DATE DUE

MAKE YOUR OWN

by

A. P. SHARPE

EDITOR OF "B.M.G."

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Foreword

THE author wishes to acknowledge the debt of gratitude he owes to Marco Roccia in not only providing, over the many years of their association, all the information contained in this book but in carefully checking all he has written therein.

MARCO ROCCIA, maker of the Clifford Essex concert size Spanish guitar which is used as a model in the following pages, is an Englishman born of Italian parents. He started his instrument-making apprenticeship as a boy; first in his father's workshops in Cassino, Italy, and later in Paris. He returned to the land of his birth in 1927, when he joined the Clifford Essex Co. and became one of the craftsmen who produced the many thousands cf guitars (of all kinds) that bear this world-famous name.

A. P. Sharpe (left) discusses a point of guitar making with Marco Roccia in the Clifford Essex workshop.

After demobilisation in 1945, Marco Roccia returned to his position with the Clifford Essex Co. and is now solely responsible for all repair work to fretted instruments entrusted to this Company. In addition, he produces the " concert size " Spanish guitars which, entirely hand made by him, have been used as a basis for the compilation of this book. The methods of this craftsman luthier, too, have been used as a guide—although, in some cases, they have had to be modified to meet the limitations of the amateur guitar maker.

Terence Usher, Tutor of the guitar at the Royal Manchester College of Music, recitalist and broadcaster, composer and arranger of works for the guitar, and author of many articles on playing the guitar, recently compiled a paper for The Galpin Society in which he paid tribute to the genius of Marco Roccia. He wrote: " Most of the modern luthiers have been content to copy the designs (fan strutting) of Torres, Enrique Garcia, Ramirez and other earlier makers whose designs are accepted as standard . . . One British luthier, however—Marco Roccia —recommenced making guitars after the second world war by casting aside all preconceived ideas except those of body size and shape and, calling upon his experience in repairing thousands of old guitars by all the world's makers, began again on new lines. The experiments included double cruciform and other unorthodox barrings; barring based on that found beneath the soundboards of early square pianos; barrings without uniformity of structure placed empirically where the soundbox was proved to be under stress . . . and variations of wood thickness of treble and bass sides of the belly and sides."

Thus although some of the instructions in this book may be found (to those acquainted with the facts) to be at variance with "usual" standards they are based on Marco Roccia's vast experience in not only repairing old instruments but on his own accumulated knowledge gained from discovering where some of these instruments " fell down " in construction over the years.

Introduction

NEVER before in the history of the Spanish guitar—and the instrument possesses a history that dates back to the early fifteenth century*—has the instrument been as popular as it is today. Literally thousands of people, from all walks of life, have taken up the Spanish guitar during the past few years and hundreds of wood-working enthusiasts have attempted (and continue to attempt) to "make a guitar." Making a guitar is even a part of the curriculum in many Secondary schools!

Although there have been dozens of books published (over the years) on how to make violins, never, to my knowledge, has a book hitherto been published giving complete and detailed instructions on how to make a guitar.

This book has been compiled to remedy this omission and it is hoped it will be found of help to the many enthusiasts who wish to make a guitar and who, I am sure, look forward to the satisfaction of playing on an instrument made by their own hands.

It should be stressed that although making a guitar, by following the instructions given in this book, is an easy (comparatively speaking) task to a man used to wood-working, to produce an instrument comparable to the finest guitars extant—and here it might be mentioned that instruments of the kind played by such world-famous artists as Andres Segovia are valued at anything up to £1,000—is far from easy. Apart from the expert selection of the various woods used in its manufacture, the making of a really outstanding guitar (outstanding in craftsmanship and tonal qualities) is generally due to the luthier's experience gained, in most cases, over many years of practical application in constructing countless instruments.

Nevertheless, the amateur guitar maker—even if he does not produce another "Stradivarius"—will derive a lot of pleasure and much satisfaction over the weeks (and months) he devotes to making his masterpiece take shape. If he is already a guitarist, the satisfaction from playing a guitar made by his own hands is immeasurable.

If the amateur guitar maker is not already a guitarist, the production of a guitar will, it is hoped, inspire him to become one.

I am only too well aware that, in many cases there are several *modus operandi* in the various stages of guitar construction—different luthiers preferring their own proved methods—but in this book I have been guided by master luthier Marco Roccia who has made (and continues to make) some of the finest guitars ever produced in England during the present century.

The would-be guitar maker is advised to read through the following pages carefully before he starts to make his first guitar—not only to become aware of the tools and materials he will require, but to be completely conversant with all the work involved and the various stages of its application.

The work necessary to make a guitar may appear, at first sight, to be formidable—but many hundreds of amateur woodworkers *have* made guitars, so it is not impossible for the real enthusiast to do likewise.

"Make haste slowly" is a good maxim to heed and by carefully following the instructions in this book *you* too can "Make Your Own Spanish Guitar."

A. P. SHARPE.

London, 1957.

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* *If you are interested in the history of the Spanish Guitar you would find the book* "THE STORY OF THE SPANISH GUITAR" *by A. P. Sharpe (Clifford Essex, 15/-) of interest. It gives a complete history of the instrument with biographies of its famous composers, personalities and players and, in addition, contains a special art supplement of full-page photographs of old and new guitars (front and back view) with details of construction and all relevant measurements.*

A photograph of the Clifford Essex concert size Spanish Guitar—used as a model throughout this book.

Making the Guitar

FIRST STEPS

The first consideration is the body size of the guitar to be made. Although the guitar is today more-or-less "standard" in body size, different luthiers vary their measurements slightly. In this book the Clifford Essex "concert size" guitar (pictured on the preceding page) is used as a model.

Fig. 1 gives the body shape in template form and this should be copied on to a large sheet of fairly stout cardboard. As this template is called into use several times, it might be advisable to copy the shape on to a thin sheet of zinc or aluminium—or even a sheet of plastic. It will then be easier to transfer the shape to the actual woods to be used later.

Each square shown in Fig. 1 represents one inch.

On the large sheet of cardboard (metal or plastic) rule off one-inch squares to cover an area twenty inches long by eight inches wide.

As both halves of the guitar are identical, only one half is shown.

The actual body of the guitar is constructed inside a mould (see Fig. 2) and as this is probably the most important part of the luthier's (and amateur guitar maker's) equipment, full details for making this mould are given.

The mould *can* be constructed from solid timber but for the amateur it might be found more convenient to build it from six laminations of ½" wood or three laminations of 1" timber. If this is done, "cross" the grains to give added strength to the mould.

Ordinary deal can be used provided it is well-seasoned.

Reference to Fig. 2 will show that the mould is made in two halves to make it easy to remove the various parts of the guitar body at the appropriate times.

When cutting out the inside shape of the mould, for which the guitar body template is used as a marking medium, cut the mould a fraction of an inch smaller in size so that the mould can then be cleaned up with the scraper and then glasspapered to the exact size required.

Accuracy in making the mould is most important, for on this piece of equipment depends the completed shape of the finished guitar. Great care should be taken to ensure that the "walls" of the mould are at perfect right-angles to the flat surfaces and that the top and bottom joins are perfect.

