June 20, 1961 E. R. EASH 2,988,948

MUSICAL INSTRUMENT VALVE CONSTRUCTION

Filed March 12, 1958

Fig. 1.

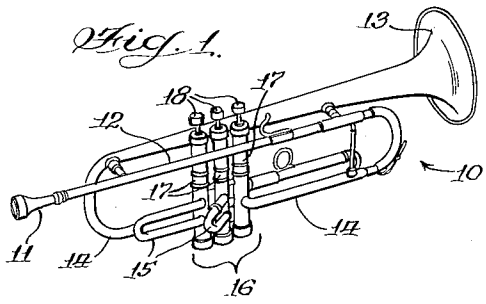


Fig. 2.

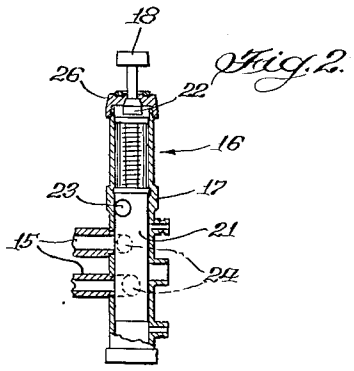


Fig. 3.

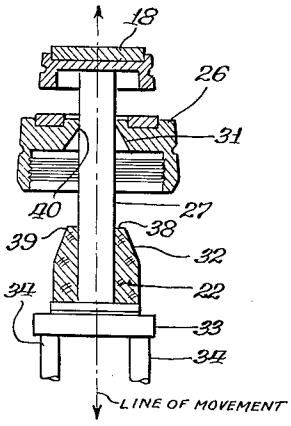


Fig. 4.

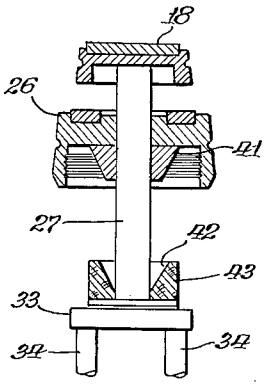


Fig. 5.

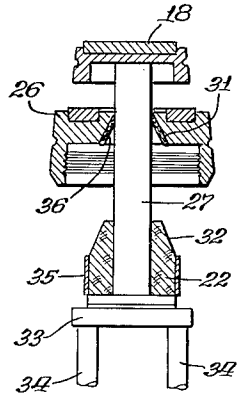


Fig. 6.

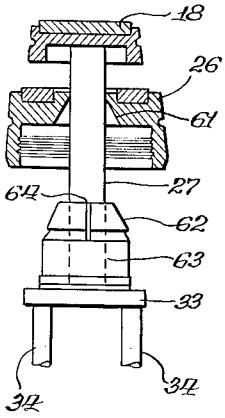


Fig. 7.

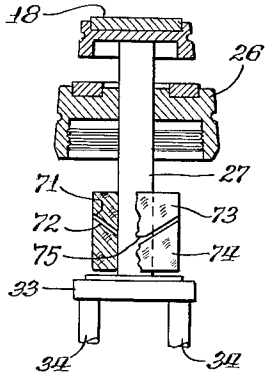
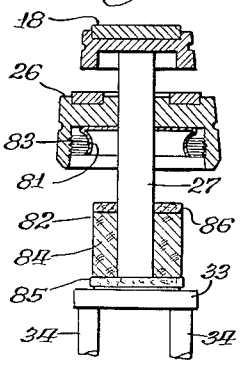


Fig. 8.



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MUSICAL INSTRUMENT VALVE CONSTRUCTION

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This invention relates generally to valves for musical instruments, and more particularly to an anti-bounce valve construction for cornets, trumpets, altos, baritones, bases and like brass-wind instruments.

