United States Patent [19]

Fajardo

[11] **4,058,046**

[45] **Nov. 15, 1977**

[54] **CYLINDRICAL HEAD JOINT WITH ACOUSTIC WEDGING FOR CONCERT FLUTES**

[76] Inventor: **Raoul J. Fajardo**, P.O. Box 5782, Pasadena, Calif. 91107

[21] Appl. No.: **711,157**

[22] Filed: **Aug. 3, 1976**

[51] **Int. Cl.**[2] **G10D 7/02**

[52] **U.S. Cl.** **84/384**; 84/386

[58] **Field of Search** ..... 84/380, 384, 386, 380 C

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,376,004	4/1921	Christensen	84/384
3,763,737	10/1973	Sander	84/384

FOREIGN PATENT DOCUMENTS

114,964	4/1942	United Kingdom	84/384

Primary Examiner—Lawrence R. Franklin
Attorney, Agent, or Firm—Fraser and Bogucki

[57] **ABSTRACT**

A cylindrical head joint has an internal cross-section that tapers down from a cylindrical shape at the tenon to a non-cylindrical shape at the embouchure end by means of a wedge internally bonded to the cylinder. The relative tuning of the three octaves of the flute can be achieved by varying the position of the wedge either rotationally or longitudinally inside the cylinder. The laborious method of tapering the head by forced shrinking of a cylindrical tube is thus avoided and a superior tone quality is achieved because the air jet that enters the embouchure hole hits a non-cylindrical wall which has a favorable effect on transient sounds and harmonics.