When an amateur makes a mould it sometimes happens that a little too much wood will be taken off in one place. This is not as serious as it may appear for such a mis-

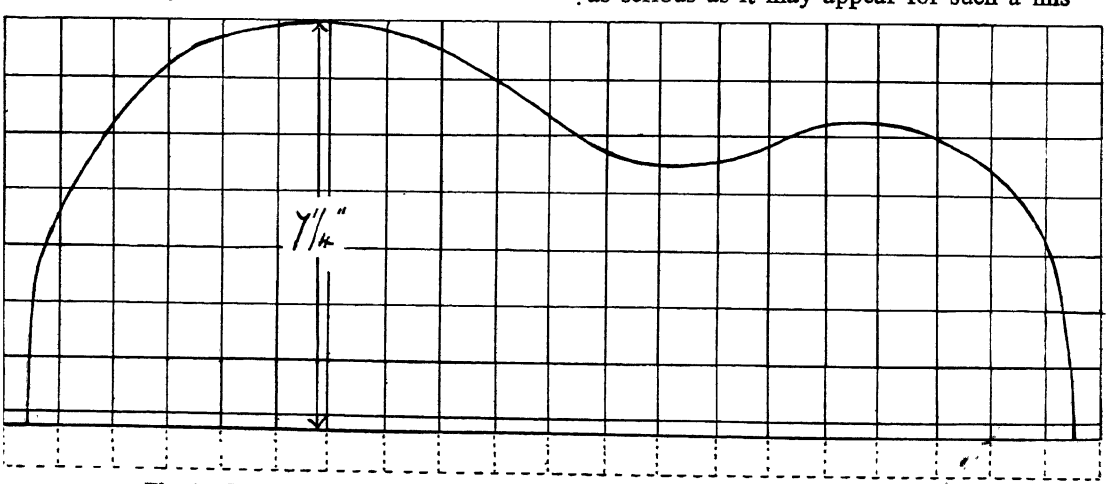


Fig. 1.—The template for marking out the body shape. Each square represents 1".

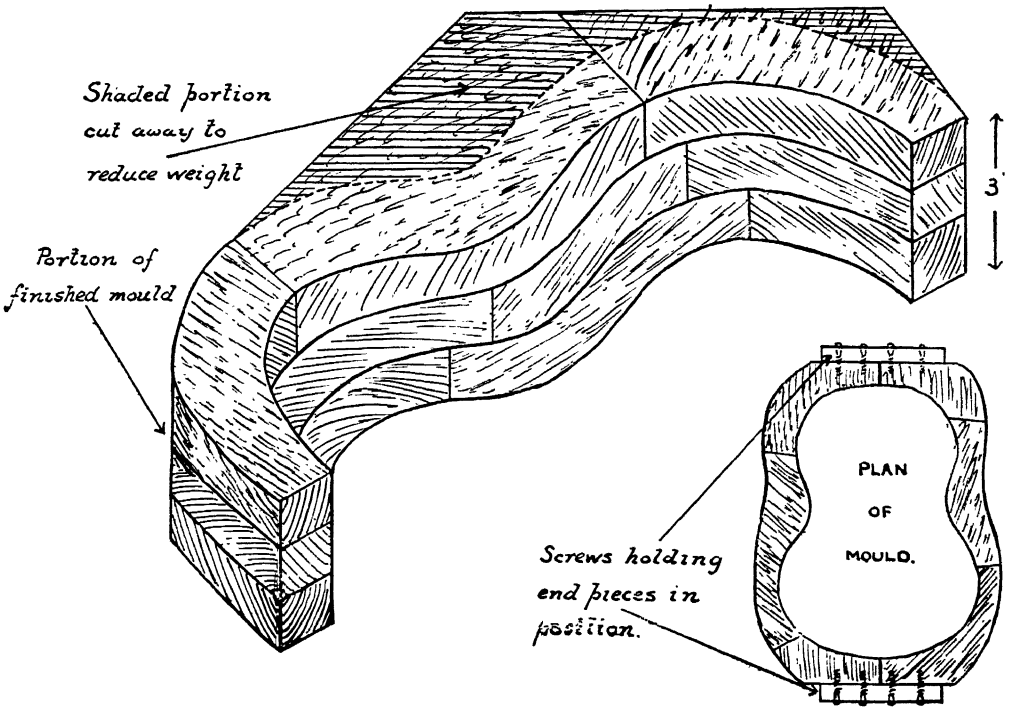


Fig 2.—The mould in which the guitar is built. Above: **One half of the mould, showing how it may be constructed from small pieces of timber.** At right: **Plan of the complete mould showing how the two halves are placed together and held in position by two screwed-on end battens.**

take can be corrected by either glueing in pieces of strong brown paper, where too much wood has been removed, or, if the mistake is more serious, a thin piece of veneer can be glued in; tapering it off at the ends which are then glasspapered down.

It cannot be too strongly stressed that the labour and time spent on producing a good mould is not wasted. It is most important that the finished mould should be perfect—the perfect guitar cannot be constructed on a mould that is not one-hundred-per-cent. perfect.

WOODS

On the opposite page is shown the various woods advised for the main parts of the guitar but it may be necessary for the amateur to compromise, as the ideal woods may not always be obtainable. The important thing is to choose the right *kinds* of wood, *i.e.* hardwood for the back and sides; spruce or pine for the face, etc.

Having prepared the mould to your completc satisfaction, the first job to be tackled is the making of the sides of the guitar.

Two pieces of rosewood, walnut, mahogany, maple or sycamore, each 3½″ wide by 30″ long and just over 3/32″ thick, are needed for making the sides of the guitar. These pieces of wood should be planed perfectly smooth on both sides without reducing the material to less than 1/16″ thick.

BENDING IRON

To "shape" the sides before inserting them into the mould it is necessary to use a "bending iron" and details of construction are shown in Fig. 3.

Although gas heating is advised (for this can be more easily controlled) electric heating can be used—1 kw. element being sufficient. If electrical heating is used, care should be taken to see that all connections are properly earthed.