Brass-wind instruments have a fundamental or prime note whose pitch is determined by the effective length of the main tube of the instrument. Certain other notes are sounded by changing the effective length of the tubing forming the instrument. In cornets, trumpets, and other brass-wind instruments, the change in length is accomplished by actuating valves which are operative to connect one or more slides or crooks into the main tube. Such valves generally have a cylindrical casing with the main tube and the crooks opening into the same. The casing is provided with a hollow piston having ports therein which may be aligned with the crook and tube openings by depressing the piston. The piston is normally biased by a spring to a home position which is defined by a stop provided at the top of the casing. When the piston is depressed and then released, it moves until it strikes the stop, and it may bounce one or more times before it comes to rest at the home position.

The tendency of the piston to bounce away from the stop after striking it is a generally recognized problem in the art. The bouncing may result in rapid mismatching of the ports and tube openings which produces garbled note endings and makes it difficult to produce clean, individual tones, particularly when rapid passages are played on the instrument. The stop may be made of compressible material so that some of the energy of the moving piston is absorbed by compression of the stop. However, it has been found that such stops do not reduce the piston bounce sufficiently to be entirely satisfactory.

Accordingly, it is an object of this invention to provide an effective anti-bounce construction for piston-type musical instrument valves.

Still another object of the invention is to provide a brass-wind instrument having bounce resistant valves without adding costly parts to the instrument.

Another object of the invention is to provide a new and improved piston-type valve construction for a brass-wind instrument wherein the returning piston is braked to reduce bouncing.

A further object of the invention is to provide a brass-wind instrument having a piston-type valve construction with an anti-bounce mechanism in which the kinetic energy of the moving piston is dissipated by friction, thereby greatly reducing piston bounce.

A feature of the invention is the provision of a brass-wind instrument having anti-bounce valves including a spring biased piston reciprocally movable in a casing between a home position and an actuated position, and further including a stop mechanism having one stop surface which slides over another stop surface when the piston returns to the home position under spring pressure, thereby producing friction which reduces the tendency of the piston to bounce away from the home position.

A further feature of the invention is the provision of a brass-wind instrument including a stop mechanism as described in the last preceding paragraph in which at least one of the stop surfaces is provided on a yieldable member which may be made of a compliant material such as cork, thus allowing freedom for relative sliding movement between the stop surfaces.

Another feature of the invention is the provision of a musical instrument including a valve casing, a valve piston reciprocally movable therein, and an anti-bounce mechanism including a stationary stop surface on the top closure of the casing and a movable stop surface on a cork spacer mounted on the piston, with the fixed and movable stop surfaces being disposed angularly with respect to the principal line of movement of the piston and being slidably movable with respect to each other as the piston approaches the closure to produce friction which reduces the piston's bounce.

The invention is illustrated in the accompanying drawing in which:

FIG. 1 is a perspective view of a cornet having valves incorporating the invention;

FIG. 2 is a cutaway view of one anti-bounce valve assembly of the cornet shown in FIG. 1;

FIG. 3 is an enlarged sectional view showing the stop mechanism provided in the valve of FIG. 2 and which forms one embodiment of the invention; and

FIG. 4 shows a stop mechanism in which the sliding parts are reversed as compared to the mechanism of FIG. 3;

FIG. 5 illustrates a modification of the stop mechanism of FIG. 3 including stiffening and noise reducing parts;

FIG. 6 illustrates another embodiment of the invention in which the stop mechanism includes a slotted metallic member;

FIG. 7 shows a further embodiment having two stop members which move with the piston; and

FIG. 8 illustrates still another embodiment of the invention in which there is a stationary stop member in the form of a clip.

The invention provides a piston-type valve construction for brass-wind instruments which virtually eliminates piston bounce, thereby making it possible to play rapid passages on the instruments without producing slurred or garbled note endings. The valve is provided with one stop surface which is moved by the spring biased piston into contact with a stationary stop surface which defines the home position of the piston. When the piston returns to the home position, the movable surface slides over the stationary one to produce friction which dissipates the energy of the piston and permits it to come to rest without bouncing to any undesirable extent. The stop surfaces may be disposed angularly with respect to the principal line of movement of the piston to permit sliding movement therebetween. The freedom of movement required to obtain the desired sliding may be achieved by providing at least one of the stop surfaces on a yieldable member. The precise positioning of the stop surfaces may be selected to suit individual specifications, and as an example, a conical cork spacer may be mounted directly on the piston, and the stationary stop surface may be countersunk in the metallic top closure for the casing.