14 Claims, 9 Drawing Figures

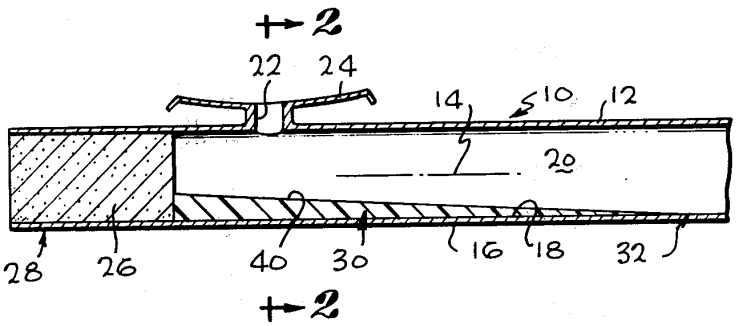


Fig. 1

Fig. 2

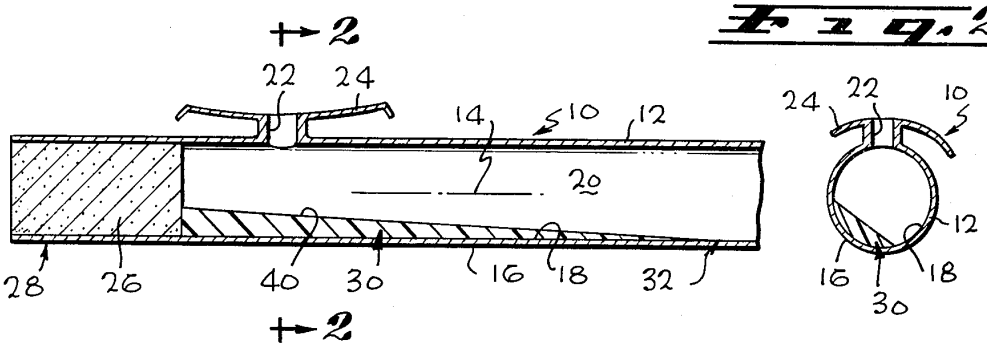


Fig. 4

Fig. 3

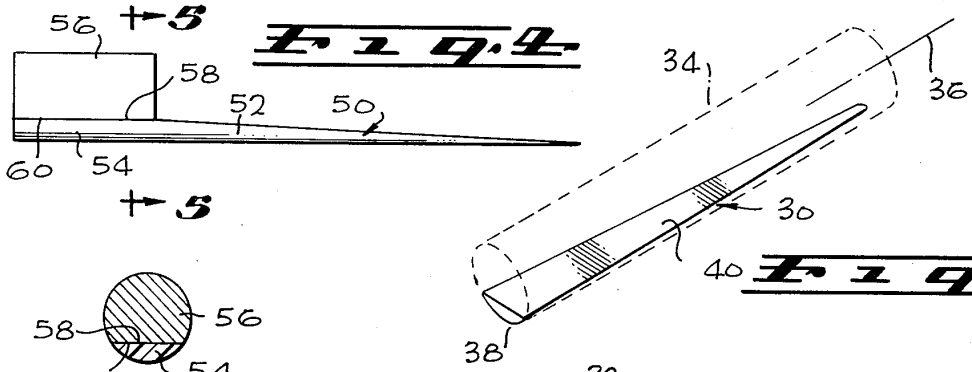


Fig. 5

Fig. 6

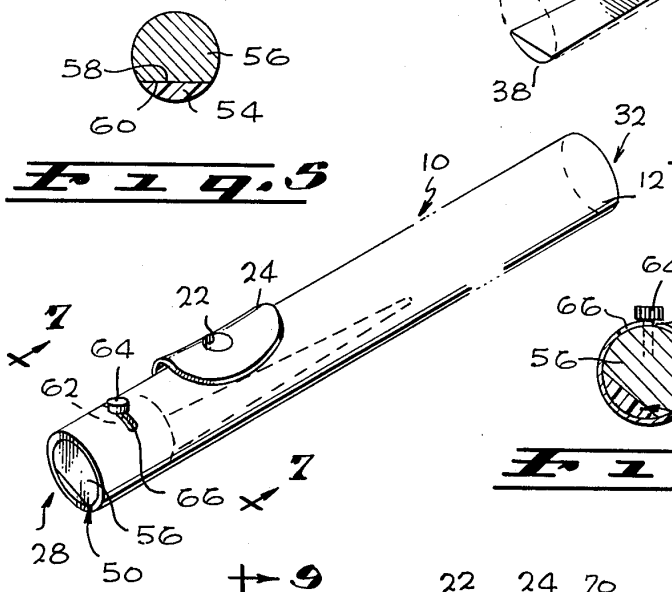


Fig. 9

Fig. 7

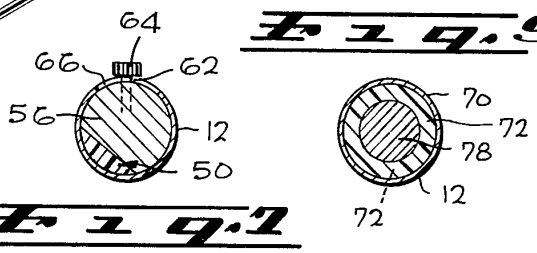
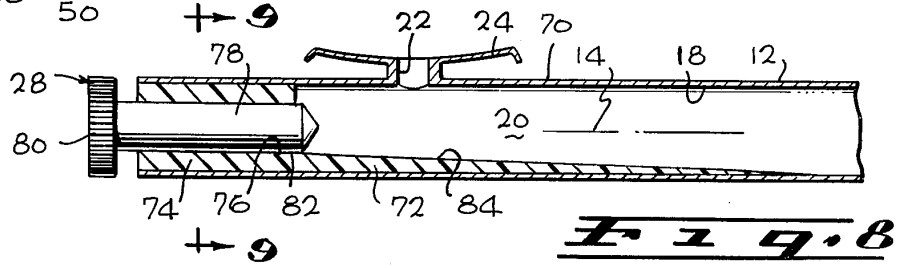


Fig. 8



CYLINDRICAL HEAD JOINT WITH ACOUSTIC WEDGING FOR CONCERT FLUTES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a head joint for a concert flute and more particularly to a head joint having an acoustic taper defined by a wedge disposed within a cylindrical chamber.