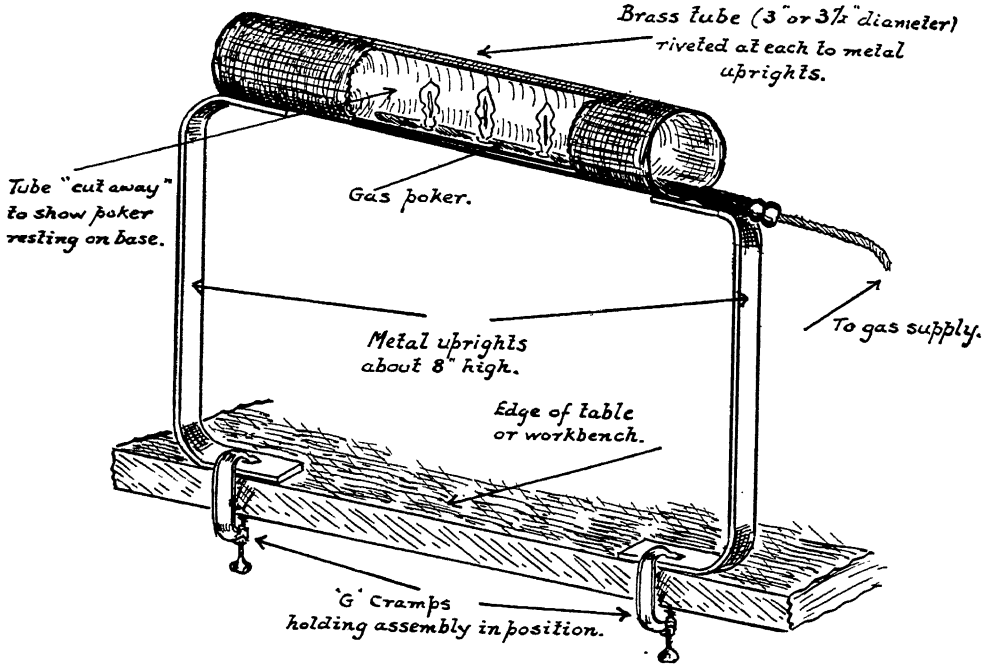


Fig. 3.—Suggested construction and mounting of the bending iron. (The constructor may vary details to suit his own purpose but it should be borne in mind that, in use, the brass tube—not iron, which will mark the wood—will become hot so it should be reasonably isolated from anything likely to be scorched).

WOOD REQUIRED

Sides: 2 pieces of rosewood, walnut, mahogany, maple or sycamore: 30″ x 3½″ x ⅛″.

Linings: 2 pieces of spruce or pine: 30″ x ⅝″ x ⅜″; 2 pieces of spruce or sycamore: 30″ x ⅝″ x 3/16″.

Back: 2 pieces of rosewood, walnut, mahogany, maple or sycamore (the same wood as used for the sides): 20″ x 7¾″ x ⅛″.

Face: 2 pieces of spruce or pine: 20″ x 7¾″ x ⅛″.

Neck: 1 piece of hard rosewood, walnut or maple: 21″ x 3″ x 3″.

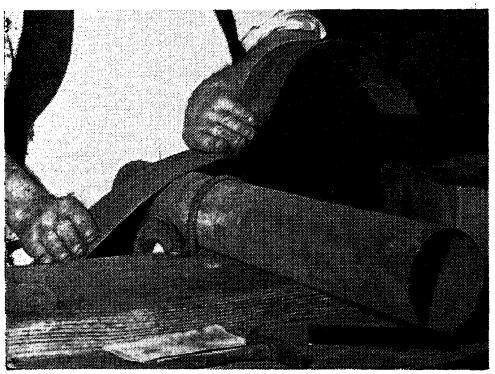
Fingerboard: 1 piece of ebony, hard rosewood, or stained pearwood: 17½″ x 2½″ x ¼″.

In addition to the above, various pieces of spruce, ebony, etc., will be needed but these requirements can be obtained as the need for them occur during the construction of the guitar.

(The amateur guitar maker might find difficulty in purchasing the appropriate woods from normal timber suppliers. The writer knows of several amateur guitar makers who have found suitable woods in secondhand furniture shops by buying an old table or sideboard, etc. This possibility should not be overlooked.)

SHAPING THE SIDES

One side of the guitar is first soaked in water for 10 or 15 minutes and when the bending iron is hot enough to almost scorch a piece of wood placed against it, the side (with the position of the waist having been marked) is pressed against the tube and gentle pressure applied on each side. The dampness of the wood and the heat coming from the bending iron will cause the wood to bend—and the extent of the curve can be regulated to conform to the shape of the mould. (See photograph.)



Showing how the guitar side is bent over the heated bending iron.

The guitar mould should be on the bench or table-top close to the bending iron so that the resulting curve(s) can be frequently checked in the mould.

It will be obvious that to make the curve of the guitar "waist" the side is turned over on the bending iron and pressure applied in the opposite direction.

Whilst bending the sides, great care should be taken not to scorch the wood. If the bending iron is too hot it will leave scorch marks on the sides being bent and whilst that is not too important when bending the sides for the upper and lower bouts of the guitar, scorching of the wood when bending for the waist will be difficult to remove.

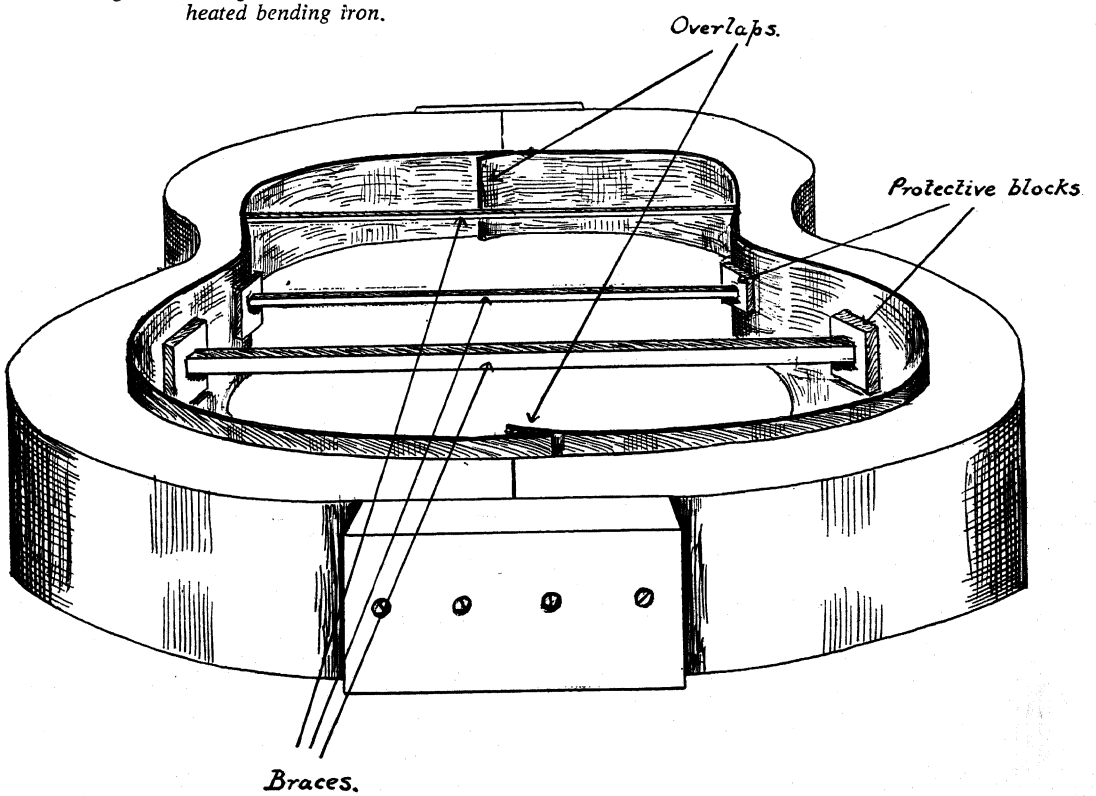


Fig. 4.—The two sides placed inside the mould and held in position by wooden "braces." Protective blocks of wood should be placed at each end of each brace to prevent the guitar sides from becoming marked.