In FIG. 1 there is shown a cornet **10** including a mouthpiece **11**, a mouthpipe **12**, a bell **13**, and a tube consisting of a main portion **14** and various crooks **15** which open into the casings **17** of valves **16**. The valves have keys **18** for actuating pistons therein to control the effective length of the instrument as previously explained.

In FIG. 2 one of the valves **16** is shown in greater detail with a portion of the casing **17** being broken way to reveal the internal parts including the piston **21** and the stop mechanism **22**. The piston **21** is free to reciprocate in the casing **17** so that the ports **23** and openings **24** may be matched to control the flow of sound through the tube. The piston **17** is shown in a home position with the stop member **22** bearing against the top closure member **26** for the casing **17**.

The stop mechanism for the valve **16** is shown in greater detail in FIG. 3. The stop member **22** is mounted rigidly on a plate **33** which is connected to the piston **21** by guide pins **34**, and the valve stem **27** extends through an aperture in member **22**. The closure member **26** has a tapered or conical surface **31** provided on the underside of member **26** adjacent the valve stem **27**. The stop member **22** likewise has a tapered or conical surface **32** which is adapted to slidably engage the surface **31** to produce friction. The end portion **39** of member **22** has a slightly greater radius than the corresponding end portion **40** of surface **31**, and member **22** is preferably made of cork so that surface **31** can yield laterally or radially. These provisions allow freedom of movement for the surface **32** to slide over the surface **31**.

The required freedom for movement along the principal line of movement may, of course, be obtained in other ways. For instance, tthe surface **32** may be normally offset laterally with respect to surface **31** and may be given a degree of freedom perpendicular to the principal line of movement so that the member **22** moves laterally as surface **32** slides over surface **31**. Thus, so long as member **22** is laterally yieldable, it is not essential that surfaces **32** and **31** be coaxial nor that the member **22** be made of yieldable material. It has been found possible to obtain some lateral freedom merely by allowing a substantial tolerance for the fit betwen the piston **21** and the casing **17**.

It has been found that the degree of bouncing of the piston can be reduced to a minimum by selecting optimum angles for the stop surfaces **31** and **32**. Tests have been conducted on a non-lubricated structure in accordance with FIG. 3 in which the surface **32** formed an angle of 28° with the principal line of movement, and the surface **31** formed an angle of 35° therewith. The length of the tapered surface **32** was about $\frac{7}{32}$ inch with a $\frac{1}{32}$ inch land **38** on the top of the member **22**. It was found that on the average the piston bounced only once a distance equal to 12.65% of its displacement. The bounce may be further reduced by lubricating the piston. Extremely good results were also obtained when the angle formed by the surface **32** was selected in the range of 25–40°, and with the angle formed by the surface **31** slightly larger than that of surface **32** and within the range of 30–45°. If the angle formed by surface **32** is too small or if difference between the angles formed by the two surfaces is too small, the piston may have a tendency to stick in the home position. However, no objectionable sticking was observed in structures where the angles were selected in the above ranges and the angular difference between the two surfaces was in the range of 2–20°.

FIGS. 4–8 inclusive show the construction of other embodiments of the invention. FIG. 4 illustrates a construction in which the stationary stop surface **41** is raised with respect to the underside of the closure member **26** instead of being countersunk as in FIG. 3. Consequently, the movable stop surface **42** is countersunk in a stop member **43** which is made of cork. Of course, the position of the cork and metallic materials may be interchanged so that cork is used for the stationary member and metal is used for the movable member.

FIG. 5 shows a modification of the structure shown in FIG. 3 wherein the member **22** has a metal band **35** encircling the flat portion of its surface to lend rigidity. The stationary stop surface **31** is lined with a washer **36** of felt, and this has been found to reduce noise.

