

[54] **KEYING MECHANISM FOR WIND INSTRUMENTS**

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[58] Field of Search 84/380, 382, 384, 385

[56] **References Cited**

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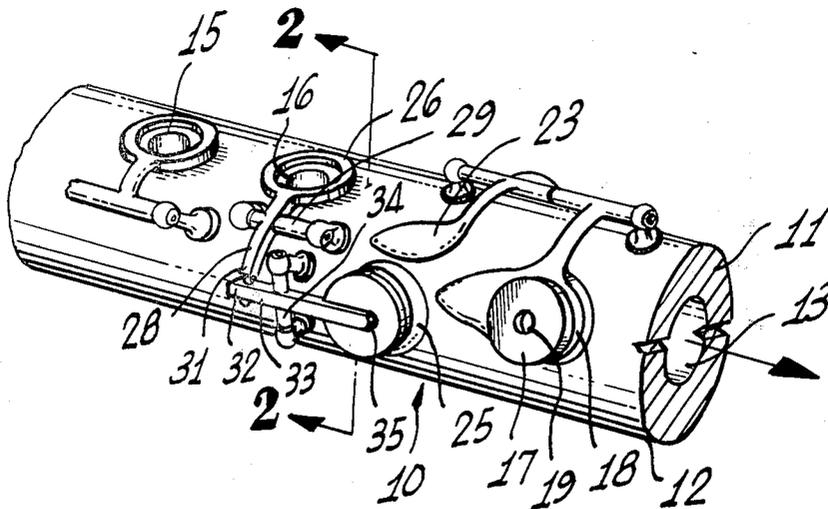
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[57] **ABSTRACT**

A keying mechanism for wind instruments wherein a second hole is provided for a particular note, such as the E flat on a flute, at the same axial location as the original hole for that note. A mechanical linkage is used to automatically open the second hole when another hole in the instrument is uncovered. In the flute, the mechanical linkage is arranged to automatically open the second E flat hole when the note E or a higher note is fingered, thus providing the proper venting and pitch, and allowing the little finger of the player's right hand to be used more easily to manipulate other keys.