It is possible for the amateur to bend the wood *too* much. If this happens the bend can be slightly straightened out by turning the side over and lightly resting it on the bending iron.

When both sides have been bent satisfactorily, they are placed inside the mould and temporary braces fitted across at the upper and lower bouts and across the waist to keep them in position whilst they dry out. (See Fig. 4.)

Fitting the bent sides into the mould.

It does not matter that the ends of the sides overlap at the ends of the mould—these will be " trimmed " later.

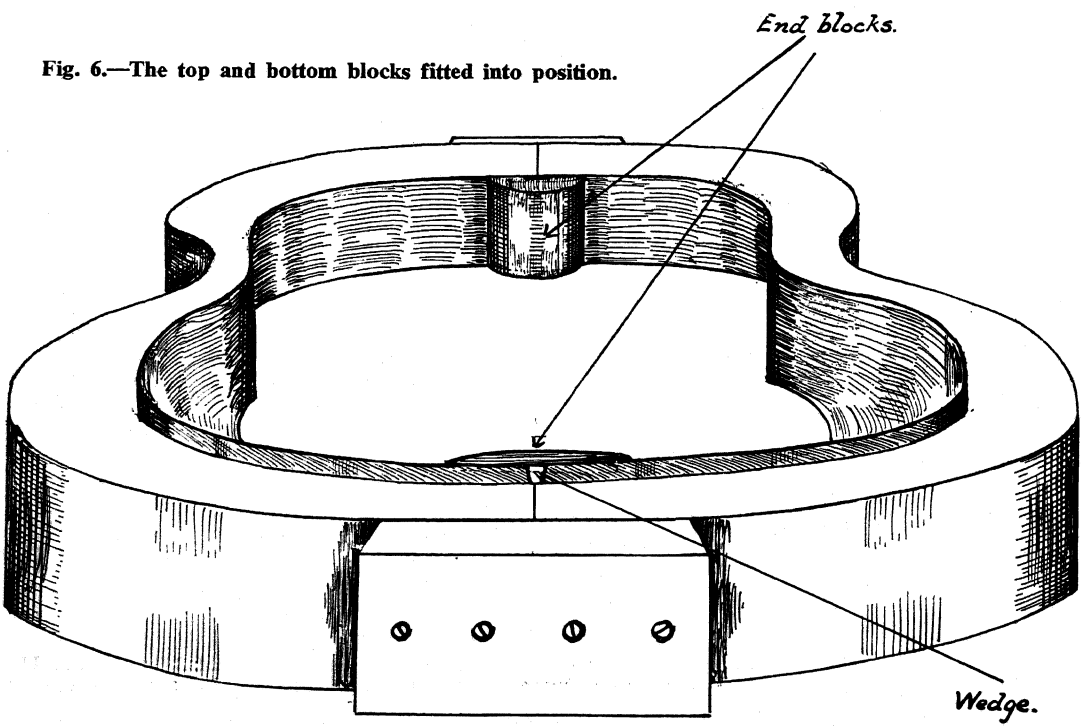
When you are sure that the sides in the mould are thoroughly dry—at least twenty-four hours should be allowed for this—the next thing is to mark the ends at top and bottom of the mould and saw off square across the width. These should then be cut to allow for a small " V " shaped wedge of maple or sycamore to be inserted. These wedges should be the same thickness as the sides and are driven home to prevent the sides from springing away from the mould.

The bottom wedge is the more important as the top joint will later be cut away when the neck of the guitar is fitted.

END BLOCKS

The end and top blocks should next be cut from a piece of straight-grained spruce (see Fig. 5)—and here it is important to see that the grain of the top block runs vertically, to provide the greatest rigidity, and the grain of the bottom block runs horizontally to give strength at the base.

Fig. 6.—The top and bottom blocks fitted into position.



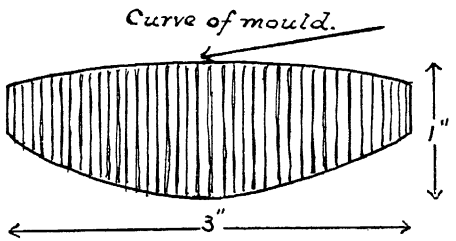
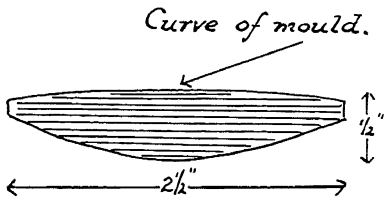


Fig. 5.—Above: The top block. Below: The bottom block. (Note direction of grain of wood.)



These blocks, which are cut from the solid slightly deeper than the height of the guitar sides, are then shaped on one side to conform to the curve of the mould; one for the top and the other for the bottom. With the guitar sides still held rigidly in position in the mould by the braces (see Fig. 4) the blocks are then glued and cramped into position. (See Fig. 6 on previous page.)

(Although synthetic glue can be used in making a guitar it is advised that best Scotch or fish glue be used throughout—and here it might be mentioned that this takes from five to eight hours to set hard, depending upon its consistency.)

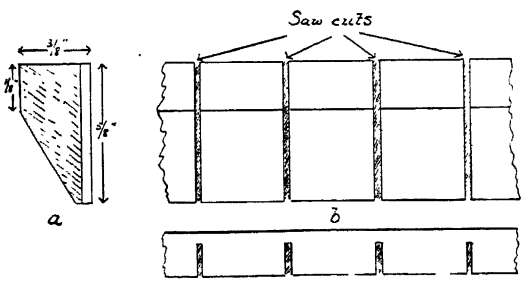


Fig. 7.—Showing how the length of spruce or pine is shaped and then sawn almost through at intervals of about ½". (Where the lining fits the inside curves of the sides it may be necessary to cut the slots closer than ½" to allow the lining to conform to the guitar shape.)

THE LININGS

The next step is to prepare the inside linings, which are fitted to the bottom and top edges of the sides. The purposes of these linings is not only to give strength to the sides but to increase the glueing area when it comes to fitting the back and face of the instrument.

The linings are of two kinds.

For the top edges of the guitar, *i.e.* where the face of the instrument is later fitted, a length of spruce or pine, $\frac{5}{8}$" by $\frac{3}{8}$" (or slightly less) is cut to the shape shown in Fig. 7 (a) and then sawn almost through at about $\frac{1}{2}$" intervals (b) so that the length of wood (not less than 30") can follow the contours of the sides.

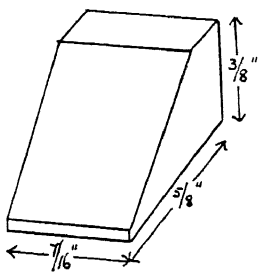


Fig. 8.

