May 22, 1945. J. RUETTIGER 2,376,453

MOUTHPIECE FOR CORNETS

Filed July 17, 1943

Fig. 1.

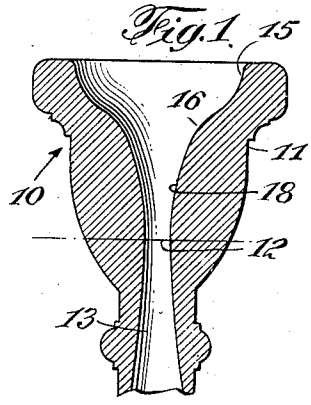


Fig. 2.

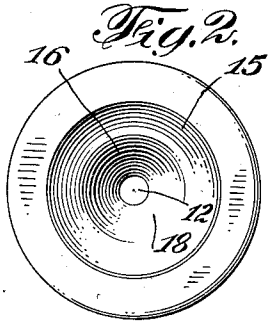


Fig. 3.

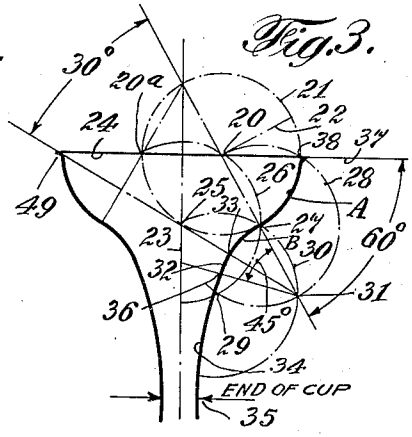


Fig. 4.

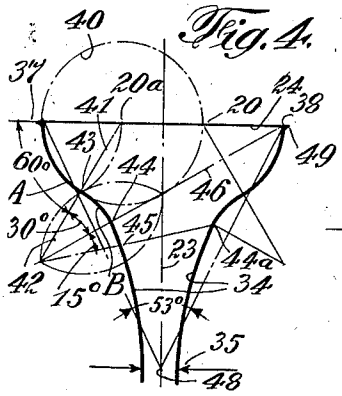


Fig. 5.

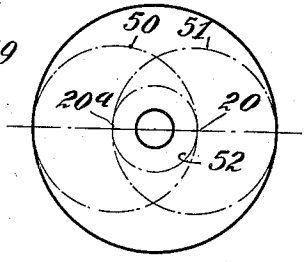


Fig. 6.

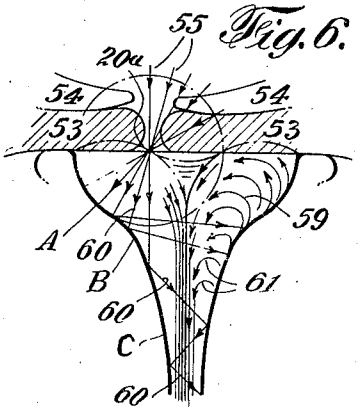


Fig. 8.

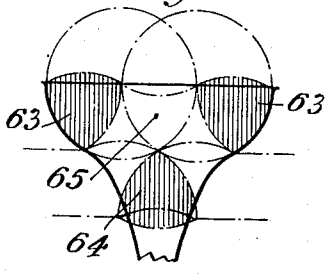


Fig. 10.

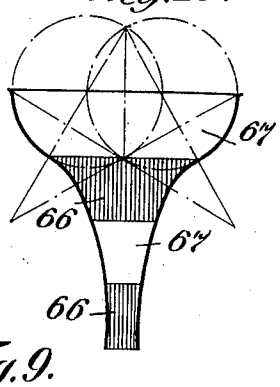


Fig. 7.

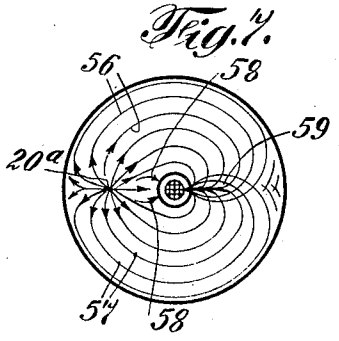
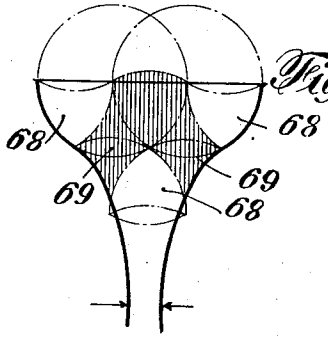


Fig. 9.



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UNITED STATES PATENT OFFICE

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MOUTHPIECE FOR CORNETS

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4 Claims. (Cl. 84—398)

This invention relates to mouthpieces for cornets, trumpets and the like.

The object of the invention is to provide a structure in which the stream of air is controlled, and in which the fundamental vibration periods and wave fronts are so directed that only sounds in distinction to noises are produced when the mouthpiece is played upon. Uncontrolled streams of air emanating from the lips set up whirls and these influence the reflection of the vibrations. When vibration periods are distorted, noises are also produced. The generally recognized frequencies of sounds are up to about 2000 vibrations per second (see patent to R. F. Norris, No. 1,726,500, of August 27, 1929) and those of noises beyond 2000 to 4000 or thereabouts. Again, production of harmonics adds to the beauty of tones—inharmonics leave dissonant or noisy impressions upon the ear.

The invention consists of a mouthpiece in which directly contiguous to the top of the same or to the rim plane a circular segment conoidal portion receives the breath from the lips and directs the stream of breath to the bore of the stem in a semi-circular path without eddy currents, whirls or cross currents, when the breath is directed from a point about one-third the diameter of the entrance bore of the mouthpiece. The curvature from this circular segment then continues in ogee curve form into a substantially circular segment, as part of a constant curve terminating in the end of the cup in its narrowest bore, the bore widening as known in the stem. The first or concave segment corresponds to a radius angle of about 60°, and the second or convex segment to a radius angle of from 30° to 45°, followed by a constant curve. The meaning of a constant curve here, is a curve, which changes its radius of curvature from point to point, until it is parallel with the axis of the cup at the end of said cup.

The advantage of this construction is that the fundamental vibration periods and wave fronts are not distorted, that resonance is obtained by the unobstructed and free flowing stream of air, and that successive unimpeded compressions and rarefications are maintained through the cup and stem to be amplified in the horn portion of the instrument.

The invention will be more fully described hereinafter, embodiments shown in the drawing, and the invention will be finally pointed out in the claims.

In the accompanying drawing—

Fig. 1 is a central section of my improved mouthpiece cup;

Fig. 2 is a plan view thereof;

Fig. 3 is a diagrammatic view showing one form of constructing the same;

Fig. 4 is a diagrammatic view showing another form of constructing the same;

Fig. 5 is a diagrammatic plan view;

Fig. 6 is a diagrammatic view showing the action of the air stream, when emanating at a point about one-third of the entrance bore diameter;

Fig. 7 is a diagrammatic plan view of Fig. 6; and

Figs. 8, 9 and 10 are diagrammatic views of the fundamental vibration actions setting up periods of compression and rarefaction, coincident with deflected spherical wave fronts of such periods.

Similar characters of reference indicate corresponding parts throughout the various views.

Referring to the drawing, and more particularly to Figs. 1 and 2, the improved cup or mouthpiece 10 is made of the usual metal, having a suitable and usual ornamental exterior contour 11. Centrally thereof is a bore having a contour terminating at the point known as the end of the cup, as at 12, and the bore continues to the end of the stem 13, which latter is inserted into the bore of a cornet, trumpet, etc., and held therein by frictional contact, all as known.

The improvement consists in directly at the open end of the central bore providing a circular segment conoidal contour 15, which forms with a circular segment conoidal contour 16, an ogee curve. From the end of this second curved contour the central bore contour of the remaining part of the cup has a constant curve to the part of the smallest diameter, which is about at the end of the cup and at the beginning of the stem.

It is important that the first circular segment conoidal portion begins directly at the entrance plane of the mouthpiece. If a cylindrical bore be interposed as proposed by the prior art, the principle to be referred to will find no application. This part of the structure is essential. The second part of the ogee curve may be composed of a segment corresponding to an angle of from 30° to 45°, and even an approximating curve will be included, when such curve forms part of the constant curve referred to. But the dominant first curve must begin at the plane of the cup and terminate at about 60° angularity from the center of curvature, when such center is placed about one-third the diameter of the entrance plane of the cup.

For this purpose, one manner of constructing the interior contour of the cup, is to determine upon the desired diameter. These are in general of standard sizes, but players prefer one or the other size. This determined upon diameter is then divided into three parts, and at one-third distance from the rim at 20, a circle 21 with a radius of curvature 22 of such one-third distance is drawn. When this circle 21 intersects the perpendicular 23 to the diameter 24, at 25, a circle 26 with the same radius is drawn, and

where this circle 26 intersects the circle 21 at 27, this point acts as a new center of curvature. Again a circle 28 is drawn with the same radius from point 27, where this circle 28 intersects circle 26, the intersecting point 29 is fixed, which acts as a new center for a circle 30. Where circle 28 intersects circle 30, the point of intersection 31 with the same radius is used to draw a circle 32 from point 27 to point 29, and this segment corresponds to 60° angularity. Here, one-half or 30° from the point 27 to point 33 is the preferred curvature, and the curvature 33 to 29 may be used, or from the point 33, the constant curve 34 can begin which terminates the end of the cup at 35. Or, the constant curve could begin at a point 36, corresponding to 45° from the point 27. It will be seen that the interior of the bore contour beginning at the plane 37 of the cup at 38, and following a truly circular curvature up to 27, then in ogee curve fashion continues in a convex circular curvature to either 33, or 36, or 29, when it continues in a constant curve to the end of the cup at 35.

Another form of construction is seen in Fig. 4. The tertiary points 20 and 20*a* are determined. A circle 40 with the third distance radius is drawn with point 20*a* as a center. The segment A desired ends at 43 which the radius 41 makes an angle with the plane 37. At an angle of 60° from the plane 37, the radius 41 is extended a distance 42 equal to the radius 41. The end of this double radius from point 20*a* is used as a point and at the radius 42 a curve or segment B is drawn at an angle of 30° or 45°, as desired, from which corresponding points 43 and 44, the constant curve 34 is then drawn to the end of the cup 35. It will be noted that the 30° line 46 passes through the point 38 of the lip, and the 45° line, through the point 44*a* which corresponds to the point 44.

It will also be noted that both in Figs. 3 and 4, the perpendicular 23 from the plane 37 to the point 48 in Figure 4, is the same length as the diameter 24, and that lines drawn from the lip points 38, to the perpendicular terminus 48 form an angle of 53°.

It will be noted that the cup at its interior at the plane 37 is slightly round to avoid a sharp corner, which would injure the lips, but this fillet 49 does not form a cylindrical bore.

In Fig. 5, a plan view showing two circles 50 and 51 are shown drawn from the teritiary points 20 and 20*a*.

The blower blows at any point along a circle 52, which circle is always one-third the diameter of the cup. The air flow enters at 20*a*, for example, as seen in Fig. 6, the lips being shown by 53, and teeth by 54. The arrows 55 show the air emanating from the mouth, and the air projections strike the segment A and are deflected to semi-circular stream lines 56 and 57 as shown in Fig. 7. Some 58 enter the bore longitudinally. The stream lines 56 and 57 merge at the diametrically opposite part of the cup at 59 and descend into the bore, as shown best in Fig. 7. Other stream lines are deflected by segment B and gradually enter the bore as shown by the deflecting lines 60 and arrows 61.

In Figs. 8, 9 and 10 are shown compression conditions 63 and 64 in Fig. 8 at one-fourth of a fundamental vibration period, and rarefaction conditions 65 which merge into compression in 66 and rarefactions 67, in Fig. 10, at one-half vibration period, and rarefaction conditions 68 and compression 69 at three-fourths vibration period in Fig. 9, which result in the same relationship as shown in Fig. 9 at the end of one vibration period.

The spherical wave fronts emanating from the lips are deflected from the circular segment A and form patterns much like those shown in Figs. 8 and 10. The point of entrance always being at the radius distance of the circular segment, the sphere of the front of the sound waves formed extends its sphere and the extended parts are reflected symmetrically. This is due to the fact that the concave circular segment portion of the cup designated A begins in the plane of the cup, and does not have any intervening cylindrical or other portion. It is the circular segment A portion when made as shown in the drawing that gives the result. A cup acting with resonance and in the production sounds without noises or distorted vibration periods and wave fronts differs from the prior art cups in which noises or distorted vibration tones are produced. Superposed waves without distortion produce harmonics. Thus, brilliancy of tone, musical sounds and resonant characteristics are produced.

It will have been noted that the invention comprises a cup of a mouthpiece, for mouthpieces of all brass instruments, which has two curvatures and its depth always related to its diameter. The depth of the cup of the mouthpiece, and measured in the direction of the axis of said mouthpiece from top of the rim through the cup to the point where cup and shank (or tube) meets and where the inside of the mouthpiece starts to be narrowest, equals about the diameter of said cup.

The inside wall of the cup of said mouthpiece where the curvatures are located can be regarded as consisting of three sections. Section A is the one next to the rim of the mouthpiece. Its curvature is concave towards the axis of the mouthpiece. The radius of said curvature equals one-third of the diameter of the cup of the mouthpiece. The opening or segment of the curvature equals 60° starting from the top of the rim. Section B is the one next to section A. Its start coincides with the end of section A and has the same radius of curvature as section B, but in reverse. That is, its curvature is convex towards the axis of the mouthpiece. The opening (or segment) of this curvature depends on the shape of section C, but it is not less than 30° nor more than 60° from its start. Section C is the connection between section B and the shank (or tube) of the mouthpiece. It may be suitably curved, convex, towards the axis of the mouthpiece, thus giving the air more activity when thrown into the mouthpiece or it may be straight, if desired, giving the air somewhat less activity. The latter depends on the character of the instrument on which the mouthpiece is to be used.

In both cases however, section C ends in the shank (or tube) of the mouthpiece and the width of the shank there, determines the width of the end of the cup.

The idea of this cup of a mouthpiece is to transform more of the spent energy of the performer into sound when playing an instrument and to produce a better, more harmonic sound by means of using sine curves and a constant curve in the construction of said cup, thus creating more ideal conditions for superposing vibration impulses (compressions, rarefactions) of the air column in the cup, on the vibrations of the lips of the performer and impulses on impulses, of

the air column in the cup of the mouthpiece. Further to make more use of the air current from the lips of the performer, which forms smaller and one large current in the cup of the mouthpiece, for support of the lips of the performer, so that the pressure of the rim of the cup of the mouthpiece on the lips gets eased, thus providing better blood circulation in the lips of the performer.

An old rule for the position of the mouthpiece on the lips of the performer is to place it in the center of the lip opening, two-thirds on one lip and one-third on the other lip. Furthermore the more producing part of the mouth should get the two-thirds while the more reducing part of the mouth (usually the lower jaw) should get the one-third. The tongue, which closes the opening of the lips, performs a backward movement, and the air contained in the lungs and throat, passes between the lips into the cup of the mouthpiece and causes the lips to vibrate. Those vibrations cause compressions and rarefactions of the air column in the cup. The escaping air current from the lips strikes the surface of the cup normally or nearly so, spreads out over the surface of the cup in the form of a current and meets opposite the axis of the cup and gives rise to a circular current of air, still having the impulses of compressions and rarefactions. Now due to the construction of the cup on the one hand and the lips closing the cup on the other hand, said air current forms, after being reflected from the surface of the cup, and after having spent some of its energy in the form of support on the lips, superposed some of its vibration impulses (compression, rarefaction) on the vibration of the lips, a so-called whirlpool occurs, getting compressed where opposite currents meet and rarefacted in the axis of the cup and so passes through the axis of the cup into the stem, and instrument.

The air current in the cup thus has a longer way to go before entering the stem as it would have if it would pass from the lips straight into the stem. Therefore more vibration impulses get superposed, wider amplitudes occur.

In the improved cup, the sine curves and the constant curve are smooth curves without abrupt endings and tend to reflect smoothly more of the air current towards the lips of the performer and so support them more than it would be with other cups. Furthermore that constant curve is no hindrance for the air current to pass, after that so-called whirlpool, through the cup into the stem, because there is constant rarefaction of the air in the axis of the cup; the current tends to fill that up. A better resonance is possible and the standing sound waves in the instrument more in harmony with the oncoming waves.

I have described several forms of my invention, but obviously various changes may be made in the details disclosed without departing from the spirit of the invention as set out in the following claims.

What I claim is:

1. A mouthpiece for cornets and the like, comprising a cup having an open bore in a plane, and inner walls forming said cup in mirror reverse, each of said walls formed of a circular conoidal concave segment of a radius of curvature equal to one-third of the diameter of said bore, the center of curvature being substantially at the point partitioning off said one third from one end of said diameter, said segment beginning at said plane and directly curving from said plane downwardly and terminating where the radius of curvature makes an angle of 60° with said plane, a second segment of convex circular curvature in downward continuation of said first segment, and a constant curve to the end of the cup, in downward continuation of said second segment.

2. A mouthpiece for cornets and the like, comprising a cup having an open bore in a plane, and inner walls forming said cup in mirror reverse, each of said walls formed of a circular conoidal concave segment of a radius of curvature equal to one-third of the diameter of said bore, the center of curvature being substantially at the point partitioning off said one third from one end of said diameter, said segment beginning at said plane and directly curving from said plane downwardly and terminating where the radius of curvature makes an angle of 60° with said plane, a second segment of convex circular curvature in downward continuation of said first segment, and a constant curve to the end of the cup, in downward continuation of said second segment, said second segment having a radius of curvature equal to that of the first segment and corresponding to an angular movement of 30° to 45°, and merging at one end in the first segment and at the other end in the constant curve, the first and second segment forming an ogee shaped curve.

3. A mouthpiece for cornets and the like, comprising a cup having an open bore in a plane, and inner walls forming said cup in mirror reverse, each of said walls formed of a circular conoidal concave segment of a radius of curvature equal to one-third of the diameter of said bore, the center of curvature being substantially at the point partitioning off said one-third from one end of said diameter, said segment beginning at said plane and directly curving from said plane downwardly and terminating where the radius of curvature makes an angle of 60° with said plane, a second segment of convex circular curvature in downward continuation of said first segment, and a constant curve to the end of the cup, in downward continuation of said second segment, said second segment having a radius of curvature equal to that of the first segment and corresponding to an angular movement of 30° to 45°, and merging at one end in the first segment and at the other end in the constant curve, the first and second segment forming an ogee shaped curve, the longitudinal axis of the cup having a length equal to the internal diameter of the cup at said plane, the connecting lines of the free end of the axis at the end of the cup and the termini of the diameter forming an angle of 53°.

4. A mouthpiece for cornets and the like, comprising a cup having an open bore in a plane, and inner walls forming said cup in mirror reverse, each of said walls formed of a circular conoidal concave segment of a radius of curvature equal to one-third of the diameter of said bore, the center of curvature being substantially at the point partitioning off said one third from one end of said diameter, said segment beginning at said plane and directly curving from said plane downwardly and terminating where the radius of curvature makes an angle of 60° with said plane, a second segment of convex circular curvature in downward continuation of said first segment, and a bore in downward continuation of said second segment, formed of a constant diminishing diameter extending from the end of said convex curvature to the beginning of the stem.

JUSTIN RUETTIGER.