3 Claims, 5 Drawing Figures



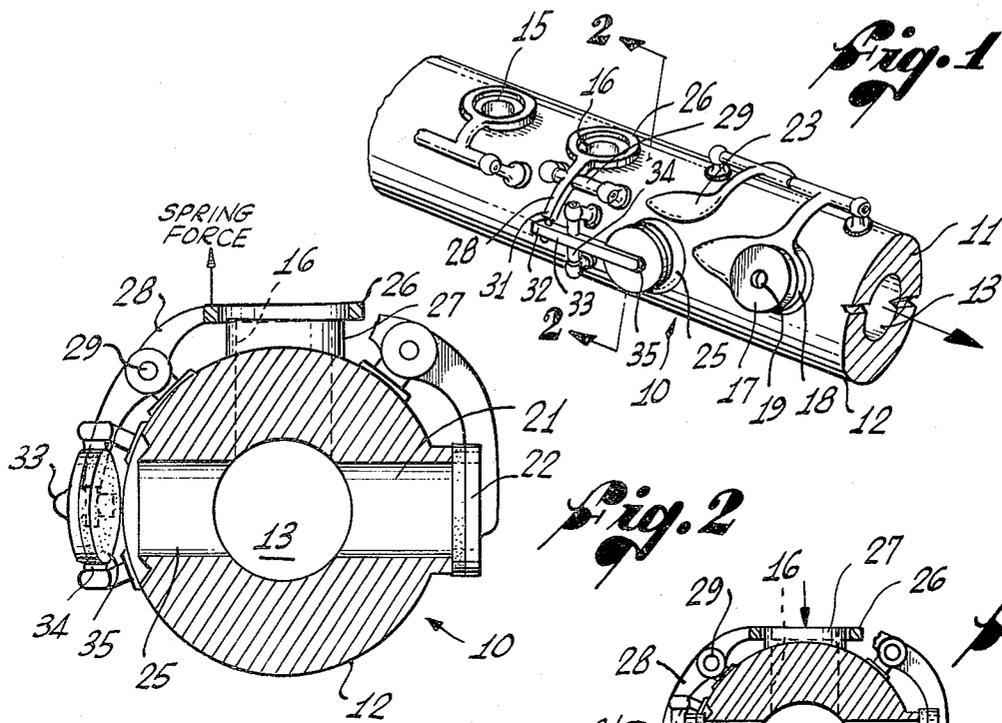


Fig. 2

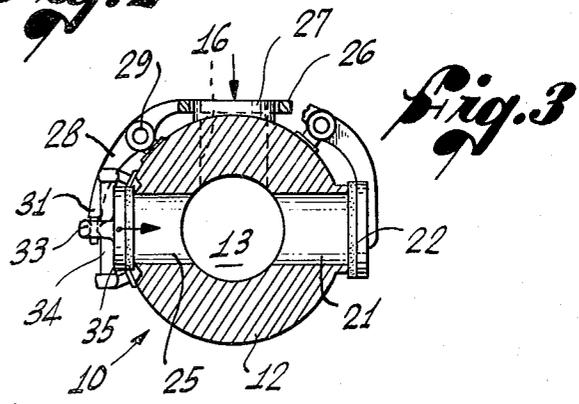


Fig. 3

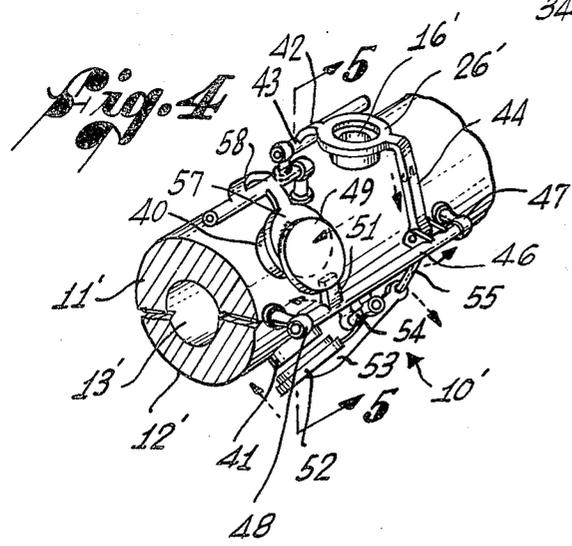


Fig. 4

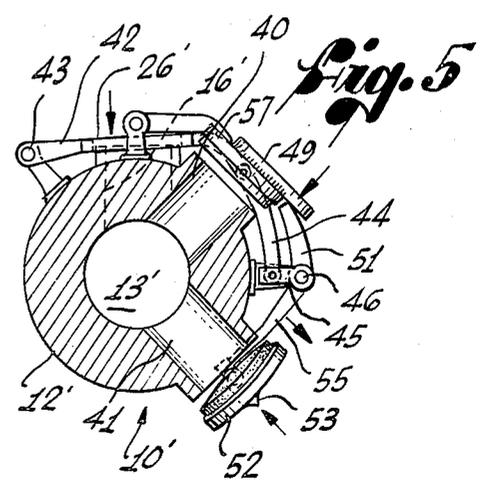


Fig. 5

KEYING MECHANISM FOR WIND INSTRUMENTS

BACKGROUND OF THE INVENTION

The present invention relates generally to musical wind instruments, and, more particularly, to keying mechanisms for wind instruments.

As is well known, wind instruments such as the flute, clarinet, oboe, bassoon, and saxophone, depend for their operation on the vibration of a column of air by means of a vibrating reed or a player's lips at a mouth-piece. The pitch of the resulting musical note depends, of course, on the effective length of the column, and this may be varied by selectively venting the column through holes which may be opened or closed by the player's fingers, either directly or with finger-operated keys. Usually, there are six finger holes, for the three main fingers of each hand. For each type of instrument, keying mechanisms have evolved to allow the player to produce every note in the chromatic scale, but, in some instances, a particular note or the transition from one note to another is very difficult to execute because of the requirements for the keying or fingering of that note.

