Jan. 10, 1956 H. W. LONEY 2,730,003

CAST LINER FOR WOODWIND INSTRUMENTS

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Fig. 1

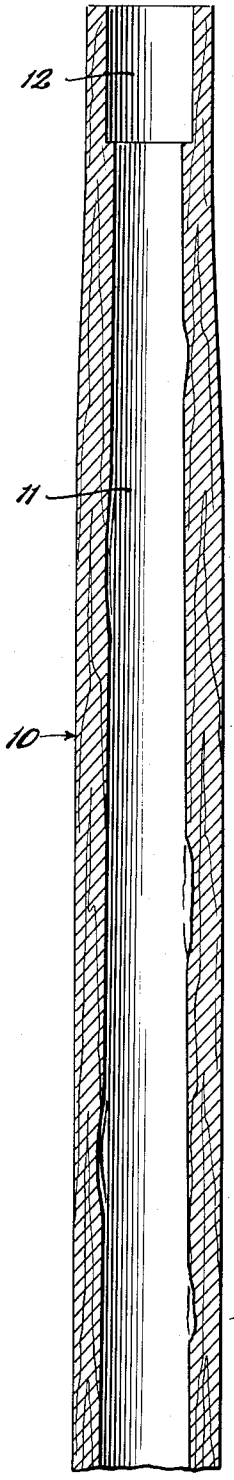


Fig. 2

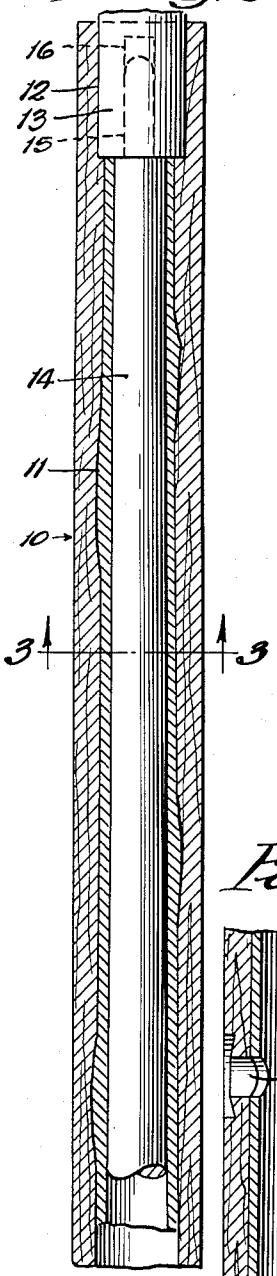


Fig. 5

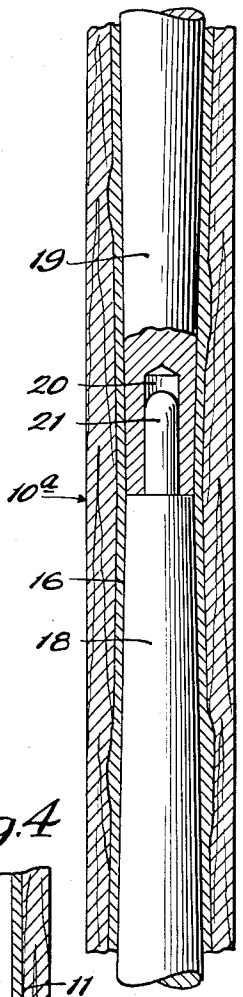


Fig. 4

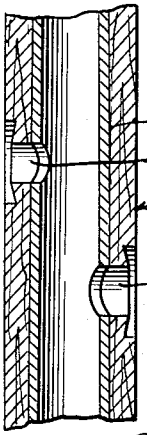
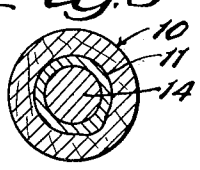


