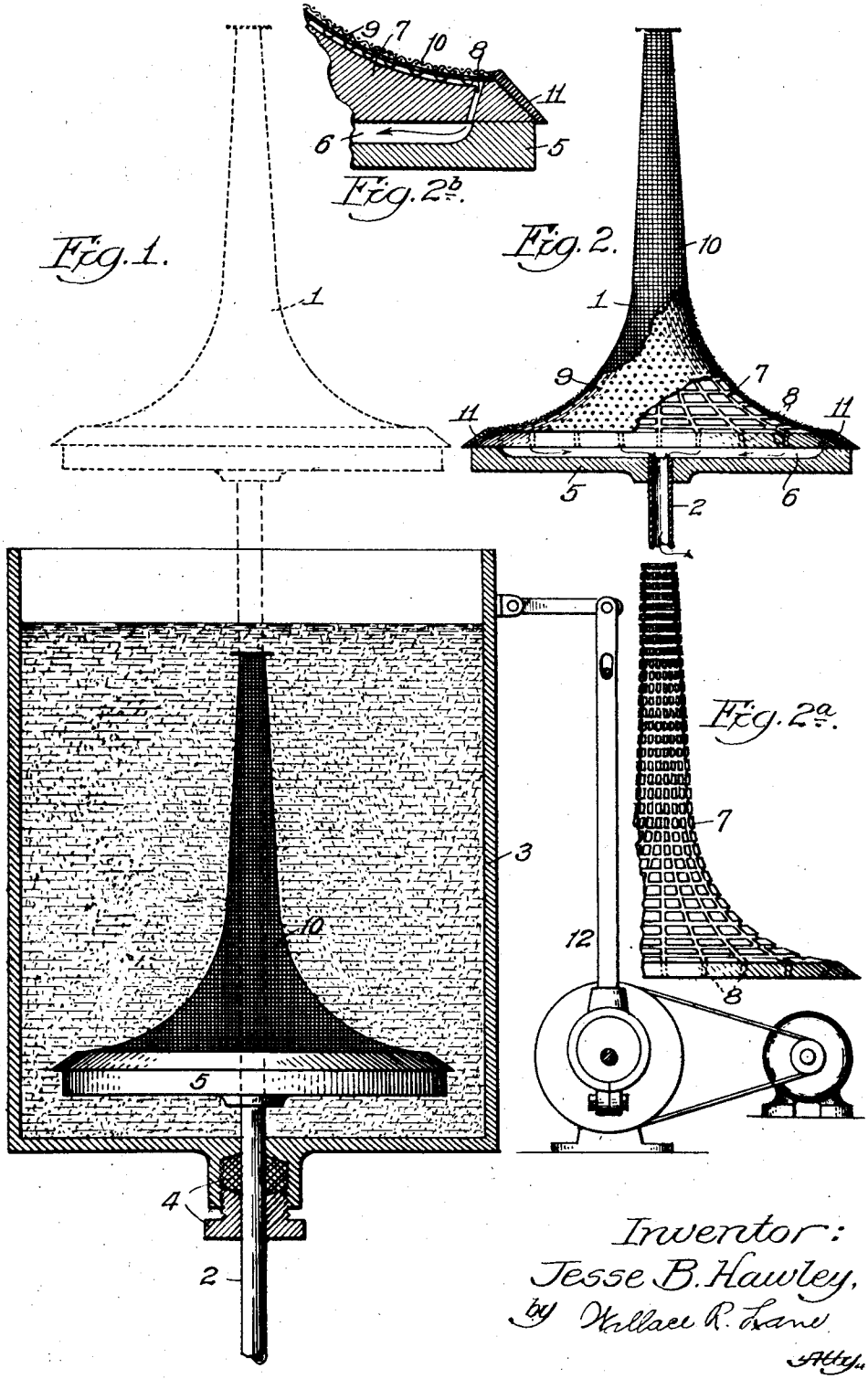
June 18, 1929. J. B. HAWLEY 1,717,775

METHOD OF PRODUCING SOUND AMPLIFYING HORNS

Filed Feb. 23, 1923 3 Sheets-Sheet 1



Inventor:
Jesse B. Hawley,
by Wallace R. Lane
Atty.