2. Description of the Prior Art

One popular wind type of musical instrument has come to be known as the Boehm or concert flute. The Boehm flute traditionally includes a head joint which is detachably connected to a body portion having fingering holes and keys thereon. The head joint has a circular cross-section which is smoothly tapered from a relatively large diameter at the connecting or tenon end to a smaller diameter at the opposite end which is normally closed by a cork. While the internal diameter traditionally has a parabolic taper, modern manufacturing techniqus have often produced a metallic head joint having a linear taper. An embouchure hole is located near the closure end and an embouchure plate is conventionally affixed to the head joint at the embouchure hole to provide a desired increased depth therefor.

A conventionally constructed Boehm flute has several undesirable limitations. Because of manufacturing difficulties, an approximately parabolic taper is seldom available in commercial flutes. The manufacture of wooden or non-metallic head joints is particularly uneconomical because of the requirement for expensive boring tools which must be frequently reconditioned. A head joint with the required inner taper cannot be economically produced from materials such as plastics, which are commercially available in easily manufactured cylindrical shapes and cannot be forced from a cylindrical shape into a tapered form except through very impractical or expensive manufacturing methods.

SUMMARY OF THE INVENTION

A flute head joint in accordance with the invention includes a cylindrical wall with an embouchure hole therethrough defining an inner cylindrical chamber, a closure element disposed to close one end of the cylindrical chamber and a wedge positioned within the cylindrical chamber in abutment with the closure element. The wedge has one end with a largest cross-sectional area in butment with the closure element and extends from the closure end past the embouchure hole to an opposite end of smaller cross-sectional area. The wedge is preferably defined by a cylinder conforming to the hollow cylinder of the head joint truncated by a plane at an acute angle relative to a central axis of the hollow cylindrical chamber. A pin secured to the wedge may extend through the cylindrical wall to permit rotational positioning of the wedge about the central axis of the hollow cylinder and the closure element may extend beyond the end of the hollow cylinder to terminate in an enlarged handle end permit axial positioning of the closure element. The wedge and closure element may be manufactured either separately or integrally as a single unitary piece of material and may be selectively rotationally and axially positioned to provide excellent tuning over the three octaves of the flute. Since the cylindrical chamber may be defined by a non-tapered cylindrical tube, any commercially available tubing whether metallic or non-metallic can be conveniently

used to define the head joint. Similarly, the wedge defining the inner taper of a cylindrical chamber may be of suitable metallic or non-metallic material.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention may be had from a consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a sectional side view of a flute head joint in accordance with the invention taken along a plane passing through a longitudinal central axis of the head joint;

FIG. **2** is a sectional end view of the head joint shown in FIG. **1** taken along plane **2—2**;

FIG. **3** is a perspective view of a wedge used in the head joint shown in FIG. **1**;

FIG. **4** is an alternative embodiment of a wedge and closure element assembly for use in the head joint shown in FIG. **1**;

FIG. **5** is a sectional end view of the assembly taken along plane **5—5** as shown in FIG. **4**;

FIG. **6** is a side view of an alternative embodiment of a flute head joint in accordance with the invention;

FIG. **7** is a sectional end view of the head joint taken along plane **7—7** shown in FIG. **6**;

FIG. **8** is a sectional side view of a flute head joint in accordance with the invention taken along a plane passing through a central axis of the head joint; and

FIG. **9** is a sectional end view of the head joint taken along plane **9—9** as shown in FIG. **8**.

DETAILED DESCRIPTION

As shown in FIG. **1**, to which reference is now made, a head joint **10** in accordance with the invention for a concert or Boehm flute includes a thin cylindrical wall **12** extending along a central axis **14** and having a cylindrical outer surface **16** and a cylindrical inner surface **18** defining a cylindrical hollow acoustic chamber **20**. An embouchure hole **22** extends through the wall **12** providing communication between the outer surface **16** and chamber **20** and an embouchure plate **24** surrounds the embouchure hole to receive the lips of a flute player and increase the thickness of the hole **22**. A cylindrical closure element **26** such as cork is positioned to close the hollow cylindrical chamber **20** between the embouchure hole **22** and a closure end **28** of the head joint **10** and a wedge **30** extends from abutment with the closure element **26** axially past the embouchure hole **22** toward a tenon end **32** of the head joint **10**.