Fig. 3



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Fig. 6

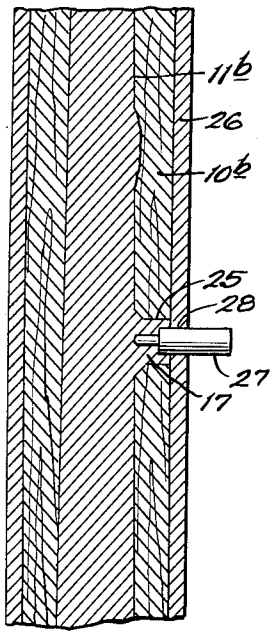


Fig. 7

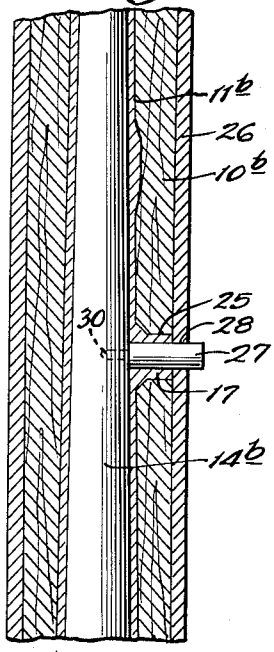


Fig. 8

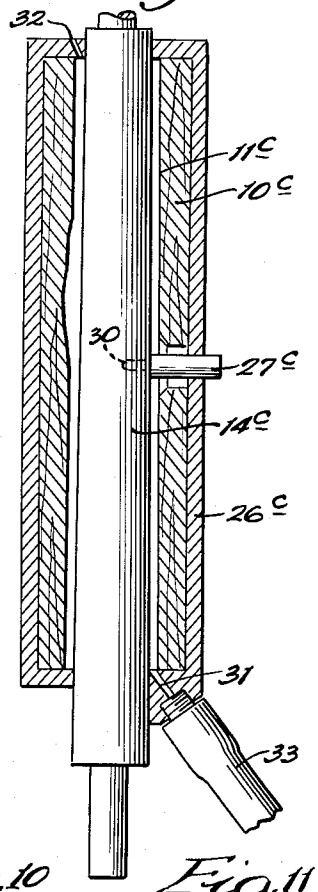


Fig. 9

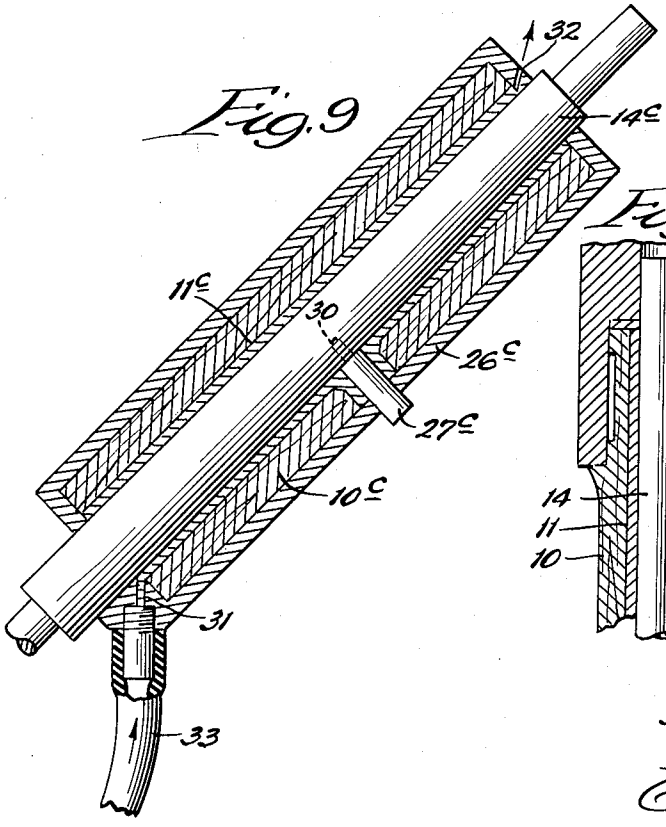
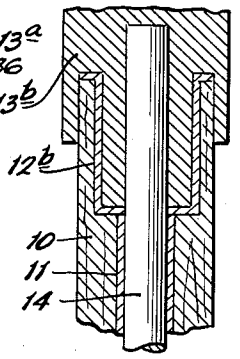


Fig. 10

Fig. 11



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CAST LINER FOR WOODWIND INSTRUMENTS

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Application August 9, 1951, Serial No. 241,104

5 Claims. (Cl. 84—380)

This invention relates generally to musical instruments of the woodwind class and more particularly to an improved plastic lined woodwind and method of fabricating same.

Since their inception woodwind instruments such as clarinets, bassoons, oboes, etc. have been constructed from hard woods. In recent years, however, some instruments have been formed from plastic materials, and from metal. Such instruments, however, have not been well received by musicians who maintain that they do not have as good tone qualities as instruments formed of hard woods such as grenadilla.

Wooden instruments, however, have certain disadvantages which have plagued manufacturers and musicians for many years. Among these is the fact that wood instruments absorb moisture as they are played and give it up during periods of inactivity. This causes weakening of the wood, swelling, contraction and warping all of which may affect the tone quality as well as the life of the instrument.

Another difficulty which has been particularly troublesome to manufacturers is the fact that it is difficult to bore and finish evenly and smoothly straight concentric holes through the instrument bodies. Tapered holes are even more difficult to provide, yet some instruments must be so bored.

One object of this invention is to provide a woodwind instrument having the advantages of an all plastic instrument as well as the tonal qualities of a wood instrument.

A further object is to provide woodwinds having concentric, straight smooth sided central bores which may be either cylindrical or tapered and an improved method of making said bores.

These objects are achieved in this invention by providing wooden instrument bodies having oversized bores lined with a relatively thick water resistant plastic material which is tightly bonded to the wood body of the instrument.

Accordingly, a further object is to provide a method for producing plastic lined wooden instruments in which the plastic is cast in its final form inside the wood body so that a minimum of finishing is required, the bore of the plastic liner being concentrically located and being held to close dimensional tolerances,

A further object is to provide an instrument having accurately located tone holes intersecting the main bore, the tone holes also being lined with plastic.

A related object is to provide a method of producing and lining the tone holes in such fashion that the tone hole linings are integral with the lining of the main bore.

Other objects and advantages of the instruments and of the processes of making them will present themselves to those familiar with the art on reading the following specification in conjunction with the drawings and the appended claims.

In the drawings:

Fig. 1 is a longitudinal section of a portion of a woodwind body which has been bored but not lined with plastic;

Fig. 2 is a similar view showing the body after the plastic has been poured with the bore forming mandrel still in place;

Fig. 3 is a section taken on line 3–3 of Fig. 2.

Fig. 4 is a longitudinal section of a finished body after the mandrel has been removed and the tone holes have been drilled;

Fig. 5 is a view of another type of body having a double tapered bore, after pouring of the plastic;

Fig. 6 is a longitudinal section showing a portion of a modified type of body which is to have lined tone holes; the body being shown enclosed in an exterior form, after pouring but prior to mandrel insertion;

Fig. 7 is a view similar to Fig. 6 showing the body with the mandrels in place;

Fig. 8 is a view of another modified casting arrangement in which the mandrels are inserted prior to injecting the plastic which is pumped in from the bottom;

Fig. 9 is a section showing the body after injection of the plastic and the manner in which the assembled mold is rotated and tilted to eliminate entrapped air bubbles.

Fig. 10 is a longitudinal section showing a modified arbor arrangement for lining the end of a body section to provide a plastic to plastic joint between sections, the internal portion of the joint being shown; and

Fig. 11 is a view similar to Fig. 10 showing the arrangement for forming a plastic lined external joint element.

As shown in the drawings a fundamental concept of this invention is to cast a plastic liner in an oversized bore provided in the wood body, a mandrel being used to form the finished bore in the plastic. The mandrel may have any desired shape such as elliptical section or may be tapered, providing that the surfaces are inclined such that the mandrel may be withdrawn after casting.

Various kinds of resinous materials may be used providing that they are suitable for casting or low pressure injection. They may be either thermosetting resins or thermo-plastic, and the examples set forth herein are intended to be illustrative rather than limiting since they have been selected with the thought in mind of demonstrating different chemical processes. Similarly several mechanically different methods are described which are representative of many others which will be apparent to those familiar with the art.

One desirable method for forming and lining a woodwind body **10** is shown in Figs. 1–4 of the drawings. The body illustrated is that of a section of a clarinet. But the same method is applicable to the other woodwinds. The outer contour of the wood body **10** is cut from a block of an appropriate wood such as grenadilla by conventional wood turning methods to have substantially the finished shape. Next the body **10** is drilled to provide an axial hole **11** extending from one end to the other. Each end of the body is then drilled to provide an oversized bore **12** at each end. These bores

serve as supporting sockets for a pair of arbors **13** (Fig. 2) which support the bore forming mandrel **14**.

The size of the hole **11** is substantially larger than the finished bore of the instrument, and it may be a roughly bored hole which is more or less eccentric as illustrated in the drawing. Regardless of irregularities in the rough bore, the finished lined bore will be true and concentric, and the rougher the finish of the oversize hole **11** the better the bond between the wood and plastic after the casting is completed.

The next step is to prepare the casting resin according to any one of the examples hereinafter specified or according to suitable conventional processes. A filler such as sand or wood flour, talc or glass fibers may be added to the resin to reduce the quantity required and to control shrinkage. The liquid casting mixture is then poured into the rough bore **11**, the lower arbor **13** having been inserted to close the bottom. The quantity of mixture poured into the bore **11** may be just sufficient to form the plastic liner with a slight excess, but it is preferred to fill the bore completely catching the overflow for reuse when the mandrel **14** is inserted. The mixture is allowed to stand until the bubbles formed in pouring have risen to the top, being stirred if necessary, and the mandrel **14** is then inserted into the bore **11**, the projecting portions **15** on the ends thereof being received in the sockets **16** in the arbors **13** so that the mandrel is concentrically supported between the bores **12**. Actually, the upper arbor **13** is inserted in its bore **12** after the mandrel has been inserted. Excess casting liquid is forced out of the top of the body when the mandrel and arbor are inserted, and in the event that any bubbles are formed when the mandrel is inserted it may be rocked back and forth or reciprocated to work the bubbles to the top prior to insertion of the upper arbor.

The plastic material is then cured by a process appropriate to the particular plastic which is used. During the cure the resin solidifies and is tightly bonded to the sides of the bore **11** since wood fibers extend into the plastic and the plastic permeates into the interstices of the wood. After the plastic has solidified, the arbors **13** are withdrawn, and the mandrel **14** is forced out of the body **10** to leave a smooth walled concentric completely lined bore extending the length of the body. In this connection it should be mentioned that casting resins having relatively low shrinkage and which do not adhere to the mandrel must be employed or they will seize the mandrel too tightly and prevent its removal. Resins of the types specified, however, have proved satisfactory from this standpoint. In some cases it may be necessary to lubricate the mandrel with substances such as metal stearates or to provide a very slight taper on the mandrel on the order of .0015 or more inches per inch.

The next step is to drill the tone holes **17** through the sides of the body **10** as shown in Fig. 4. This operation is conventional as are the following steps of finishing the instrument.

If desired, the arbor locating bores **12** which may be utilized as sleeve joints in the finished instrument may also be lined with plastic material by under cutting the arbors **13** to provide cavities into which the plastic may flow. One arrangement for doing this is illustrated in shown. The arbor **13***a* (Fig. 10) forming the internal joint component is provided with a bore slightly longer than the end of the joint, being seated on a flange **35** provided on the body. Thus a cavity **36** is formed at the end of the body which is filled with plastic during casting. A similar ararngement is used to line the external portion of the joint shown in Fig. 11. In this instance the arbor **13***b* has a projecting portion extending into the oversized end bore **12***b* which is slightly smaller than the bore. The arbor **13***b* is so located with respect to the body that the cavity also extends beyond the end of the body. Thus a complete, contiguous, plastic liner is provided at the joint on casting. Other modifications in this respect will present themselves to those familiar with the art when particular woodwinds are considered, depending upon the type of joints used therein.

A modified body **10***a* is shown in Fig. 5. This body is provided with a double tapered bore having a minimum diameter portion near the middle of the body. To form such a body, two tapered mandrels **18** and **19** are used, one of which has an axial socket **20** in one end which receives a projection **21** on the other mandrel so that once inserted they are securely held together in the proper concentric relationship. The ends of the mandrels **18** and **19** are supported by arbors the same as in Fig. 2, and the method is otherwise the same. If the tapers are slight the two mandrels may be inserted as a unit and withdrawn separately facilitating alignment.

In Figs. 6–9 two modified methods for forming bodies having plastic lined tone holes are illustrated. The method of Figs. 6 and 7 is very similar to that described in Figs. 1 and 2 except that oversized tone hole openings **25** are drilled through the sidewalls of the body **10***b* prior to pouring the plastic liner. Next the body **10***b* is slipped into an exterior form or framework **26**. The plastic casting liquid is then poured into the axial bore **11***b* as in the preferred method, the tone hole openings **25** being sealed by the exterior form **26** and tone hole pins **27** which are slipped part way into the openings **28** provided in the sides of the form **26**. After the casting liquid has stood long enough for the bubbles to rise, the central mandrel **14***b* is inserted and the tone hole pins **27** are pushed inwardly into openings **30** provided in the sides of the mandrel. The openings **30** are slightly oversize so that the liquid may flow out as the pins are inserted.

On solidification of the resin the tone hole pins are pulled out to release the mandrel so that it may be withdrawn. The body **10***b* is then removed from the exterior form and is finished in the conventional manner. The beveled interior edges of the tone holes in the wood allow the junctures between these holes and the central bore to be rounded or beveled to any desired shape without exposing the wood.

The method illustrated by Figs. 8 and 9 is similar in many respects to that described above. It differs, however, in that the liquid resin is pumped into the bore through an opening **31** in the bottom of the exterior form **26***c*. Thus the instrument body **10***c* is initially inserted in the exterior form **36***c*, and the mandrel **14***c* and tone hole pins **27***c* are installed in the positions illustrated in Fig. 8. When this has been done the casting resin is pumped into the bore through the opening **31** until it flows out of the sprue opening **32** provided at the upper end of the exterior form **26***c*. To insure that no bubbles will be formed in the resin, the exterior form **26***c* is preferably mounted on a universal bracket (not shown) so that it may be inclined as shown in Fig. 9 and rotated about its axis during the injection of the liquid. To facilitate this, a flexible hose **33** is preferably provided to connect the reservoir of casting liquid to the inlet opening **31**. It is preferred that the enclosing body **26***c* be rotated during the filling process in order that each of the tone holes extends upwardly part of the time during the filling so that no bubbles may be caught therein. After the body is filled the resin is cured and, when hard, the mandrel and pins are removed, the same as in the above described method.

As stated previously, various casting resins may be employed. The preferred chemical process is as follows:

Example A

Polyester casting resin of the addition type copolymer class such as Selectron 5003, manufactured by the Pittsburgh Plate Glass Company, is mixed with a quantity of a related polyester resin such as Selectron 5208 from the same supplier, the latter serving as a plasticizer. Both of these materials are in the liquid form and they are mixed

cold. Next a peroxide catalyst such as benzoyl peroxide, t-butyl hydro-peroxide, lauroyl peroxide or 1 hydroxy cyclohexyl hydro-peroxide is added to accelerate polymerization. Only a small quantity of catalyst, preferably between 0.05 and 2.0 percent is required. A filler such as sand flour, talc or glass fiber may be added if desired either before or after the addition of the catalyst to reduce shrinkage. This also reduces the amount of resin required. Actually the catalyst need not be used since the material will cure in time regardless of whether the catalyst is present. However, the use of the catalyst shortens the curing time considerably and is recommended. It is preferred to use a composition approximately as follows:

	Per cent by weight
Selectron 5003	53.1
Selectron 5208	26.7
Micronized china clay	20.1
Tertiary butyl hydro-peroxide	.1

After mixing the liquid is allowed to stand for a short period of time until the bubbles formed have risen to the top surface. It is then poured into the bore of the instrument to be lined and allowed to stand with or without stirring until any additional bubbles have been eliminated. The mandrel is then inserted and held in place by the locating arbors.

The instrument is preferably maintained at a temperature of 70–80° F. for approximately sixteen hours during which the plastic sets into "gel" form. After gelation the temperature is raised to between 110 and 120° F. for a period of approximately forty-five minutes when a complete cure is effected. The locating arbors are removed and the mandrel is pressed out of the instrument to leave a smooth wall concentric bore through the body.

Example B

Liquid methacrylate monomer is partially polymerized either by preheating or by dissolving polymer in the monomer until a honey-like syrup is produced. This syrup is allowed to stand until all bubbles have risen to the surface, and then it is poured into the instrument bore. The instrument is then subjected to a temperature of approximately 130° F. for a period of about 9 hours. At the end of this time the temperature is increased about 15° and maintained for 8 to 10 hours. The cure is then completed by raising the temperature to 225° F. and maintaining the temperature for 8 more hours.

In thickening the monomer to prepare the casting liquid 3% to 4% dibutyl phthalate may be added to the monomer together with 0.02% benzoyl peroxide. When this is done the monomer is heated to a temperaure above 150° F. for approximately 8 to 10 minutes until thickened.

Example C

A phenolic casting resin, which is essentially a mixture of phenol alcohols substantially condensed to the advanced A stage, is mixed with a small quantity of an accelerator such as hydrochloric acid and allowed to stand for about two hours at a temperature of 70° F. During this time the mixture is slowly agitated drawing all bubbles to the surface. The mixture is let stand for 15 minutes and then poured slowly into the bore of the instrument, a riser preferably being provided so that additional bubbles which form after pouring may rise to the surface. The mandrel is inserted and the resin is allowed to stand for a period of approximately 4 hours during which time the small bubbles rise to the surface and are collected in the riser which may be readily provided by utilizing a long arbor having a cavity within it at the upper end of the instrument. Then follows a baking period when the instrument is raised to the temperature of 140° F. for a period of 8 hours. The mandrel and arbors may be removed after two hours of baking in order to minimize the likelihood of shrinkage occurring which will bind the mandrel, for the largest shrinkage occurs during the latter portion of the cure.

In carrying out this method a casting resin such as Durex 7421a mixed with 5% Durez 7422 has proved quite successful. These resins are manufactured by Durez Plastics and Chemicals Incorporated of Tonawanda, New York.

Other casting resins, whether thermosetting or thermoplastic may be utilized, the manufacturers' directions for formulation, casting and curing being followed. It is preferred, however, to use resins and procedures in which little shrinkage results during the curing operation. For this reason thermosetting resins which are cast hot are generally not adaptable since higher shrinkages are generally experienced with such materials. It is preferred to select resins which do not evolve other substances such as water or alcohol during curing, because such products may produce bubbling. It is also undesirable to employ thermosetting resins having a softening temperature below 150° F. since the finished instruments may be occasionally subjected to such temperatures, for example, when carried in the trunk of an automobile on a sunny summer day.

From the foregoing specification it will be apparent that not only can various casting resins and chemical procedures be employed but also that various types of linings may be formed utilizing various physical casting procedures. Other changes and modifications in addition to those expressly set forth therein may be made without departing from the spirit of this invention whose scope is commensurate with the following claims.

What is claimed is:

1. A woodwind musical instrument comprising an elongated wood body formed with an axial bore therethrough, said body having a plurality of oversized tone holes through the sides thereof and a one piece cast liner of plastic material molded within said bore and tone holes of said wood body in integral relation therewith, said liner having a finished axial bore with a smooth inner surface concentric with the exterior of the body, and said portions of said liner within said oversized tone holes having openings therein communicating with said finished axial bore.

2. A musical instrument comprising an elongated wood body formed with an irregular rough bore therethrough, a tubular moisture proof liner of plastic material having substantial thickness molded within said bore of said body, said plastic liner being integrally bonded throughout its entire exterior surface to the inner wall of the bore and having a finished axial bore therethrough a smooth inner surface concentric with the exterior of the body.

3. A body for use in a musical instrument comprising an elongated piece of hardwood having an axial bore therethrough and intersecting bores through the side wall to provide tone holes, and an integral plastic liner cast in integral relation with said body and completely lining said axial and intersecting bores thereof, said liner having substantial thickness throughout and being tightly bonded to said hardwood body, and said liner having finished bores therein extending within and substantially concentric with said axial and said intersecting bores in said hardwood body.

4. A musical instrument including in combination, an elongated body formed of hardwood having a rough axial bore therethrough, a tubular moisture proof liner of plastic material cast within said axial bore in integral relation with said hardwood body so that the exterior surface of said liner is directly and tightly bonded to said rough axial bore, said plastic liner having substantial thickness and having a smooth inner surface substantially concentric with the exterior of said hardwood body and tapered inwardly from either end thereof toward a central portion of minimum diameter.

5. A musical instrument including in combination, an elongated body formed of hardwood having a rough axial bore therethrough, a bore of larger diameter at one

end of said body, an integral liner of plastic material cast within said hardwood body in integral relation therewith, said liner being of tubular configuration having substantial thickness and being directly and tightly bonded throughout its entire exterior surface to said rough bore and to said bore of larger diameter, said tubular plastic liner having inner surfaces substantially concentric with the exterior of said hardwood body.

References Cited in the file of this patent

UNITED STATES PATENTS

968,694	Rubright	Aug. 30, 1910
1,395,107	Hawk	Oct. 25, 1921
1,801,187	Artley et al.	Apr. 14, 1931
1,801,690	Pruefer	Apr. 21, 1931
2,160,108	Reid	May 30, 1939
2,397,626	Shriver, Jr.	Apr. 2, 1946
2,484,225	Herzig	Oct. 11, 1948
2,596,260	Linton	May 13, 1952
2,602,364	Loney	July 8, 1952
2,613,397	Borkland	Oct. 14, 1952

FOREIGN PATENTS

29,380	Germany	Nov. 26, 1884

OTHER REFERENCES

Modern Plastics by Harry Barron, 2nd edition revised, London, Chapman & Hall Ltd., 37 Essex St., W. C. 2, 1949.