One such instance arises from the fingering requirements of the Boehm flute. This flute mechanism and the corresponding Boehm-system clarinet mechanism have become practically world-wide standards. In the Boehm flute, and in many alternative designs, fingering of almost any note above low D (the note one tone above middle C) preferably requires the actuation of a so-called E flat key which opens an E flat hole in the flute. Without use of the E flat key for those notes, there is insufficient venting of the flute, and the resulting sounds are "breathy" and slightly flat. Use of the E flat key, on the other hand, gives proper pitch and improves intonation.

Operation of the E flat key is often difficult, however, since it must normally be operated by the little finger of the right hand, and since this finger may also be required to operate other keys in fingering certain notes. Consequently, there is a need for a keying mechanism for wind instruments which automatically opens a hole, such as the E flat hole, and thereby facilitates fingering of certain notes on the instrument. The present invention fulfills this need.

SUMMARY OF THE INVENTION

The present invention resides in the provision of a second hole for a note to be automatically actuated, the second hole being practically identical to the original hole for that note, but angularly spaced from it around the column of the instrument. Basically, and in general terms, the mechanism of the invention comprises a cover for the second hole and a mechanical linkage adapted to lift the cover from the second hole when the player covers or uncovers a particular hole in the instrument.

More, specifically, and by way of example, the invention may be applied to a flute to provide a second E flat hole which is automatically opened when the note E or any higher note is fingered. In a presently preferred embodiment of the invention, the mechanical linkage to uncover the second E flat hole is connected with a ring-key operable when the lower of the six basic finger-holes of the flute is covered. This hole is uncovered to play the note E and most of the notes above E, and the mechanism of the invention ensures that, when the hole

is uncovered, the second E flat hole will also be uncovered. Thus, the notes E and above will be played with the correct pitch and intonation automatically.

The mechanical linkage in this preferred embodiment comprises two rocker-arms, one supporting the cover of the second E flat hole and the other attached to the ring-key, the two being connected so that inward movement of the ring-key towards its hole results in inward movement of the cover. Resilient means urge the cover and the ring-key into a normally open position.

In an alternate embodiment of the invention, a ring-key is connected through a pivoted link to a shaft which is rotatable by movement of the ring-key to open or close two separate E flat holes simultaneously. A cover for one of the E flat holes is connected to a crank on the rotatable shaft, while a cover for the other E flat hole is attached to one end of a center-pivoted lever, the other end of which is movable by another crank on the shaft.

It will be appreciated by those of ordinary skill in the art that the present invention is not limited to the flute, nor to a means of providing an additional E flat. It may be used in a variety of ways in the various wind instruments, wherever it is desired to provide an alternate, and usually simplified fingering for a particular note or key. In brief, the invention provides a simple yet effective means of simplifying the fingering and improving the intonation of the flute and other wind instruments. Furthermore, it may be either incorporated as a feature of newly designed instruments or added relatively easily to existing conventional instruments. Other aspects and advantages of the invention will become apparent from the following more detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a portion of a flute including a second E flat hole controllable in accordance with the invention;

FIG. 2 is an enlarged cross-sectional view taken substantially along the line 2—2 in FIG. 1 and showing the second E flat hole open;

FIG. 3 is a cross-sectional view similar to FIG. 2 but drawn to a reduced scale and showing the second E flat hole closed;

FIG. 4 is a perspective view of a portion of a flute illustrating an alternate embodiment of the invention; and

FIG. 5 is an enlarged cross-sectional view taken substantially along the line 5—5 in FIG. 4.

DETAILED DESCRIPTION

As shown in the drawings for purposes of illustration, the present invention concerns an improved keying mechanism for wind instruments, particularly woodwinds, and, in a presently preferred embodiment, it is incorporated into a flute. A flute is usually manufactured and sold in two or three separate "joints" or sections which are then fitted together to form a single elongated tube. A row of six basic holes is spaced along the length of the tube, and each hole may be covered by one of three fingers of each hand of a player. Only a portion of the lower or "foot" joint 10 is illustrated and the foot of the flute is at the right-hand end 11 of the portion illustrated in FIG. 1.