Some craftsmen prefer to make small individual blocks (see Fig. 8) which are glued in all round the upper edge of the sides. It will readily be seen that this method is more laborious (both in preparing the small blocks and in fitting them) but it *does* help to reduce the weight of wood used and, in addition, allows the face to vibrate more freely when the instrument is played.

Whichever method it is decided to use, once the strips of wood or small blocks are prepared, the next process is to glue them in position. The amateur guitar maker will probably find that fairly large spring clothes-pegs is the best means of holding the strip or blocks in position as they are fitted to the sides in the mould.

As the sides of the guitar can be lifted slightly to project above the surface of the mould it will be easy to clamp the clothes-

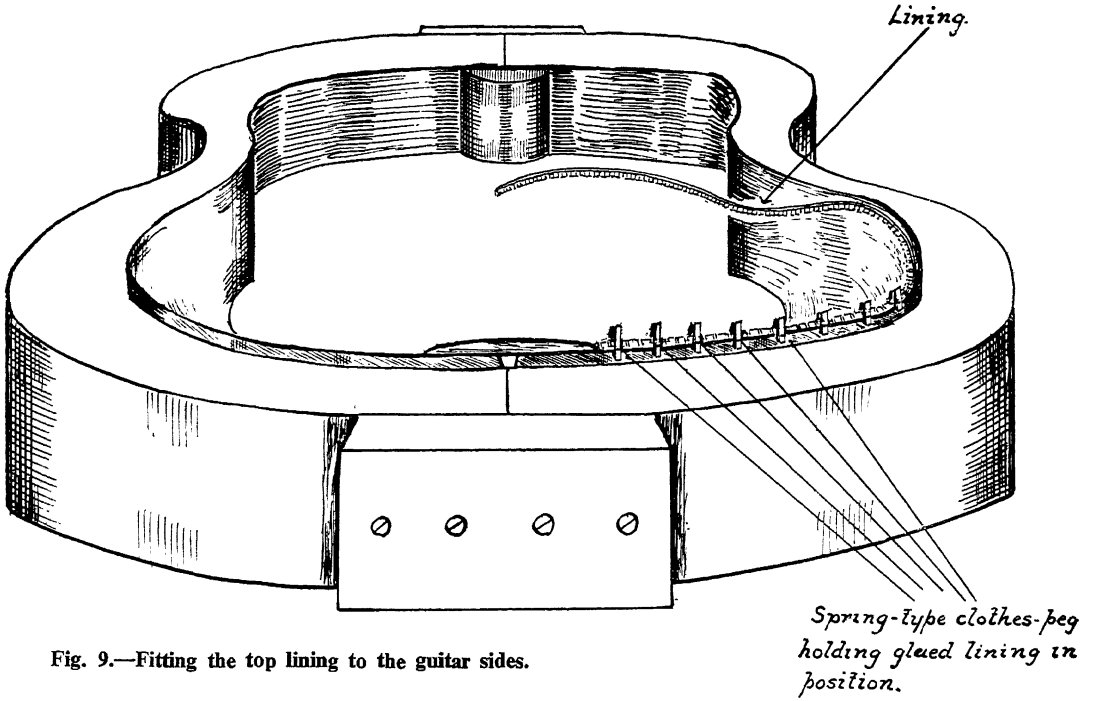


Fig. 9.—Fitting the top lining to the guitar sides.

pegs on to the strip or blocks. (See Fig. 9.)

TAPERING THE BODY

Before fitting the bottom lining, both sides of the guitar at the upper bout should be slightly tapered towards the top block. This should be done by starting the taper from the upper curve of the waist so that the side view of the sides show a slight curve as in Fig. 10. Be sure that the taper on each side is exactly the same.

The bottom lining, *i.e.* to which the back of the guitar is later fitted, can be two lengths of spruce or sycamore and these are fitted to the sides in a similar manner as that used for the top lining.

Although the outer edge of this lining should be perfectly square to the edge of the side, the top edge (the edge farthest away from that which will later take the back of the instrument) should be nicely tapered off with chisel and fine glasspaper. (See Fig. 11.)

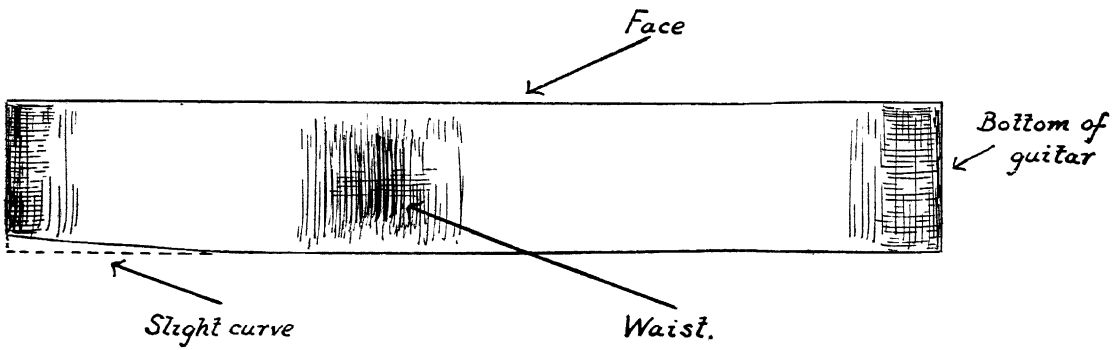


Fig. 10.—Showing how the sides are tapered at the upper bout (i.e. top-block end).

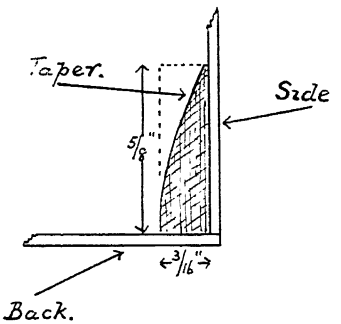


Fig. 11.—Details of the bottom lining, showing how it is tapered off after fitting.

When you are sure that both the top and bottom linings are satisfactory, and well glued into position, the next step is to see that top and bottom surfaces of both the top and bottom blocks are perfectly level with the sides of the guitar.

Now go carefully over the work completed so far and remove any surplus glue with a small chisel, taking the greatest care not to cut into any wood. It is very important that a perfectly smooth finish be achieved on all inside work. Smooth surfaces will not collect dust — accumulated dust inside a guitar can harbour damp which will be detrimental to both instrument and the tone it produces.

THE BACK

The next part of the instrument to be made is the back. For this you need two pieces of wood the same material as the sides and these should be 20″ long by about 7¾″ wide and ⅛″ thick.

When purchasing this timber the guitar maker can select a suitable piece of wood the size he requires but at least ⅛″ more than twice the thickness needed. (This ⅛″ is to allow for the wastage in cutting the timber into two pieces.) The timber merchant will cut the piece of timber down the thickness on the circular saw and, when it is "opened out," the grain in each half will match.

These two pieces are then glued together to form the two-piece back — and care should be taken to "marry" the grain at the join. The "run" of the grain should be towards the bottom of the guitar so if the resulting board of wood is narrower at one end, watch for this. (See Fig. 12.)

