Nov. 18, 1952 D. W. MARTIN 2,618,191

MICROPHONE PICKUP ENCLOSURE

Filed Feb. 3, 1949 2 SHEETS—SHEET 1

Fig. 1.

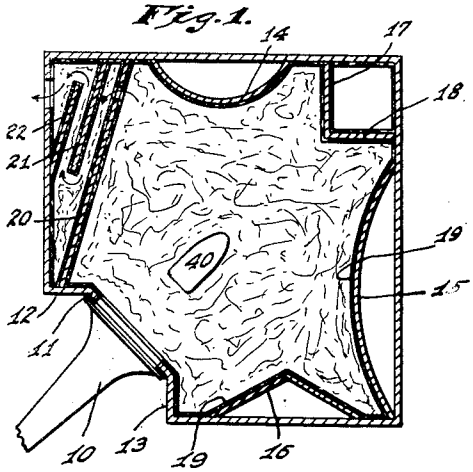


Fig. 3.

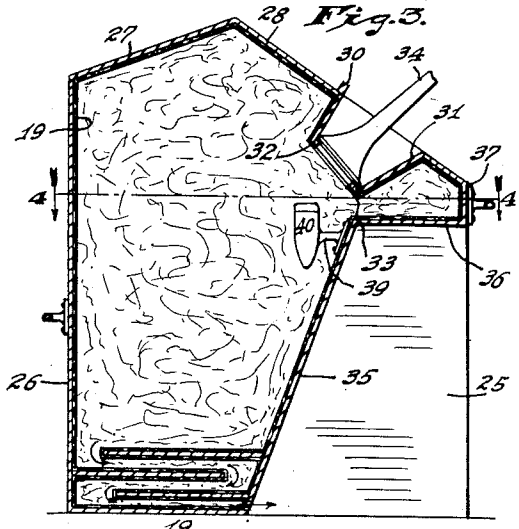


Fig. 2.

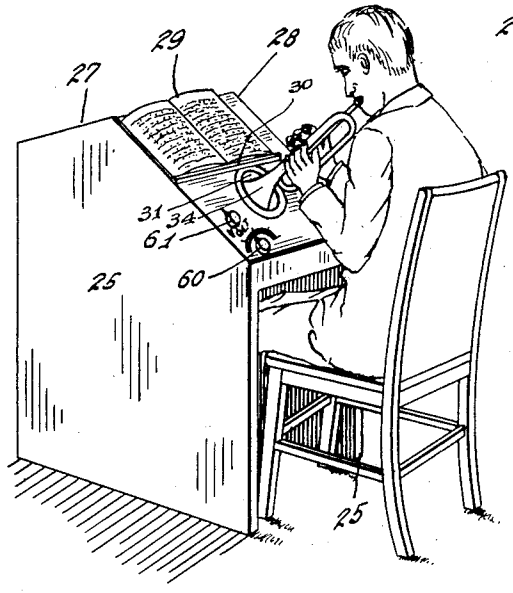


Fig. 4.

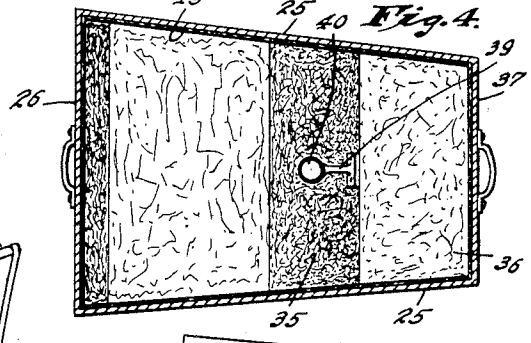
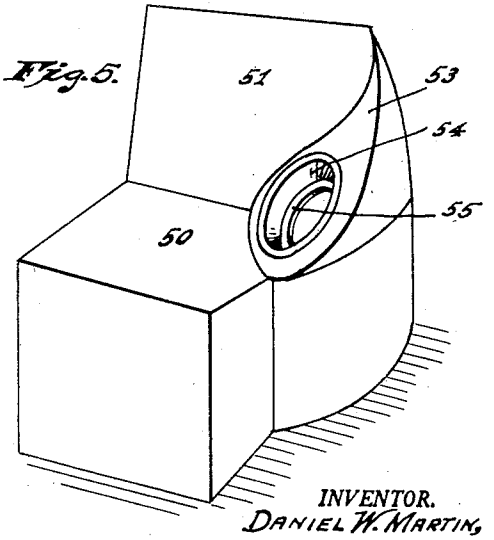


Fig. 5.



INVENTOR.
DANIEL W. MARTIN,

BY
Schley, Dasti & Jenkins
ATTORNEYS.

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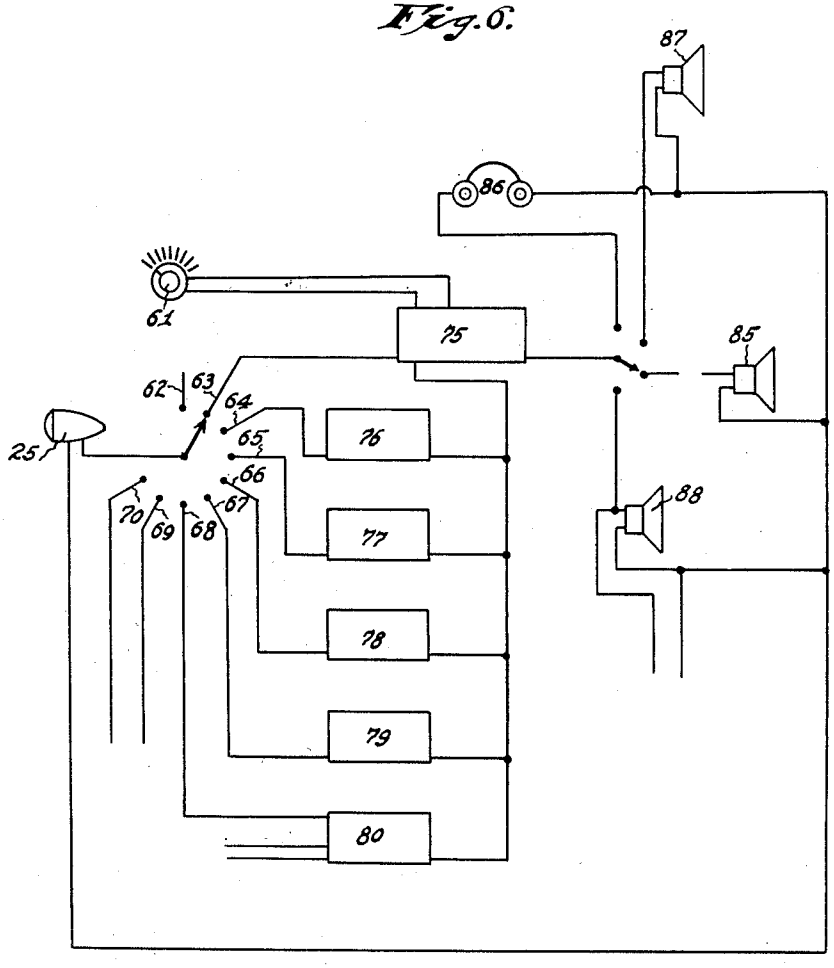
Filed Feb. 3, 1949 2 SHEETS—SHEET 2

Fig. 6.



INVENTOR.
DANIEL W. MARTIN,
BY
Schley, Nash & Jenkins
ATTORNEYS.

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MICROPHONE PICKUP ENCLOSURE

Daniel W. Martin, Blackwood, N. J.

Application February 3, 1949, Serial No. 74,332

17 Claims. (Cl. 84—453)

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This invention relates to acoustical and electrical control of the output of a musical instrument. More particularly, my invention relates to a device for use with or combined with an individual musical instrument to attenuate the direct sound therefrom, and with which a microphone of a reproducing system is associated. My invention has special applicability to use with the conventional brass wind instruments, of which the cornet, trumpet, and French horn may be taken as examples.