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Filed Feb. 23, 1923 3 Sheets-Sheet 2

Fig. 3.

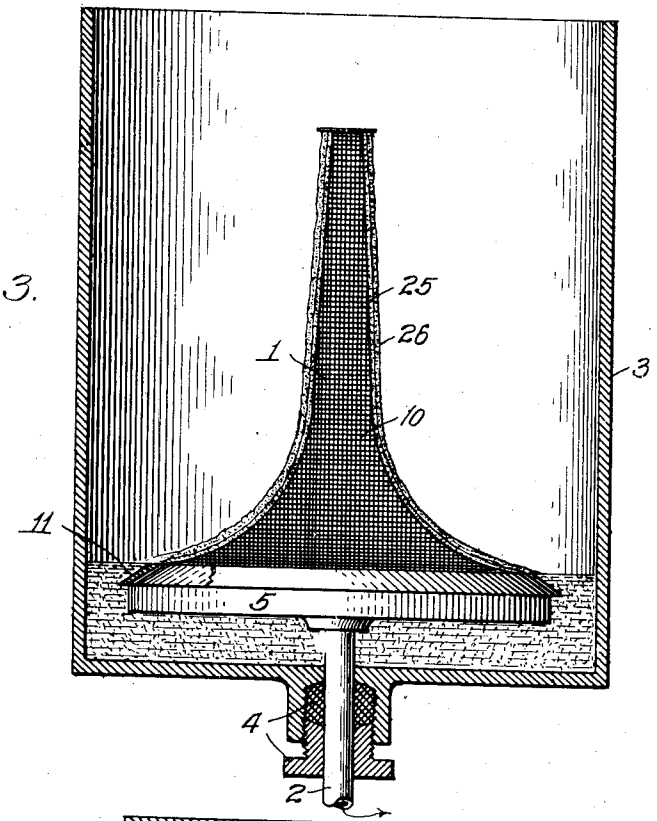
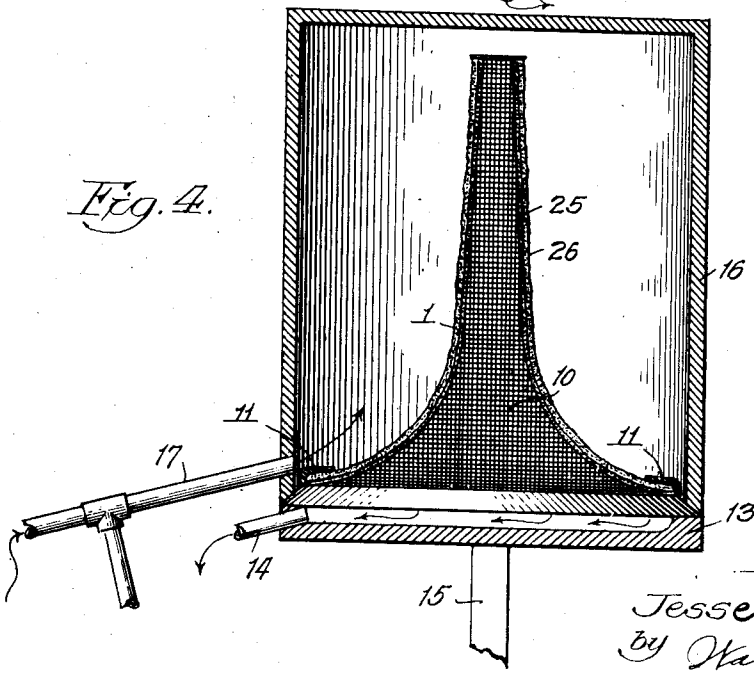


Fig. 4.



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Filed Feb. 23, 1923 3 Sheets-Sheet 3

Fig. 5.