Some makers will prefer to "build up" the back from three (or more) thin veneers. If this is done the two outer layers should both be "matched" for grain.

It should be mentioned that it has been proved that a better tone is imparted to the finished instrument by using a solid piece of timber cut as described above.

A cabinet scraper is the best tool to use for working the solid wood down to the required thickness (or should one say "thinness"?). A scraper blade need only be a piece of hard steel, about 1/16″ thick, with the scraping surface whetted perfectly square on a fine oilstone. The other edge of the scraper can be sharpened like the cutting edge of a plane for rough scraping.

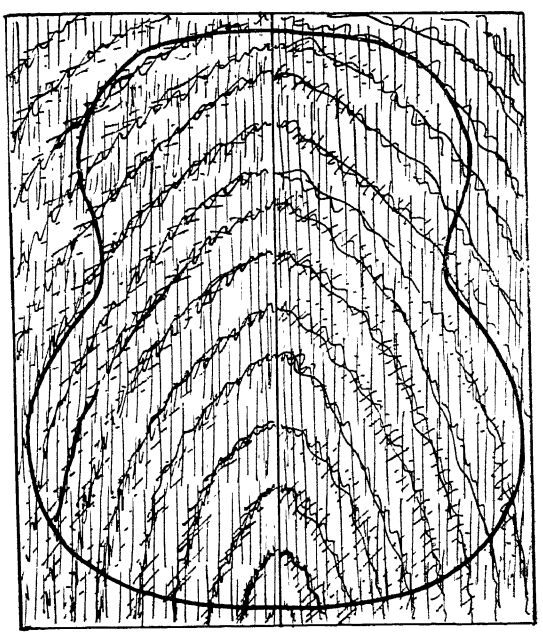
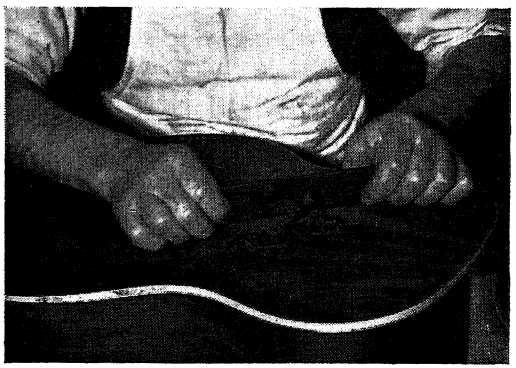


Fig. 12.—The two pieces of wood for the back are glued together (with the grain of the wood carefully matched) and then the shape is marked out—using the mould as a template.

Held as in the accompanying photograph, it is possible to "shave" the wood as desired. Be sure to keep the scraper sharp at all times otherwise it will "tear" the wood.



The outline of the back can be marked on the prepared wood by removing the sides from the mould and using the latter as a template. When doing this, be sure that the centre join in the back corresponds with the centres of the top and bottom blocks, and that the grain of the wood runs towards the bottom of the instrument. (See Fig. 12.)

Having correctly marked out the outline of the back, saw off the surplus wood to about a $\frac{1}{4}$" margin all round the outside of the line.

CROSS STRUTS

You now require three or four cross struts for the back, each about $\frac{5}{8}$" deep and about $\frac{3}{8}$" thick. These should be of the straightest-grained spruce or pine.

The face of the struts (*i.e.* the surface fitted to the back of the guitar) must be shaped at each end to a slight curve about 3/16" from the straight (see Fig. 13) and great care should be taken to ensure that each strut has a similar curve. The grain of the struts should be from top to bottom as shown in the diagram.

These cross struts are fitted to the back thus:

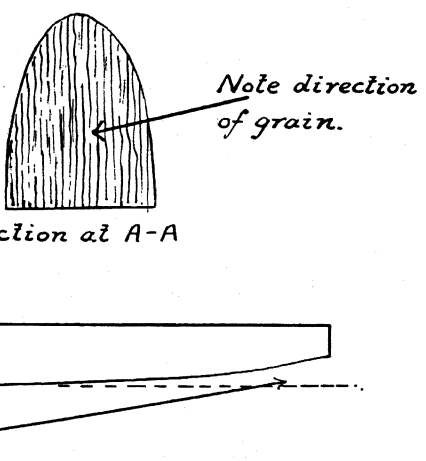
One at a distance of 5" from the bottom curve of the guitar; one at a distance of $4\frac{1}{2}$" from the top curve; and the final one $9\frac{1}{2}$" from the bottom curve—if three cross struts are being fitted. If four cross struts are being fitted, the top and bottom struts are each placed 1" nearer to the top and bottom curves of the guitar. One of the remaining struts is fitted $3\frac{1}{2}$" from the top strut and the remaining strut $3\frac{1}{2}$" from the bottom strut.

GLUEING THE STRUTS

Glueing these struts into position is best done by using a flat strip of wood about 3/16" thick by about 2" wide, placed under the back of the guitar opposite where the strut is being glued. The strip of wood should be planed perfectly smooth and be of even thickness throughout its length so that it bends evenly.

Using this method it is possible to fix the strut in position by using a small G cramp at each end (see Fig. 14). When the cramps are tightened the back of the guitar will bend to conform to the curves of the strut.

Fig. 13.—The cross struts for the back. The slight curve at each end is about $\frac{3}{16}$" from the straight.



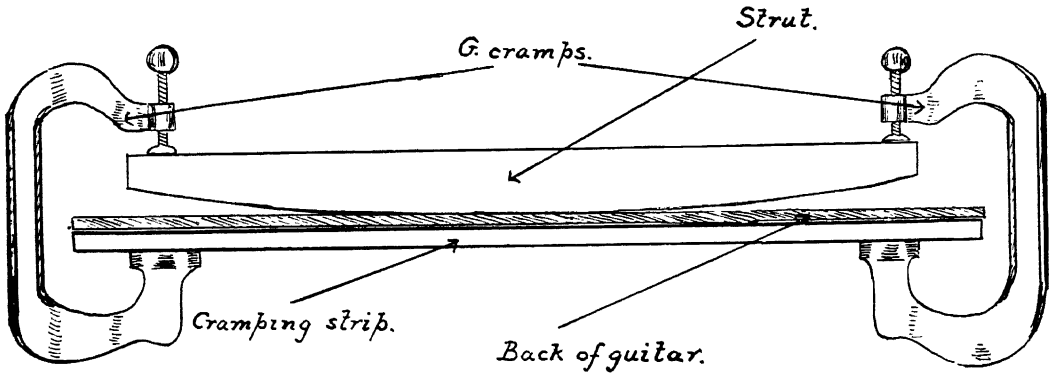
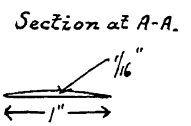


Fig. 14.—Showing how the cross struts are glued to the guitar back. (When the G cramps are tightened, the guitar back will conform to the curve of the cross struts.).

When the glue is perfectly dry, these cross struts are then shaped at the ends and along the entire length as shown in Fig. 15 and finally glasspapered perfectly smooth.

A central strut, from top block to bottom block, is next fitted. This "seals" the centre join in the back and prevents any possibility of it opening. This strut, which will be in four (or five) sections—depending upon the number of cross struts used—is glued in between the cross struts and is prepared from a piece of spruce or sycamore about 1″ wide and not more than about 1/16″ high at its centre, the edges being scraped down to a feather edge before fitting. (See Fig. 16.)



Now clean up the work done by carefully removing any surplus glue with a chisel and finally glasspapering all the struts.

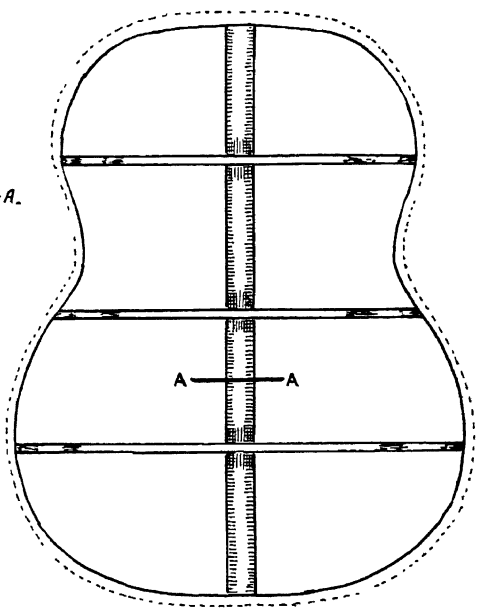
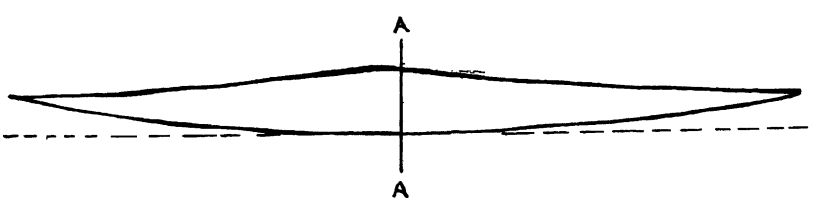


Fig. 16.—Showing the completed strutting of the guitar back.



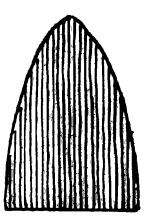


Fig. 15.—When fitted to the back the cross struts are then shaped at the ends and over their entire length—as shown in this diagram.

FITTING THE BACK

Place the back on the mould and mark at the sides of the guitar where the cross struts come on the side linings. The struts themselves are then cut off about 1/16″ *short* of the outline of the guitar as marked on the back and small recesses cut into the lining on each side of the guitar. Great care should be taken to see that these recesses *do not enter the actual sides of the guitar.* The recesses should be in the *lining* strip only!

If this operation is correctly and successfully carried out it should be possible to place the back of the guitar on the sides (which are, of course, still in the mould) so that the back struts fall neatly and easily into the recesses previously cut in the linings to take them. If they do not, any little fouling can be located by rubbing a piece of coloured chalk over the end of the cross struts and trying to fit the back to the sides again. This will leave a small chalk mark on the lining where the offending strut(s) does not fall into the recess.

It is most important that the back of the guitar should "fall into place" without any forcing whatsoever. If this operation is successfully completed the sides will hold the back in position without strain on either sides or back. It has been said that this easy fitting of back to sides has a marked effect on the tone that will emerge from the finished guitar, for it has been found that a guitar possesses a better tone when back and sides fit together without forcing. It probably has something to do with the wood not being under stress at these points and thus allows for freer vibration.

THE FACE OR FRONT

Now we start to work on the face (or front) of the guitar. The ideal material is radially-sawn silver spruce, or pine, of the straightest and closest grain. This, like the back, is made from two pieces of wood joined together, with the narrowest (closest) grain in the centre. The finished thickness should not be more than 3/32″ overall; although the area on the treble side of the guitar can be slightly thinner to make the instrument "speak" better.

When the two pieces have been joined together, the outline of the front is marked out and then cut in the same way as employed for the back. As you did when cutting out the back, leave about $\frac{1}{4}$″ margin all round the *outside* of the outline of the front.

At a point $5\frac{7}{8}$″ from the top of the marked outline, and exactly on the centre join, put a small dot. On the under face side of the front, glue a small square of hardwood (about $1\frac{1}{2}$″ square $\frac{1}{8}$″ thick). This will later help to take the pressure of the cutting tool. Then, with a pair of compasses or dividers, scribe a circle $3\frac{3}{8}$″ diameter with the centre exactly on the previously-marked dot. This is to be the finished size of the soundhole of the guitar.

Allowing a fraction of an inch for final cleaning up, cut out this circle—and here different workers will have their own methods. For the amateur guitar maker it would be best to use a cutting tool or very sharp pointed knife.

Clean up the edge of the cut-out hole to the final size and then carefully inspect the edge to see if at any point the grain of the wood has been torn. Mark the least perfect side of the wood to be the "inside."

It is usual to inlay round the soundhole and for this work it will be necessary to use a small cutting gauge. Working from inside the soundhole, shallow cuts are made and the wood removed from the resulting channels with a narrow chisel. Great care must be taken not to make the cuts too deep. (Not more than half the thickness of the wood is sufficient.)

The design and number of inlays can be decided by the maker. Purfling of the type used on violins can be purchased from most crafts shops, in various colours, to form a pleasing pattern. Here the individual's aesthetic outlook can be exercised.

Most Spanish guitars have a simple circular design of alternating black and white woods, as shown in Fig. 17 (a, b and c) but if the worker wishes he could copy one of the more elaborate marquetry inlays such as shown in Fig. 17 (d)—or even produce a design of his own.

When all the inlaying of the purfling has been completed and time allowed for the glue to dry, it is smoothed down to the level of the face of the guitar with the scraper and finished off with fine glasspaper.