As further illustrated in FIGS. **2** and **3**, while the wedge **30** may have other shapes it is advantageously defined by a plane truncating a cylinder **34** having a central axis **36** at an acute angle with respect to the axis **36**. The wedge thus has a cylindrical surface **38** which engages the inner surface **18** of wall **12** in conformal mating relationship and a flat surface **40**. The wedge **30** may be positioned generally opposite the embouchure hole **22** and selectively rotated about axis **14** to permit tuning of the head joint **10** by selectively changing the angle of the wall opposite the embouchure hole **22** or its longitudinal distance from the embouchure hole **22**.

While the shape and dimensions of the wedge may be manufactured as desired, in one preferred embodiment a wedge in the shape of the wedge **30** shown in FIG. **3** has a cylindrical surface **38** with a diameter of approximately ¾ inch, a maximum thickness of approximately 3/16 inch, an axial length of approximately 4 11/16 inches, and a taper along a flat surface **40** at an angle of

approximately 2.3° with respect to axis **36** to a zero cross-sectional area at a small end opposite the large end.

In an alternative arrangement shown in FIGS. **4** and **5** a wedge **50** has a wedged shaped section **52** identical to the wedge **30** shown in FIGS. **1–3** and a constant cross-section part **54** which extends axially from the wedge shaped portion **52** to the closure end of the head joint **10** with a cross-section that conforms to and abuts with the cross-section of the large end of the wedge portion **52**. A cylindrical element **56** has a flat created on one side thereof to engage a flat portion **60** of the non-tapered or constant cross-section portion **54** of wedge **50**. The closure element **56** thus closes the portion of the hollow cylindrical chamber **20** that is not closed by the constant cross-section portion **54** of wedge **50**. The closure element **56** may be selectively axially positioned within the cylindrical chamber **20** to provide proper tuning of the head joint **10**. This axial positioning may be independent of the axial position of the wedge **50**.

As further shown in FIGS. **6** and **7**, the closure element **56** shown in FIGS. **4** and **5** may be provided with a pin **62** such as a set screw **64** which extends through a pin hole or slot **66** in the wall **12** to provide for selective rotational positioning of the closure element **56** and hence the wedge **50**. The hole **66** is conveniently positioned between the embouchure plate **24** and closure end **28** of the head joint **10** at a circumferential position just behind the embouchure hole **22**. After the closure **56** and wedge **50** are rotationally positioned as desired, the set screw **64** may be tightened to inhibit further changes in the positions of these elements relative to the wall **12**.

In still another embodiment shown in FIGS. **8** and **9**, a head joint **70** is manufactured with a wedge **72** being integral with a cylinder **74** having an outer circumference which sealing engages the inner circumference **18** of wall **12** at the closure end **28** and has a central bore **76** extending axially therethrough concentric with the central axis **14** of the head joint **70**. A generally cylindrical closure element **78** of about **7/16** inch diameter extends through the central bore **76** and extends beyond the closure end **28** to terminate in an enlarged end forming a handle **80** to provide convenient axial positioning of the closure element **78**. The diameter of the bore **76** is advantageously selected to cause the bore **76** to be tangential with a termination point **82** of a taper plane **84** of wedge **72**.

While there have been shown and described various arrangements of a flute head joint in accordance with the invention for the purpose of enabling a person of ordinary skill in the art to make and use the invention, it will be appreciated that the invention is not limited thereto. Accordingly, any modifications, variations, or equivalent arrangements within the scope of the attached claims should be considered to be within the scope of the invention.

What is claimed is:

1. A flute head joint comprising:
- a wall having an embouchure hole therethrough and a closed inner surface defining a hollow cylinder extending along a central axis between opposite ends of the wall;
- a closure element disposed to close the hollow cylinder between one end and the embouchure hole; and
- a wedge positioned within the hollow cylinder and decreasing continually in cross-sectional area from one end disposed on one side of the embouchure hole to an opposite end disposed on an opposite side of the embouchure hole a substantial distance therefrom to provide an acoustic taper to the hollow cylinder.