When it is desired to extend greatly the musical capability of a conventional melodic or solo type of musical instrument, by electrical means, it is necessary to gain control of the acoustical output of the instrument. Although the dynamic range may be extended upward from the loudest normal tones by simple amplification, the degree of extension is limited by the tendency for the sound reproducing system to feed back from the loudspeaker to the microphone. When the dynamic range is to be extended downward from the softest normal tones it is necessary to attenuate the direct acoustical output of the instrument in order to achieve the lower acoustical output from the reproduced sound without interference from the direct sound. Similarly, if the tonal or pitch characteristics of the sound are to be extended or modified, the direct sound must be attenuated sufficiently to avoid interference with the sound reproduced in modified form.

Examples of the many situations in which these factors are limiting are found in the use in the same instrumental ensemble of musical instruments normally having a large acoustical output with other musical instruments normally having a small acoustical output. Thus, great difficulty is encountered in attempting to combine in a single musical ensemble the brass wind instruments, which have large output, and the stringed instruments, which have small output. Except for the unsatisfactory expedient of having the loud instruments played as softly as possible and the soft instruments played as loudly as possible, the only previous solution has been to space the soft instruments away from the loud and to attempt to amplify the output of the soft instruments without simultaneously amplifying the output of the loud instruments and to balance the reproduced sound against the direct sound. The result, if balanced, can only be loud.

In the past, some attenuation of the sound of loud instruments, such as the cornet and trumpet, has been obtained by the use of mutes, but this attenuation has not always been sufficient and it

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has generally sacrificed the true tone of the instrument; and while the muted tone has been widely used for novelty effects, these effects have been limited to a class of which the mute is capable; furthermore, whether muted or not, the electrical reproduction of the tone is limited by the occurrence of feedback through the amplifying system.

It is the primary object of my invention to attenuate the direct sound of a musical instrument and simultaneously to capture the true sound of the instrument, and to do this by means which will overcome acoustical feedback limitations and which can be utilized at the will of the musician, and without substantially disturbing the normal use of the instrument or the usual arrangement of musical instruments in an ensemble or the freedom with which such arrangements may be made as desired. Pursuant to these objects, my invention extends greatly the freedom with which loud musical instruments may be used and the freedom with which various instruments may be combined in a desired musical ensemble. The captured sound may be reproduced in any desired strength, in balance with other instruments employed, substantially without interference from the direct sound of the instrument producing the captured sound, and with substantially no danger of acoustical feedback. Reproduction of the captured sound may be a true reproduction, or a reproduction which is modified, and any desired modification may be made, either with respect to loudness, or tone quality, or pitch, or apparent location or direction. For example, by electrical modification, as with suitable filters, the reproduced sound may be in the usual muted tones, or may be made to similate some other instrument, or to create novel tones; and the sound, whether true or otherwise, may be reproduced as from a distance, for example as offstage, yet may be played from the usual position of the musician. The acoustical attenuation and control may be employed to suppress the whole sound, as during practice, and the captured sound, either with or without other modification, may be reproduced in headphones worn by the musician. My invention provides great freedom and flexibility of control, which may be utilized in many ways and to many advantages by musicians and conductors.

It is a further object of my invention to accomplish acoustical and electrical control of the output of a musical instrument without modification of the instrument itself and without changing the performance of the instrument; and pref-

erably to do so without changing or limiting the normal technique or attitude with which the instrument is ordinarily played, and by means which may be used at the will of the musician without limiting the normal use of the instrument.

My invention is especially applicable for use with the brass wind instrument family; for with such instruments, substantially all of the sound emitted is radiated from the mouth of the instrument.

In carrying out my invention, I provide an enclosure which may be sealed about the sound emitting portion of the instrument and which will receive and attenuate substantially the whole acoustical output of the instrument, and I associate therewith a microphone to respond to the sound which is to be reproduced. Preferably, I make the enclosure of such acoustical characteristics and associate therewith a microphone in such position, that the direct sound radiated by the combination is greatly attenuated with respect to the normal output of the instrument, and that the sound emitted by the instrument is picked up by the microphone in a tonal quality true to the normal sound of the instrument.

The attainment of the proper acoustical characteristics of the enclosure involves several factors, for the enclosure must not distort or modify the true tone at the point where it is picked up by the microphone, and must avoid the creation at the microphone of sounds not normally part of the true tone of the instrument; and the volume of the enclosure must be sufficient to cause no acoustical reaction upon the normal operation of the instrument.

I find that with an enclosure having suitable other characteristics, the volume of the enclosure may be of a size which is wholly practical for use in a normal arrangement of musical instruments. The minimum volume is related to the fundamental frequency of the lowest tones in the playing range of the instrument, and to the cross sectional area of the mouth of the instrument. The volume should be great enough to avoid considerable reaction on the performance of the instrument and hence to avoid changing the normal technique of playing it, and must be great enough to provide an adequate "true-sound" space for the microphone.

The shape of the enclosure is such as to avoid forming an extension of the instrument, which would modify its tonal characteristics, and to minimize standing-wave effects within the enclosure. To avoid having the enclosure form an extension of the instrument, I preferably form the walls to provide a sharp break in contour adjacent the rim of the bell of the instrument, and carry the wall sharply back away from the contour of the instrument. Standing-wave effects may be minimized by employing a broken and unsymmetrical contour for the enclosure, and by avoiding parallel walls.

The walls of the enclosure should be rigid, to suppress sound transmission, both to suppress the outward transmission of the attenuated sound and to suppress inward transmission of external sounds to the microphone, to avoid feedback. In addition, the walls are desirably covered on the inside with some sound absorbing material, preferably some matted material such as hair felt or a soft porous material, to minimize reverberation and standing-wave effects.

The enclosure is desirably acoustically sealed, but provides for escape of air, as through a long passage of small cross section, to permit the normal flow of air employed in playing the instrument.

The enclosure has a suitable opening to receive the bell of the instrument, desirably in sealed relationship. The bell of the instrument may project into the free space within the enclosure and the enclosure may be sealed about the bell at a point behind its mouth. Conveniently, however, the opening is of a size to receive the rim of the bell and that rim is sealed against the edge of that opening. In the preferred form, the bell receiving opening is at the inner end of an inwardly extending generally frusto-conical wall, and the bell-receiving opening is surrounded by a lip which carries a soft gasket; for this provides the desirable sharp contour break at the rim of the instrument bell, and guides the bell to proper position, and the instrument may be brought into acoustically sealed association with the enclosure in a convenient position for playing, simply by inserting the bell of the instrument through the frusto-conical portion of the walls and pressing it against the gasket at the lip.

With the enclosure constructed in accordance with these principles, it is possible to position a microphone, desirably of small physical size, at a position within the enclosure and in front of the mouth of the instrument so that it will not of its own presence distort the sound yet will respond to the sound produced, and will transmit a corresponding electrical signal characteristic of the normal sound of the instrument when played in a free field. Preferably, the microphone is placed in front of the mouth of the instrument, desirably close to the axis of the instrument bell and spaced from the walls of the enclosure, in a position between the mouth of the instrument and the main body of the space within the enclosure. The microphone should be spaced from the mouth of the instrument a distance approximately equal to the diameter of the mouth of the instrument, say about 4 inches in the case of the cornet and up to about 10 inches for larger-mouthed instruments such as the French horn and mellophone.

Preferably, the enclosure is formed in, or combined with, a piece of orchestra equipment or furniture having other functional uses, for example a seat or a music stand or the like, but it need not be so associated, and may be wholly separate.

The accompanying drawings illustrate my invention:

In such drawings, Fig. 1 is a somewhat schematic diagram of an enclosure embodying my invention; Fig. 2 is a perspective view of an enclosure adapted for use with a cornet or trumpet and embodied in a music stand, and showing the method of its use; Fig. 3 is a vertical longitudinal section of the enclosure shown in Fig. 2; Fig. 4 is a horizontal section, taken on the line 4—4 of Fig. 3; Fig. 5 is a perspective view of another embodiment of my invention in the form of a box-like seat, and adapted for use with a mellophone; and Fig. 6 is a schematic diagram of an electrical system for use with an attenuating enclosure.