Like the other joints of the flute, the foot joint 10 is formed as a tube 12 with a generally central bore 13.

which may be cylindrical. In the portion of the foot joint 10 illustrated in FIG. 1, holes 15 and 16 are the lowest-positioned two of the six basic holes in the flute. The flute is normally held with the foot joint 10 in the right hand, and the holes 15 and 16 may be covered by the right middle finger and the right ring finger, respectively.

Toward the foot end 11 is a C key 17 which may be operated by the little finger to cover a normally open C hole 18. The C key 17 has a small hole 19 through it so that it may be operated to cover the C hole either fully or partially. For example, when all six basic holes are covered and the C hole 18 is covered, the middle C note is sounded when the flute is played; but if the C key 17 is operated with its small hole 19 uncovered, the C sharp note is sounded. With the C hole 18 uncovered completely, the note D is produced when all six basic holes are covered.

Between the C hole 18 and the ring-finger hole 16 is an E flat hole 21 (FIGS. 2 and 3). This is normally closed by a spring-loaded cover 22, but may be opened by means of an E flat key 23 usually operated by the little finger. With all six basic holes covered and the E flat hole 21 uncovered, the E flat note is produced. To produce the note E, both the hole 16 and the E flat hole 21 must be uncovered, and to produce almost any note above E, the E flat hole must remain open to provide proper venting of the instrument, and to maintain proper pitch of the desired note. This raises a problem, since the little finger is also required to manipulate other keys on the instrument when certain notes are fingered.

In accordance with the invention, an additional hole 25 is provided at the same axial location on the flute as an existing hole, such as the E flat hole 21, and the additional hole may be closed simultaneously with the opening or closing of another existing hole, such as with the covering of the hole 16 by the ring finger of the right hand. Consequently, when the hole 16 is uncovered to play the note E, the additional E flat hole 25 is automatically uncovered to provide the required venting and accuracy of pitch.

More specifically, when the ring-finger hole 16 is closed, a ring-key 26 surrounding the hole may be moved by the same finger down over a short cylindrical projection 27 extending slightly above the outer surface of the tube 12. The ring-key 26 is mounted at one end of a center-pivoted lever 28 which is pivoted near its center on a bearing shaft 29 mounted in generally parallel relation with the axis of the tube 12. Downward or inward movement of the ring-key 26 causes upward or outward movement of the opposite end 31 of the center-pivoted lever 28. This opposite end 31 is pivotally connected with one end 32 of a second center-pivoted lever 33 independently mounted on a second bearing shaft 34 generally at right angles to the first, and supporting a hole-cover 35 at its other end. A spring (not shown) urges the hole-cover 35 into a normally open position and the ring-key 26 outwardly from the hole 16.

Consequently, the additional E flat hole 26 is kept closed so long as the ring-key 26 is depressed by the finger covering hole 16. However, as soon as the hole 16 is uncovered, to play notes E and above, and the ring-key 26 is released, the additional E flat hole 25 is uncovered automatically to provide proper venting and pitch.

An alternate embodiment of the present invention is illustrated in FIGS. 4 and 5, in which corresponding primed numerals are used to label features with exact counterparts in FIGS. 1-3. In this embodiment, the ring-key 26' may be used to simultaneously control the opening and closing of two separate E flat holes 40 and 41. The ring-key 26' is mounted by a short arm 42 on a bearing shaft 43, and is pivotally connected to a link 44, which, in turn, is pivotally connected to a short crank 45 on a rotatable shaft 46 mounted on end-bearings 47 and 48 on the tube 12' in generally parallel relation with the tube axis. When the ring-key 26' is depressed, the link 44 and the crank 45, which is generally oriented between the shaft 46 and the tube 12, turn the shaft approximately one-quarter turn in a counterclockwise direction as viewed from the foot end 11'.