A reduction of piston bounce may be obtained when both stop surfaces are of the same material, and the material of both may even be metal. Such a construction is illustrated in FIG. 6 where the stop surface **61** is countersunk in the metal closure member **26** and the movable stop surface **62** is provided on a metallic member **63**. Open-ended slots **64** are provided around the periphery of the surface **62** so that it will yield after it contacts the surface **61**.

FIG. 7 shows an embodiment having stop surfaces which are both provided on members made of compliant material such as cork. The members **73** and **74** have V-shaped surfaces **71** and **72** which engage each other. The member **73** is held stationary when it abuts against the closure member **26**, and the member **74** is rigidly mounted on the plate **33**. Both members move with the piston, and both members yield somewhat under pressure so that surfaces **71** and **72** can slide with respect to each other when the piston moves to the home position thereof. The angles of the surfaces **71** and **72** may be slightly different, and the point of the V on one member may be flattened as at **75** in FIG. 7 to allow room for sliding.

In FIG. 8 there is shown still another embodiment of the invention in which the stationary stop member **83** is a clip member having a curved surface **81** facing the valve stem **27**. The movable stop member **84** is made of cork and has felt washers **85** and **86** on either side thereof. When the member **84** is moved into contact with the clip **83**, the vertical surface **82** thereof slides over the surface **81**. The cork surface **82** yields under the pressure applied by the piston to allow the desired sliding movement.

It is apparent from the foregoing description that the invention provides an improved valve construction which reduces piston bouncing to a minimum. The construction is simple and does not substantially increase the cost of manufacturing the musical instrument, and yet it provides a very effective anti-bounce mechanism which is thought to be an improvement over known constructions.

I claim:

1. A valve construction for a musical instrument of the brass-wind type, including in combination, a valve casing, a piston reciprocally movable in said casing along a principal line of movement between actuated and home positions, a spring for biasing said piston to said home position, first stop means defining said home position and having a first stop surface forming an acute angle with respect to said principal line of movement of said piston, second stop means movable with said piston and having a second stop surface forming an acute angle with respect to said principal line of movement of said piston, said second stop surface being engageable with said first stop surface and slidably movable thereon as said piston returns to its home position, said second stop surface having a substantial coefficient of friction on said first stop surface, so that when said piston is moved by said spring the kinetic energy thereof is dissipated by sliding friction between said first and second stop surfaces produced as said second stop surface slides on said first stop surface, thereby effectively reducing the tendency of said piston to bounce away from said home position.

2. A valve construction for a musical instrument of the brass-wind type, including the combination defined in claim 1 with the angle of one of said stop surfaces with the principal line of movement of said piston being in the range of about 30–45°, with the angle of the other of said stop surfaces with the principal line of movement of said piston being smaller than the aforementioned angle and in the range of about 25–40°, and with the difference between the angles of said stop surfaces being in the range of about 2–20°.

3. An anti-bounce valve construction for a brass-wind musical instrument, including in combination, a valve casing, a piston reciprocally movable in said casing between actuated and home positions, a spring for biasing said piston to said home position, first stop means having a first conical stop surface, means for holding said first stop means stationary to define said home position, second stop means movable with said piston and having a second conical stop surface engageable with said first stop surface and slidably movable thereon as said piston returns to its home position, said first and second stop surfaces having a substantial coefficient of friction with respect to each other, one of said first and second conical stop surfaces being laterally yieldable and one thereof having a portion

of greater radius than a corresponding portion of the other to facilitate relative sliding movement therebetween, so that when said piston member is moved by said spring, the sliding friction between said stop surfaces effectively reduces the tendency of said piston to bounce away from its home position.

4. An anti-bounce volve construction for a musical instrument of the brass-wind type, including in combination, a cylindrical valve casing, a piston reciprocally movable in said casing along a principal line of movement between actuated and home positions, a spring for biasing said piston to said home position, first stop means having a first stop surface forming an acute angle of the order of 35° with said principal line of movement of said piston, means for holding said first stop means stationary to define said home position, second stop means movable with said piston and having a second stop surface forming an angle of the order of 28° with respect to said principal line of movement, said second stop surface having an end portion of greater radius than the corresponding end portion of said first stop surface and engageable with an intermediate portion of said first stop surface, said second stop surface being slidably movable on said first stop surface, so that when said piston member is moved by said spring from an actuated position to said home position, the sliding friction between said stop surfaces reduces the tendency of said piston member to bounce.

5. An anti-bounce valve construction for use with a musical instrument of the brass-wind type, said valve construction including in combination, a cylindrical valve casing, a piston reciprocally movable in said valve casing along a principal line of movement between actuated and home positions, a spring for biasing said piston member to said home position, a valve stem on said piston for actuating the same, said valve stem extending from an end of said valve casing, a closure member on the end of said valve casing from which said stem extends, said closure member having a conical first stop surface coaxial with said valve stem and directed towards said piston for defining said home position, second stop means comprising a tubular spacer member mounted on said piston with said valve stem extending through the same, said second stop means having a conical second stop surface coaxial with said valve stem and in alignment with said first stop surface, said second stop surface being engageable with said first stop surface and slidably movable thereon as said piston returns to its home position, thereby producing friction which dissipates the kinetic energy of said piston to reduce the tendency of the same to bounce.

6. An anti-bounce valve for a brass-wind musical instrument, including in combination, a valve casing, a piston reciprocally movable in said casing between actuated and home positions, a spring for biasing said piston to said home position, first stop means having a first stop surface for defining said home position of said piston, second stop means secured to and movable with said piston and having a second stop surface slidably engageable with said first stop surface, said first and second stop surfaces being constructed to present a substantial coefficient of friction therebetween, at least one of said stop surfaces having a contour flared in the direction of movement of said piston and at least one of said stop means being laterally yieldable in the direction transverse to the direction of movement of said piston, whereby the tendency of said piston to bounce away from said home position when moved thereto by said spring is effectively reduced by sliding friction between said first and second stop surfaces during sliding movement of said second stop surface on said first stop surface.

7. An anti-bounce valve as defined in claim 6 in which said first stop means is a resilient clip having a yieldable flared clip portion and said second stop means is a yieldable cylindrical member slidably engageable with said clip portion as said piston is moved from an actuated position to a home position.

8. A valve construction as defined by claim 6 in which each of said first and second stop surfaces are of generally V-shaped configuration with one of said stop surfaces having a flattened portion at the apex thereof.

9. A valve construction as defined in claim 6 and further including a compressible washer lining said first stop surface, and a retaining ring surrounding a portion of said second stop means for adding rigidity thereto.

10. A valve construction as defined by claim 6 in which said second stop means has a metallic end portion on which said second stop surface is provided, and with said end portion having at least one slot extending therethrough which is open at one end thereof for rendering said second stop surface laterally yieldable.

11. A valve construction for use in a musical instrument of the brass-wind type, including in combination, a cylindrical valve casing having a plurality of tube openings therein, a piston reciprocally movable in said casing along a principal line of movement between actuated and home positions, said piston having a plurality of ports therein for alignment with said tube openings for controlling the flow of sound through said valve casing, a spring for biasing said piston to said home position, first stop means having a first stop surface of revolution forming an acute angle with respect to said principal line of movement of said piston, means for normally holding said first stop means stationary to define said home position, second stop means secured to and movable with said piston and having a second stop surface of revolution forming an acute angle with respect to said principal line of movement, said second stop surface being engageable with said first stop surface and slidably movable thereon as said piston returns to its home position, said first and second stop surfaces having a substantial coefficient of friction with respect to each other, and one of said first and second stop means being made of compliant material to provide freedom for relative sliding movement between said stop surfaces, so that when said piston member is moved by said spring from an actuated position to said home position the sliding friction between said stop surfaces reduces the tendency of said piston to bounce to thereby prevent mismatching of said ports and said tube openings.

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