General characteristics which I may employ in microphone-enclosing attenuators embodying my invention are indicated diagrammatically in Fig. 1. As shown in Fig. 1, the bell 10 of the musical instrument is seated against a gasket on a lip 11 and directed into the enclosure. The

walls 12 and 13 of the enclosure extend rearward from the lip 11 to form an abrupt change from the smooth contour of the bell 10 and to break sharply away from that contour. The other walls of the enclosure are of broken and irregular shape, so that the enclosure as a whole is of irregular shape. To provide a suitable irregular shape, the walls may avoid substantial areas which are parallel with each other, and may be curved, as indicated by the walls 14 and 15, to present a convex surface to the inside of the enclosure. Other walls, as indicated by the walls 16, 17, and 18, may be made up of relatively small panels set at an angle to each other. The use of curved, irregular, and angular walls not only obtains the desirable irregularity in the shape of the enclosure, but also contributes to rigidity. The walls all carry on their inner surface a layer of sound absorbing material 19.

To permit the escape of air from the enclosure and hence to avoid interference with the normal small air flow which occurs in the playing of the instrument, while maintaining an acoustically sealed enclosure, a circuitous air escape path of small cross section may be provided, as by the walls 20, 21, and 22.

A microphone 40, which may have narrow directional characteristics, is positioned within the enclosure at a point of true sound, preferably on or close to the axis of the bell 10 of the instrument, facing the instrument and spaced from the mouth of the instrument a distance of the order of the diameter of the mouth, in order to receive the desired sound directly from the instrument and to receive a minimum of extraneous sound.

Desirably, the enclosure is embodied in some functional piece of orchestra or bandstand equipment, such for instance as a seat, a music stand, or the like. Figs. 2 to 4, inclusive, show a music stand which I have found to give quite satisfactory results. It is a box-like structure made of plywood ½'' thick, which in the device shown I find to provide sufficient rigidity. It has non-parallel side walls 25, a front wall 26, and a top wall formed of two oppositely inclined panels 27 and 28. The top surface of the panel 28 is provided with a cleat 30, and forms a convenient support for sheet music 29. Below the cleat 30, the panel 28 supports an inwardly extending frusto-conical wall section 31 which has a lip 32 at its inner end covered by a soft rubber gasket 33. The inner end of the frusto-conical wall 31 and the lip 32 are of the size suitable to receive the rim of the bell of the instrument with which the music stand is to be used, in this case, the bell 34 of a cornet or trumpet, and are arranged to position the instrument in a convenient position for playing. The rear wall 35 of the enclosure is disposed at an oblique angle with respect to the other walls, and is displaced forwardly from the rear edge of the side walls 25, to provide knee space for the musician. A horizontal wall section 36 and a short vertical rear wall 37 join the upper edge of the wall 35 to the rear edge of the top panel 28.

A microphone 40, desirably of relatively small size, is conveniently supported on a bracket 39 mounted on the rear wall 35.

The enclosure shown in Figs. 2 to 4, for use with a cornet or trumpet, may have a volume of about 10 cubic feet. A somewhat smaller volume, say down to about 8 cubic feet, is not un-workable; and a larger volume may of course be used, but this makes the device cumbersome and less convenient. I consider about 10 cubic feet to be the optimum for a stand of this type and for this use.

The inner surfaces of the walls of the enclosure are covered with a suitable sound absorbing blanket, such as hair felt, and I have found that a layer about ½'' thick gives satisfactory sound absorption without making the device unduly heavy.

Fig. 5 shows a seat for use by a mellophone player and formed to provide an enclosure to attenuate the sound of the mellophone. For a French horn player the curved portion of the seat would be on the player's right. It includes a seat 50, a back 51, and enclosing walls to form an attenuating chamber below and behind the seat 50 and back 51. At the left side, the seat 50 and back 51 join an inclined wall 53 which supports a short inwardly extending cone 54 having a lip 55 at its inner end to receive the edge of the bell of the mellophone with the instrument in a position suitable for playing. The enclosure formed within this box-like seat shown in Fig. 5 embodies the same factors which have been described above. Thus, the enclosed space is of irregular and broken shape, with generally non-parallel walls, and with the walls rigid and covered on the inside with sound absorbing material. A microphone is positioned within the enclosure, opposite the opening defined by the bell-receiving lip 55. This enclosure, for use with the mellophone, desirably has a considerably larger volume than the enclosure shown in Figs. 2 to 4 and intended for use with the trumpet or cornet, because of the lower range of the mellophone; and I preferably use a minimum volume of about 20 cubic feet.

With a device embodying my invention, substantially full control is readily obtained of the acoustical output of the instrument, and the true sound of the instrument is captured as an electrical signal corresponding to that true sound, and a corresponding sound may be reproduced as desired from that electrical signal. Usually the reproduced sound will be modified with respect to the original sound, and the modification may be only of loudness, with the reproduced sound otherwise true to the original sound.

Other modifications of the captured sound may be made in many ways for, because by my invention the acoustical output is effectively attenuated and feedback is substantially eliminated, great freedom may be used in reproducing the captured sound, without danger of interference from the direct sound or from feedback. Thus, the electrical signal may be reproduced as coming from a different position or direction, as from off stage, or the reproduced sound may be made to simulate the tones of the commonly employed mutes or to simulate the tones of some other musical instrument. For example, the original sound of the cornet may be reproduced in simulation of the tones of a trombone or of a French horn. The reproduced sound may be reproduced in headphones, so that the device may be used for practice, to produce in the headphones worn by the musician a true or modified sound as desired, and to suppress the direct sound.

A schematic diagram of electrical apparatus for producing several modified reproductions is shown in Fig. 6. The control of the electrical circuits may be largely or wholly by the musician, as by the multiple position switch 60 mounted on the top panel of the instrument shown in Figs. 2 to 4, and by the volume control 61 mounted adjacent

the switch 60. Either or both could, of course, be operated by pedals instead of manually.

As indicated in Fig. 6, the multiple position switch 60 is connected to the microphone, and controls the circuit of the microphone 25 to connect it alternatively to any of a number of modification circuits. The switch 60 may have an off position, indicated by the contact 62. The next adjacent contact 63 may be connected to an amplifier 75, controlled by the volume control 61, and through such amplifier 75 to a loudspeaker 85. In a third position, the switch 60 connects the microphone circuit to a contact 64 which is connected through a filter 76 to the amplifier 75. The filter 76 may be such as to modify the electrical signal so that the sound reproduced at the speaker 85 will simulate the tones of a muted cornet. A fourth contact 65 of the switch 60 may be connected through a filter 77 to the amplifier 75, with the filter arranged to modify the electrical signal so that the reproduced sound simulates that of a French horn. Another contact 66 may be connected to the amplifier 75 through a filter 78 which modifies the electrical circuit to produce otherwise modified sounds. Another contact 67 may be connected through an electronic circuit 79 which changes the pitch of the reproduced sound. Another contact 68 may be connected through electrical apparatus 80 to mix the electrical signal with signals produced by other instruments. Still other contacts 69 and 70 may be connected through electrical apparatus to modify the signal in other desired respects.

The circuit from the amplifier 75 to the speaker 85 may also contain a multiple position switch 81, by which the signal passing through such circuit may be connected for reproduction either by the loudspeaker 85 or by some other instrument. For example, such switch may provide positions by which that signal may be reproduced by earphones 86, or at a remote speaker 87, or through a monitoring control station 88.

In practical use, as with the embodiment shown in Figs. 2 to 4 inclusive, my invention provides a device in the form of a piece of orchestra equipment not greatly different from those ordinarily employed. Its use is entirely at the will and under the control of the musician. When it is desired to use the device, the musician simply inserts his instrument, in this case a cornet or trumpet, into the frusto-conical opening and seats the rim of the instrument against the lip 32. The multiple position switch 60 is set at the position to produce the desired reproduction, and the volume control 61 is set to obtain the desired volume of reproduction. When the instrument is then played, the direct sound from the instrument is largely, if not wholly attenuated. I have found that a device constructed substantially as shown in Figs. 2 to 4 produces an attenuation of the order of 20 decibels or more, and that this reduction is quite satisfactory. The true sound of the instrument, however, is picked up by the microphone 25, and a corresponding electrical signal is obtained. This signal now passes to the electrical apparatus, such as the amplifier 75 and loudspeaker 85, with or without modification as by the filters 76 to 78; and such electrical apparatus reproduces from the signal a reproduced sound either the same as or modified from the original sound. The reproduction may be either through one or more loudspeakers, such as the loudspeaker 85, or may be by some other instruments such as the earphones 86 or the distance speaker 87.

I claim as my invention:

1. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically sealed enclosure forming a space to receive and attenuate the normal sound so radiated from the bell of the instrument, said enclosure having a frusto-conical wall portion with the small end thereof projecting inward into said enclosure and opening thereto at its inner end, a seat at the small end thereof to receive the rim of the instrument bell, the frusto-conical wall portion extending from said seat rearward with respect to the bell to form an abrupt break away from the contour thereof and to guide the bell into engagement with said seat.

2. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising a substantially rigid-wall enclosure having acoustically absorbent inner surfaces, an outer wall of said enclosure having an opening to pass the bell-end of the instrument to an inwardly projecting position with respect to the main body of the enclosure, means for acoustically sealing to said enclosure an instrument so disposed, said enclosure being of irregular and unsymmetrical shape and the walls thereof being spaced differently and presented differently with respect to the space immediately adjacent the bell mouth of an instrument so disposed, whereby said enclosure attenuates sound radiated from the bell mouth of the instrument so disposed without acoustical reaction thereon and said immediately adjacent space is a substantially true-sound space.

3. An acoustical attenuator as set forth in claim 2 in which the means to seal the instrument to the enclosure comprises an inwardly projecting generally frusto-conical wall and a seat at the inner end thereof to receive the rim of the bell of the instrument, the frusto-conical wall extending from said seat rearward with respect to the bell to form an abrupt break away from the contour thereof.

4. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically sealed enclosure the walls thereof having an opening surrounded by a seat to receive the rim of the bell of the instrument in acoustically sealed relationship, the cross-sectional area of said enclosure transverse to the axis of an instrument bell so received being many times greater than the cross-sectional area of such bell, the walls of said enclosure about said opening extending therefrom at an angle away from the wall of a bell so received to form an abrupt break away from the contour of the bell, and said enclosure being of irregular and unsymmetrical shape.

5. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically-sealed enclosure having a volume at least of the order of eight cubic feet, said enclosure having an opening to receive the bell-end of an instrument in an inwardly projecting position, the enclosure being of irregular and unsymmetrical shape with respect to the axis of a bell so received and the enclosure walls being substantially rigid and having acoustically absorbent inner surfaces.

6. An acoustical attenuator for a musical in-

strument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically-sealed enclosure having a volume at least of the order of eight cubic feet and of irregular and unsymmetrical shape, an acoustically absorbent inner surface on the enclosure walls, and said walls having an opening surrounded by a seat to receive the rim of the bell of the instrument in acoustically sealed relationship, whereby sound radiated from the bell of an instrument so received will be received and attenuated by said enclosure substantially without acoustical reaction on the instrument.

7. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising a substantially rigid-walled enclosure having acoustically absorbent inner surfaces, an outer wall of said enclosure having an opening to pass the bell-end of the instrument to an inwardly projecting position with respect to the main body of the enclosure, means for acoustically sealing to said enclosure an instrument so disposed, a microphone positioned in the space immediately adjacent the bell-mouth of an instrument so disposed, said enclosure being of irregular and unsymmetrical shape and the walls thereof being spaced differently and presented differently with respect to said immediately adjacent space, whereby said enclosure attenuates sound radiated from the bell mouth of the instrument so disposed without acoustical reaction thereon and said immediately adjacent space is a substantially true-sound space.

8. An acoustical attenuator as set forth in claim 7 in which the means to seal the instrument to the enclosure comprises an inwardly projecting generally frusto-conical wall and a seat at the inner end thereof to receive the rim of the bell of the instrument, the frusto-conical wall extending from said seat rearward with respect to the bell to form an abrupt break away from the contour thereof.

9. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically sealed enclosure having acoustically absorbent inner surfaces, said enclosure having an opening surrounded by a seat to receive the rim of the bell of the instrument, a microphone mounted in said enclosure at a point spaced inward from said opening in a microphone space comprising the projected area of said opening and extending inward therefrom a distance to include said microphone, the enclosure having a volume many times greater than said microphone space and of irregular and unsymmetrical shape with respect to said microphone space.

10. An acoustical attenuator for a musical instrument having a bell mouth from which the greatest part of the sound of the instrument is radiated, comprising an acoustically sealed enclosure having acoustically absorbent inner surfaces, said enclosure having an opening for the bell-end of the instrument, means for acoustically sealing the instrument to the enclosure in a substantially predetermined position with respect thereto, a microphone mounted in said enclosure at a point spaced inward from the predetermined position of the bell-mouth of the instrument, said microphone being disposed in a microphone space comprising the projected area of the bell-mouth of an instrument in said predetermined position and extending from such bell mouth inward a distance to include said microphone, the enclosure having a volume many times greater than said microphone space and of irregular and unsymmetrical shape with respect to said microphone space.

11. A functional piece of furniture, comprising substantially-rigid walls forming a hollow body, said body comprising an acoustical attenuator as defined in claim 10.

12. A music stand, comprising substantially rigid walls forming a hollow body, said body comprising an acoustical attenuator as defined in claim 10.

13. A musician's seat, comprising substantially rigid walls forming a hollow body, said body comprising an acoustical attenuator as defined in claim 10.

14. A music stand, comprising walls forming a hollow body and including an upper wall positioned to support sheet-music thereon, acoustically absorbent inner surfaces on said hollow body, said body-walls having an instrument receiving opening, a seat at said opening to receive the rim of the bell of a musical wind instrument in acoustically sealed relation, the walls adjacent said opening being positioned to extend at an abrupt angle away from the contour of an instrument bell seated on said seat, said opening and seat being disposed to position the instrument with its mouth piece in position for playing from a point of reading observation of sheet-music on said upper wall, said hollow body being acoustically sealed, whereby said music stand forms an attenuating enclosure for sound radiated from an instrument seated at said opening.

15. A music stand, comprising walls forming a hollow body and including an upper wall positioned to support sheet music thereon, acoustically absorbent inner surfaces in said hollow body, a generally frusto-conical wall converging inward from an upper outer wall of said body and open at its inner end, said body being otherwise acoustically sealed, a seat at the inner end of said frusto-conical wall to receive the rim of the bell of a musical wind instrument, said seat being positioned inward from the plane of said music-supporting wall, whereby a wind instrument having a bell and an oppositely disposed mouth-piece may be disposed with its bell against said seat and with its mouth-piece in position for playing from a position of reading observation of sheet music on said upper wall.

16. A microphone enclosure, comprising substantially rigid walls forming a hollow body and having an opening, a seat at the edge of said opening to receive in acoustically sealed relation an instrument bell seated thereon, the walls of said body extending from said opening at an obtuse angle with respect to the axis of said opening, whereby the inner surfaces thereof form an abrupt break away from the contour of an instrument seated on said seat, acoustically absorbent surfaces inside said hollow body, said body including a free microphone-receiving space comprising the projected area of said opening and extending a substantial distance inward from said opening, said hollow body having an interior volume many times that of said microphone-receiving space, the walls of said body being non-parallel and the space within said body being of irregular and unsymmetrical shape with respect to said projected-area space.

17. A device for use with a musical instru-

ment, comprising substantially rigid walls having acoustically absorbent inner surfaces and forming an enclosure, said enclosure having an opening with which the sound-radiating bell of a musical instrument may be registered, the space within said enclosure including a free space comprising the projected area of said opening and extending a substantial distance inward, the whole volume of said enclosure being many times the volume of said free space and of irregular and unsymmetrical shape, whereby said free space is a substantially true-sound space, a microphone positioned in said free space to receive sound therein, and electrical means to modify the electrical signal from said microphone and to reproduce therefrom a sound modified from the sound so received.

DANIEL W. MARTIN.

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