A hole cover 57 positioned over the first E flat hole 40 may be lifted independently by a conventional E flat key 58. A circular plate 49 of approximately the same size as the hole-cover 57 is rigidly secured to the top of the hole-cover and slightly offset therefrom, as best shown in FIG. 4. A short arm 51 connected to the shaft 46 extends under the plate 49. Thus, when the shaft 46 is rotated in a clockwise direction (as viewed from the foot end 11'), the short arm 51 lifts the plate 49 and, with it, the hole-cover 57, but the hole-cover 57 may also be lifted independently of the shaft rotation, by means of the conventional E flat key 58. A second hole-cover 52 is positioned over the second E flat hole 41 and is carried on one end of a center-pivoted lever 53 mounted on a bearing shaft 54. As the shaft 46 rotates in the counterclockwise direction, another crank 55 on the shaft moves the opposite end of the center-pivoted lever 53 outwardly from the tube 12, thus moving the second hole-cover 52 to close the second E flat hole 41.

As in the first-described embodiment, a spring (not shown) urges the ring-key 26' away from the tube 12' and, consequently, urges the hole-covers 57 and 52 away from the E flat holes 40 and 41, respectively. Therefore, there will be an automatic E flat opening if the ring-key 26' is released. However, even if the ring-key 26' is held down, thereby rotating the shaft 46 counterclockwise and closing the second E flat hole 41, the first E flat hole 41 may still be uncovered by means of the conventional E flat key 58.

It will be appreciated from the foregoing that the present invention greatly facilitates the fingering of certain notes and transitions between notes on the flute and other wind instruments. Moreover, it is relatively uncomplicated to install on existing, conventional instruments or to manufacture in new instruments.

Although particular embodiments of the invention have been described in detail herein for purposes of illustration, it will be appreciated by those of ordinary skill in the art that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

I claim:

1. In a flute having a tubular body with a plurality of holes therethrough selectively coverable by a player's fingers, and including an E flat key operable to open a normally closed E flat hole, the improvement wherein: the body includes an additional E flat hole at substantially the same axial location as the original E flat hole; and

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the flute further includes
 a cover for said additional E flat hole,
 a key operable simultaneously with the covering of
 a particular existing hole,
 mechanical means linking said key with said cover, 5
 and
 resilient means urging said cover open;
 whereby said additional E flat hole is automatically
 uncovered as said key is released by removal of a
 finger from the particular existing hole, and simult- 10
 aneous operation of the E flat key is rendered un-
 necessary.

2. The improvement as defined in claim 1, wherein
 said mechanical means includes:
 a first center-pivoted lever carrying said cover at one 15
 of its ends; and
 a second center-pivoted lever attached to said key by
 one end and pivotally attached by its other end to
 the other end of said first center-pivoted lever,
 whereby depression of said key results in an inward 20
 movement of said cover and release of said key re-
 sults in an outward movement of said cover.

3. In a wind instrument having a generally tubular
 body with a plurality of holes therethrough selectively 25
 coverable by a player's fingers, and a plurality of keys
 operable to cover and uncover other holes in the instru-
 ment to produce desired notes, the improvement
 wherein the body includes an additional hole at sub-
 stantially the same axial location as a first existing hole,
 and wherein the instrument further includes: 30

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cover means for said additional hole, movable be-
 tween two positions;
 mechanical means connected with said cover means
 and operable to move said cover means simulta-
 neously with opening and closing a second existing
 hole on the instrument, said mechanical means
 having
 key means pivotally mounted on the body for
 movement with respect to said second existing
 hole,
 a rotatable shaft mounted on the body,
 linkage means connecting said key means with said
 shaft to rotate said shaft in response to move-
 ment of said key means,
 a center-pivoted lever having one end connected to
 said cover means,
 a crank attached to said shaft and pivotally con-
 nected with said center-pivoted lever to effect a
 displacement thereof in response to rotation of
 said shaft, and
 resilient means urging said cover means open;
 cover means for said first existing hole; and
 an additional crank attached to said shaft and extend-
 ing generally radially therefrom toward and be-
 neath said cover means for said first existing hole;
 whereby, on release of said key means, said resil-
 ient means rotates said shaft, thereby lifting said
 cover means for said first existing hole and said
 cover means for said additional hole.

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