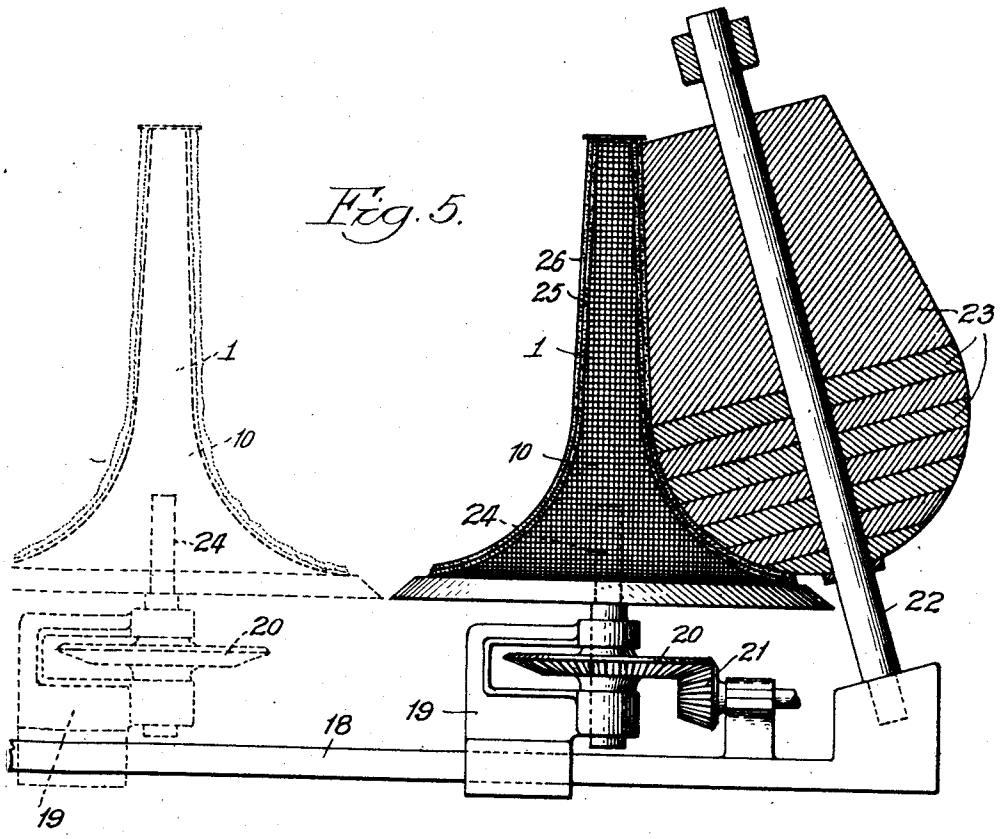


Fig. 6.

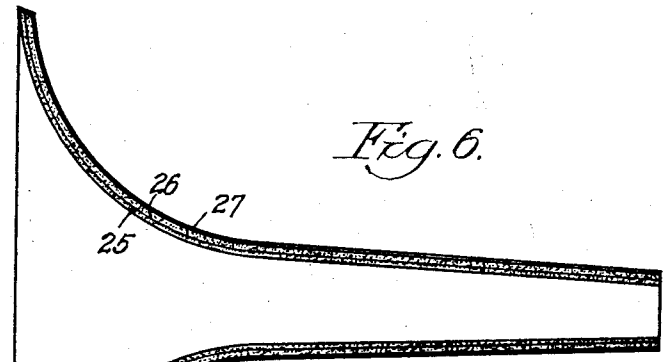
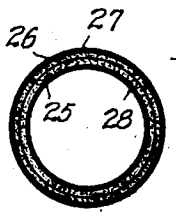


Fig. 7.



Inventor:
Jesse B. Hawley,
by Wallace R. Lane
Atty.

Patented June 18, 1929. 1,717,775

UNITED STATES PATENT OFFICE.

JESSE B. HAWLEY, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO UNITED REPRODUCERS CORPORATION, OF ST. CHARLES, ILLINOIS, A CORPORATION OF NEW JERSEY.

METHOD OF PRODUCING SOUND-AMPLIFYING HORNS.

Application filed February 23, 1923. Serial No. 620,579.