2. The flute head joint according to claim **1** above, wherein the wedge has a part cylindrical outer surface disposed in mating conformal relationship with the inner surface of the wall throughout at least an axially extending portion of the wedge which decreases continuously in crosssectional area.

3. The flute head joint according to claim **1** above, wherein the one end of the wedge is in abutment with the closure element.

4. The flute head joint according to claim **1** above, further comprising a pin that is secured to the wedge and extends through the wall to provide selective tuning of the head joint by enabling selective rotational positioning of the wedge about the central axis of the hollow cylinder.

5. The flute head joint according to claim **1** above, further comprising a constant cross-section element having a cross-section of the same shape and size as a cross-section of the one end of the wedge and positioned to extend from the one end of the wedge to the one end of the hollow cylinder and wherein the closure element has a cross-sectional shape conforming to a cross-section of the hollow cylinder at the one end that is not occupied by the constant cross-section element.

6. The flute head joint according to claim **5** above, wherein the wall has a pin hole therethrough for receiving a pin and further comprising a pin secured to the wedge and extending through the pin hole to permit rotational positioning of the wedge about the central axis of the hollow cylinder and means for selectively inhibiting motion of the pin.

7. The flute head joint according to claim **1** above, wherein the closure element includes a first portion having a central aperture extending axially therethrough and a second portion that is axially movable within the central aperture of the first portion.

8. A flute head joint defined by a cylindrical wall that is closed at one end and has an embouchure hole therethrough and a wedge secured within a chamber defined by the cylindrical wall and imparting an acoustic taper to the chamber, the wedge extending with continuously decreasing cross-sectional area from a closed end of the chamber past the embouchure hole, at least a portion of the wedge extending past the embouchure hole engaging the cylindrical wall in conformal mating relationship.

9. A flute head joint comprising:
- a wall having an embouchure hole therethrough and a closed inner surface defining a hollow cylinder extending along a central axis between opposite ends of the wall;
- a closure element disposed to close the hollow cylinder between one end and the embouchure hole; and
- a wedge positioned within the hollow cylinder with one end of the wedge having a given cross-sectional area positioned nearer the closure element and decreasing continuously in crosssectional area to an opposite end on the other side of the embouchure hole, the closure element and wedge being a single unitary, integral piece of material.

10. A flute head joint comprising:
- a wall having an embouchure hole therethrough and a closed inner surface defining a hollow cylinder

extending along a central axis between opposite ends of the wall;

a closure element disposed to close the hollow cylinder between one end of the hollow cylinder and the embouchure hole; and

a wedge positioned within the hollow cylinder with one end having a given cross-sectional area positioned nearer the closure element than an opposite end having a smaller cross-sectional area than the area of the one end of the wedge, the wedge having the shape of a cylinder with a central axis and a diameter equal to a diameter of the hollow cylinder defined by the wall, truncated by a plane having an acute angle with respect to the central axis of the wedge.

11. The flute head joint according to claim **10** above, wherein the acute angle is approximately 2.3°.

12. The flute head joint according to claim **10** above, wherein the wedge is positioned with a cylindrical outer circumference in mating abutment with the inner surface of the wall and further comprising means for changing the rotational position of the wedge about the central axis of the hollow cylinder.

13. The flute head joint according to claim **10** above, wherein the wedge is coupled to the closure element and further comprising means for controlling the axial position of the wedge and closure element.

14. The flute head joint according to claim **10** above, further comprising an embouchure plate disposed about the embouchure hole.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,058,046

DATED : November 15, 1977

INVENTOR(S) : Raoul J. Fajardo

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

Column 1, line 22, "technigus" should read --techniques--; line 49, after "in" and before "with", "butment" should read --abutment--; line 60, after "handle", "end" should read --and--. Column 4, line 11, after "in", "crosssectional" should read --cross-sectional--; line 62, before "and", insert --than an opposite end having a smaller cross-sectional area than the area of the one end of the wedge--; line 63, "crosssectional" should read --cross-sectional--.

Signed and Sealed this

Ninth Day of May 1978

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks