hence vary the biasing force developed therebetween in the direction of the string, whereby for a given setting of said plugs the string when gradually increased in tension will snap said projecting shaft inward toward said plugs, in a direction away from the string when a desired tension is attained in the string.

9. A force and deflection measuring instrument comprising:
(a) aligned magnetic elements,
(b) housing means mounting said elements for relative movement toward and away from each other on a common axis,
(c) one magnetic element being fixed in said housing means and the other biased by said one element in one direction in said housing,
(d) means limiting the extent of movement of said other magnetic element in said one direction,
(e) means for adjustably setting said magnetic elements in selected spaced condition to adjustably vary said bias on said other element, and
(f) force transmitting means connected to said other magnetic element to transmit said selected bias to a product being tested.

10. For a stringed musical instrument having a body, one or more strings bridging a portion of the body and means for adjusting the tension in the string an automatic tuner for the string comprising:
(a) a tuning mechanism fixed in the instrument body portion adjacent the string,
(b) said mechanism including means for applying a

limited deflection to the string with a predetermined force corresponding to a function of the tension required in the string for a desired tuning,

(c) said means including a force transmitting member engageable with the string and operating force biasing magnet elements operating on said force transmitting member with a predetermined selected magnetic developed force.

11. An automatic tuner according to claim **10**,

(a) said magnetic elements being adjustable to selectively vary said magnetic developed force.

12. A tuner for stringed musical instruments comprising:

(a) a housing,

(b) means positioning the housing in fixed position adjacent the string,

(c) force transmitting means for engaging the string in a direction normal thereto to deflect the string from normal substantially straight line condition,

(d) stop means limiting the movement of said force transmitting means in the direction of the string to limit the string deflection to a predetermined amount,

(e) magnetic means providing a predetermined selected force in the direction of the string through said force transmitting means for maintaining the deflection of the string until the tension in the string is manually adjusted to overcome said biasing force and thereby cause the string to snap back to normal substantially straight line condition.

References Cited

UNITED STATES PATENTS

2,618,153	11/1952	McKernan	73—144
2,925,731	2/1960	Cammack	73—144
3,174,334	3/1965	McKernan	73—144
3,176,510	4/1965	Kimmell et al.	

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