My invention relates to the method of manufacture thereof, and comprises among its objects to produce a horn which will give the desired tone quality to sounds emitted therefrom; to do away with the metallic sounds so customarily present when a metallic horn is used for this purpose; to do away with the other undesirable tone qualities present when horns of other materials are used; to provide a sound amplifying horn composed of accretions of fibres interlaced on a porous horn-shaped former, as by suction, so as to provide a horn wall relatively soft to substantially eliminate resonance; to further provide such a horn wherein the superficial fibres of the relatively soft horn wall are compacted and finished to provide a wall having zones of variant density which still further tends to dampen resonance; and further to provide such a horn wall wherein the surfaces thereof are finished to provide a somewhat smooth or polished surface whereby to provide sound reflecting surfaces of greater efficiency; to produce a strong horn which is still not unduly heavy; to produce a new method of manufacturing horns of the type referred to; and such further objects, advantages and capabilities as will later more fully appear.

My invention further resides in the combination, construction and arrangement of parts illustrated and the method described, and, while I have shown in the appended drawings a preferred embodiment, I desire the same to be understood to be illustrative only and not as limiting my invention.

In the accompanying drawings, Fig. 1 shows partly in section and partly in elevation an apparatus for carrying out the invention and for producing a horn of the character referred to. Fig. 2 shows partly in fragmentary sectional and partly in elevational view the construction of a part of the apparatus shown in Fig. 1. Fig. 2^a is a fragmentary elevational view showing a certain feature of the present construction, while Fig. 2^b is a fragmentary sectional view designed to show other features thereof. Fig. 3 is a longitudinal sectional view showing one stage in the process of manufacturing a horn in accordance with my present invention. Fig. 4 is a longitudinal sectional view showing another stage in the process of manufacture. Fig. 5 is a similar view showing another stage in the manufacture of the improved horn. Fig. 6 is a longitudinal section of a horn constructed in accordance with the present invention and having applied to the exterior face thereof a coating. Fig. 7 is a cross section showing both outer and inner faces of the horn as provided with coating material.

Referring more in detail to the annexed drawings, numeral 1 designates the former, or mandrel, on which is formed the sound horn. During the first two stages of the process of manufacture of a horn this former is secured to the upper end of a pipe 2 which may be connected by means of a flexible connector to a suction device for the purpose of withdrawing liquid through the former to cause formation of a deposit on the exterior face thereof. Where the pipe 2 passes through the bottom of container 3 there is a packing gland 4 to prevent leakage of the fluid from the container around the pipe 2. To the upper end of the pipe 2 is secured a plate 5, preferably by means of screw threading. The plate 5 is shown as having its upper face hollowed out to form a concavity 6 into which liquids may drain to be carried off by means of pipe 2.

The former comprises a core 7 together with a plurality of layers of material arranged thereover. The core 7 is provided with a plurality of longitudinal and transverse grooves connected at their lower ends, by means of openings 8, with the concavity 6. Fitting closely over the surface of the core 7 is a perforated sheet metal form 9 which serves to support on the core 7 a fine mesh wire netting 10 and prevent the same from being distorted by pressure upon the surface thereof. Around the lower bevelled edge of the core 7 is arranged a flexible band 11, preferably constructed of rubber, the purpose of which will appear hereinafter. In the construction shown in Fig. 1 there is provided a vibrating apparatus 12 for the purpose of vibrating the upper portion of the container 3 to keep the contents thereof in agitated condition and to assist in causing uniform deposit of the fibrous materials upon the form. Although a single means for vibrating a portion only of the container is disclosed it is to be understood as illustrative only since other means for agitating the liquids, including mechanism for simultane-

ously vibrating both the top and bottom of the container may be used. It is also found very satisfactory to cause agitation of the suspension by means of a jet or jets of air forced into the receptacle in which the suspension is contained.

The apparatus shown in Fig. 4 is for the purpose of carrying out a stage in the method of making the horn subsequent to those stages which are carried out in the apparatus of Figs. 1 to 3 inclusive. This apparatus comprises a base plate 13 corresponding to the base plate 5 of the previously described apparatus, said base plate having a concave upper surface from which leads a pipe 14 for drawing off liquids from the interior of the apparatus. A plunger or like device 15 forces the plate 13 up against the bottom of the container 16 which is prevented from moving upwardly by means of a rigid portion of the apparatus against which the top of container 16 presses. Opening through the wall of container 16 is a pipe 17 by means of which steam can be admitted to cause drying thereof.

Fig. 5 shows a mechanism for further compacting the felted or interlaced fibres and then burnishing the outer surface thereof. This mechanism comprises, in the form shown, a bar 18 on which slides a frame 19 carrying a bevel gear 20 adapted to mesh with a bevel pinion 21 carried in a fixed bracket on the bar 18. The bevel pinion is carried by a shaft which may be driven from any suitable source of power which does not need to be shown herein. A shaft 22 is preferably mounted at an angle to the bar 18 and carries thereon a burnishing member 23 comprising a plurality of separately rotatable parts which rotate at different speeds as the horn is rotated by the driving of the bevel pinion 21.

In the carrying out of my new method the pipe 2 is pushed upwardly through the packing gland 4 until it occupies the dotted line position shown in Fig. 1 and a liquid containing therein suspended fibrous felt or cotton linters, rag stock or other soft, suitable fibers is poured into the container 3 until it is well above the position which the top of the former will occupy when lowered into the tank 3. The former 1, comprising parts 7, 9, 10 and 11 is placed on the base 5 and lowered into the container, to the position shown in Fig. 1. Suction apparatus connected to the pipe 2 is now operated to cause the withdrawal of the liquid through the former 1. This causes a deposit of the fibers upon the fine mesh wire netting 10 and this operation is continued until fibers to the desired thickness have been deposited upon the former. On a commercial scale the container is large enough so that any desired number of horns may be made at one time. When a sufficient amount of the fibers have been desposited upon the former to suit the requirements of the operator, the suction is reduced and the suspended material and liquid removed from the container. Another suspension, such as paper pulp in water, is now introduced into the container 3 to substantially the same height as before and the suction is increased to cause withdrawal of the liquid through the former and deposit of a layer of pulp upon the outer surface of the felt or other fibers previously deposited. As will be obvious, there is considerable pressure upon the surface of the netting as the felt is being built up thereon, but the netting is sustained by the metal form 9 upon which it rests, and this in turn is sustained by the core 7. The liquid reaching perforations 8 by way of the longitudinal and transverse channels cut in the surface of the core passes into the chamber 6, as will be readily understood, and is withdrawn therefrom through the pipe 2 by the suction apparatus. By reason of the operation of the vibrating apparatus 12 or other agitation, as by air jets, the liquid and the particles suspended thereby are kept in constant agitation and suspension and the particles are prevented from settling to the bottom of the container. This also, together with the suction, causes the fibers to be deposited in accretions, the fibers interlacing and tending to arrange themselves, substantially parallel to the direction of the surface as formed. The vibrating apparatus shown is merely typical of any one of several which I may employ and which may be used to vibrate the upper portion of the container as shown, or may be used to vibrate both the top and bottom thereof. Also, vibration is to be understood as typical of any mode of keeping the suspension in agitation. It should perhaps be stated that during the operation just described the member 11 rests on the edge of the core 7 to prevent deposit of the fibrous materials thereon.

When the operation above described has been completed the former is preferably raised to the dotted line position shown in Fig. 1 and the band 11 is turned up over the edge of the felt as shown in Fig. 4. The former and deposited felt are then placed on the table or platform 13 and enclosed within the container 16 which, as heretofore indicated, is held tightly against the edge of the core by upward pressure upon the supporting member 15. Live steam is then introduced through the pipe into the container 16 and passes through the formed horn and the former and out through pipe 14. This results in sufficient pressure upon the fibers to compact the same and the steam has a tendency to evaporate the moisture from the felt and cause a reasonable drying thereof. The purpose in turning the band 11 over the edge of the formed horn is to prevent the same

from running out in a thin edge over the former and to give proper shape to said edge.

When the horn has been properly compacted and dried in the manner shown in Fig. 4, the former and horn are removed to the spindle 24 connected with bevel gear 20, which spindle is non-circular in form and fits into a correspondingly shaped opening in the bottom of the core 7. After the parts have be arranged as shown in dotted lines in Fig. 5, the bracket 19 is moved longitudinally along bar 18 until bevel gear 20 meshes with pinion 21. Rotation of the bevel pinion 21 will now cause the horn to be turned in contact with the burnisher which is made up of separate parts, so that the different sections of the horn and burnisher may turn at substantially the same peripheral speed notwithstanding their different and varying radial dimensions. Besides burnishing the surface of the horn this loosens the horn from the form. After the horn has been finished in the manner indicated the horn and former are separated and the surface of the horn may be coated and hardened either internally or externally or both, in any desired manner, as, for example, by metallizing, by painting, by varnishing, or shellacking or applying a glue or the like. One method of metallizing is by spraying molten metal upon the surface thereof. In the constructions shown in Figs. 6 and 7, numeral 25 is used to designate the inner or felt layer, 26 the outer or pulp layer, 27 the outer coating and 28 the inner coating. Whether one or both surfaces of the horn will be coated will depend upon the character of use which is to be made of this horn and the character of tones which it is desired to have produced thereby. These considerations will also determine the characteristics of the coating material to be used.

By "felted material", as used in this specification and claims, is meant a material made from fibers which are interlaced or intertwined in a promiscuous manner but substantially parallel to the direction of the surface being formed.

Some people prefer to have the external surface of the horn left rough, as it is before submission to the burnisher or calendering machine, and when this type of finish is desired, the burnishing or calendering step is omitted.

Also, when the type of construction required necessitates a reversal of the steps of the process, this reversal may be accomplished by using a hollow form lined with netting or having an equivalent construction. This former is then placed within a container and the two are connected in an airtight manner so that when suction is applied to the container the liquid of the pulp, felt, or other suspension, will be drawn through the form to deposit the fibrous material on the interior thereof. By this method it will be possible to secure a rough inner surface if desired, as pointed out above with regard to the outer surface.

While in most cases it is desirable to have an inner dense layer backed by a softer layer, even this is not universal, since, in some cases, it is preferable to have a soft layer for the inner surface. The arrangement of layers must be chosen in accordance with the characteristics of the sound which it is desired to produce. In this connection it is noted that the horn may be made up of several layers of varying degrees of compactness or hardness. This is accomplished by using suspensions of different grades of fibrous material and applying each of them for a short period of time. The fineness of the fibrous material may be regulated by the length of time the material is beaten when being prepared.

From the foregoing description it must be evident that the process disclosed is peculiarly adapted to the production of sound amplifier horns, first because any shape of horn may be easily made by merely changing the shape or configuration of the porous former; second, because of the manner in which the horn wall is built up by accretions of fibers which lay themselves, relatively loosely, under the influence of the suction, on the porous former and therefore the horn wall is characteristically relatively soft and tends to dampen resonance which is usually set up in rigid elastic walls by the sound vibrations; third, because of the compacting of the superficial fibers of the horn wall, as by suitable pressure (in the illustrated instance by steam pressure, or by the pressure incident to the burnishing operation) which compacting provides a relatively harder or more dense exterior wall and a softer interior or core. This wall of combined hard and soft portions is even more peculiarly adapted to dampen resonance. Fourth, because the smoothing of the exterior surfaces of the wall as by burnishing and coating with paint, varnish or shellack or the like, provides a somewhat polished sound reflecting surface which materially augments the amplification of the sound.

It is therefore understood that the specific description of structure and methods set forth above may be departed from without departing from the spirit of my invention.

Having now described my invention, I claim—

1. The method of making sound horns which comprises immersing a former of the shape desired in a felt bath, depositing felt on the former by drawing the liquid of the bath through the former until the desired thickness of felt has been deposited, immersing the former and deposited felt in a pulp bath, depositing pulp on the previously deposited felt by drawing the liquid of the bath through the felt, placing the former on a bur-

nishing machine and burnishing the surface of the horn, and finally finishing the surface of the horn.

2. That part of the method of making sound horns which comprises immersing a former of the shape desired in a felt bath, depositing felt on the former by drawing the liquid of the bath through the former until the desired thickness of felt has been deposited, immersing the former and deposited felt in a pulp bath, depositing pulp on the previously deposited felt by drawing the liquid of the bath through the felt, and burnishing the surface of the horn.

3. That part of the method of making sound horns which comprises immersing a former of the shape desired in a felt bath, depositing felt on the former by drawing the liquid of the bath through the former until the desired thickness of felt has been deposited, immersing the former and deposited felt in a pulp bath, and depositing pulp on the previously deposited felt by drawing the liquid of the bath through the felt.

4. That part of the method of making sound horns which comprises forming a fibrous material horn, burnishing a surface thereof, and applying to a surface of the horn a suitable finishing coat.

5. That part of the method of forming a sound horn which comprises depositing on a former a layer of felt and then a layer of pulp, then applying steam to compress and dry the deposited materials and then burnishing the surface of the formed horn.

6. The method of making sound horns comprising successively forming superposed layers of fibrous materials of different densities, and applying a hardening substance to a surface portion of one of said layers.

7. The method of making sound horns comprising successively forming superposed layers of fibrous materials of different densities, and forming sound reflecting surfaces by applying a hardening substance to exposed surface areas of said layers.

8. The method of making sound horns, comprising the forming of a layer of fibrous accretions of a given degree of compactness, forming an adjacent and integral layer of fibrous accretions upon said first mentioned layer and of a different degree of compactness, and finishing the resultant layers.

9. The method of making sound horns, comprising the forming of a layer of fibrous accretions of a given degree of compactness, forming an adjacent and integral layer of fibrous accretions upon said first mentioned layer and of a different degree of compactness, and applying hardening substances to an exposed surface portion of one of said layers.

10. The method of making sound horns, comprising the forming of a layer of fibrous accretions of a given degree of compactness, forming an adjacent and integral layer of fibrous accretions upon said first mentioned layer and of a different degree of compactness, and hardening the exterior surface portions of said layers while retaining a softer condition in the remaining portions of said layers.

11. The method of making sound amplifying horns which comprises causing fibrous material to form on a porous horn-shaped former in interlaced accretions varying in compactness whereby to form a horn wall, the cross-section of which includes a zone of relatively softer fibers.

12. That part of the method of making sound horns which comprises forming a layer of hard felted fibrous material in horn form, and then on that a layer of soft felted fibrous material.

13. A sound amplifying horn formed by sucking fibers onto a porous, horn-shaped former whereby to provide a relatively soft horn wall adapted to dampen resonance.

14. A sound amplifying horn formed by sucking fibers onto a porous, horn-shaped former whereby to provide a relatively soft horn wall, the superficial fibers of the wall being suitably compacted to provide a relatively harder surface, which combined with the softer portion of the wall substantially eliminates wall vibrations.

15. A sound amplifier having its walls formed by accretions of interlaced fibers, certain of which are more closely compacted than others whereby to provide a less resonant sound wall.

16. A sound amplifier having its walls formed by accretions of interlaced fibers including a strata of felt fibers and a strata of pulp fibers.

17. A sound amplifier having its walls formed by accretions of relatively loosely interlaced fibers, the superficial fibers of the wall being compacted.

18. A sound amplifier having its walls formed by accretions of relatively loosely interlaced fibers, whereby to dampen resonance in said walls.

19. A sound amplifier having its walls formed by accretions of relatively loosely interlaced fibers, the superficial fibers being compacted and smoothed to provide sound reflecting surfaces.

20. A sound horn having its walls formed by accretions of interlaced fibers of pulp formed by sucking the fibers onto a porous horn-shaped former, the superficial fibers of the horn wall being compacted, smoothed and coated to provide sound reflecting surfaces and substantially non-resonant walls.

In witness whereof, I hereunto subscribe my name to this specification.

JESSE B. HAWLEY.