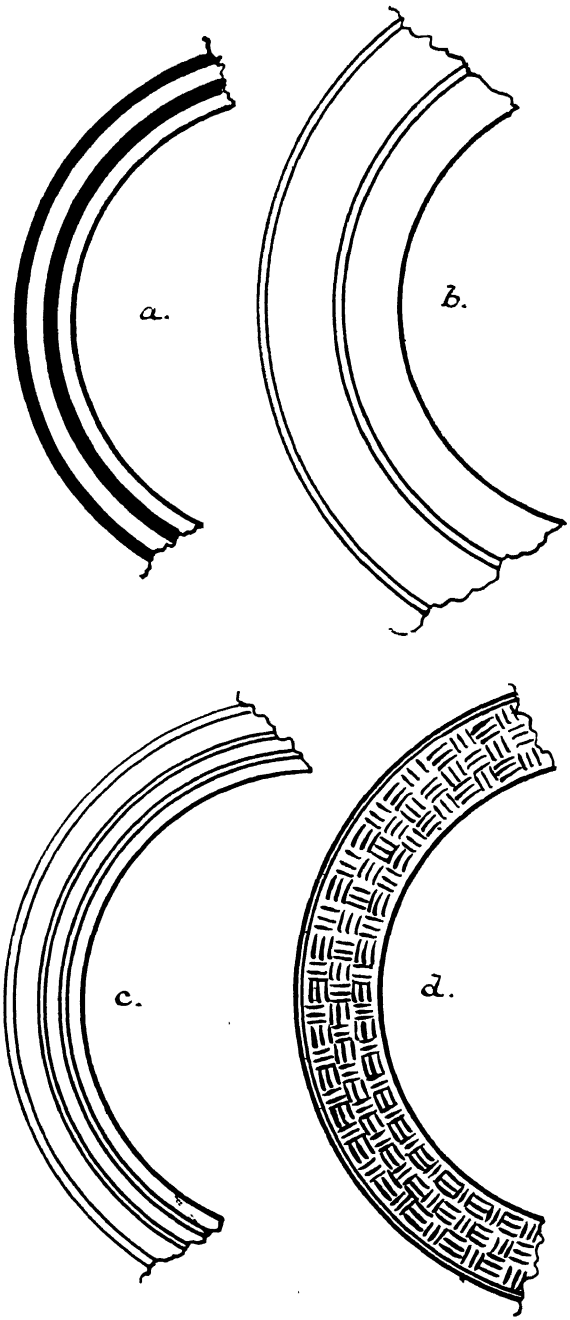


Fig. 17.—Some suggested designs for inlays round the soundhole. a. b. and c. use plain inlays of black wood; d. can be built up of different coloured woods.

UNDERFACE STRUTS

The next job to undertake is the making and fitting of the cross braces and struts to the underface of the front. Full details are given in Fig. 18.

It may be wondered why the face of the guitar is made in (to the amateur guitar maker) such a complex pattern. The simple answer is in the high degree of flexibility required. To be responsive over the wide range of the guitar's compass, the face of the instrument must be thin—and being thin, it cannot withstand the stress imposed upon it by the strings. Thus arises the need for cross-bars and struts as reinforcement against string pull and for making sure that the face vibrates as a whole unit. In addition, of course, the struts give mechanical strength to a naturally weak piece of wood —being fixed *across* the grain.

First, two main cross struts about $\frac{1}{2}''$ wide (as shown in the diagram) are cut from straight-grained spruce or pine and these are fitted in a similar manner to the struts fitted to the back. Next, two pieces of spruce or pine are fitted on each side of the soundhole and another piece of similar material glued between the soundhole and the top block. The purpose of these is to take pressure at these points and to prevent the splitting of the front of the guitar.

Having successfully fitted these struts, we now come to the " fan-strutting " under that portion of the front where the bridge is fitted.

Different luthiers have (and have had) their own ideas of where these struts should be positioned; their number; and how long (and how thick) they should be. It is suggested that about $\frac{1}{4}''$ wide struts be used. In case the amateur guitar maker wishes to experiment, Fig. 19 shows details of fan-strutting by several past luthiers. We will proceed to give details of the design evolved by Marco Roccia.

The struts — seven in number — are of varying length and density and if the face of the guitar is to have a slight " arch " (and it should be mentioned that many Spanish guitars today are made without this arch,

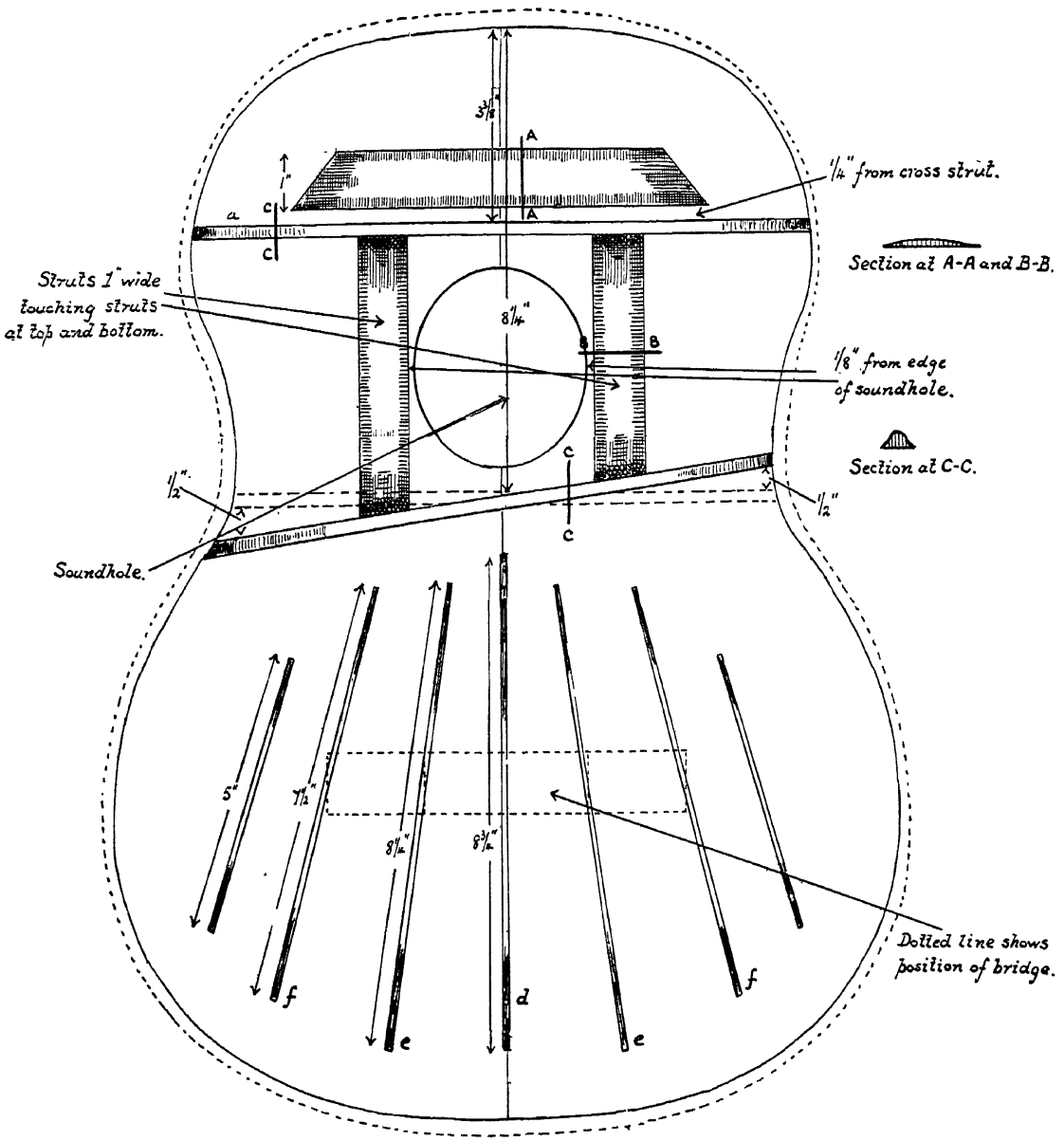


Fig. 18.—Details of the strutting of the guitar face.

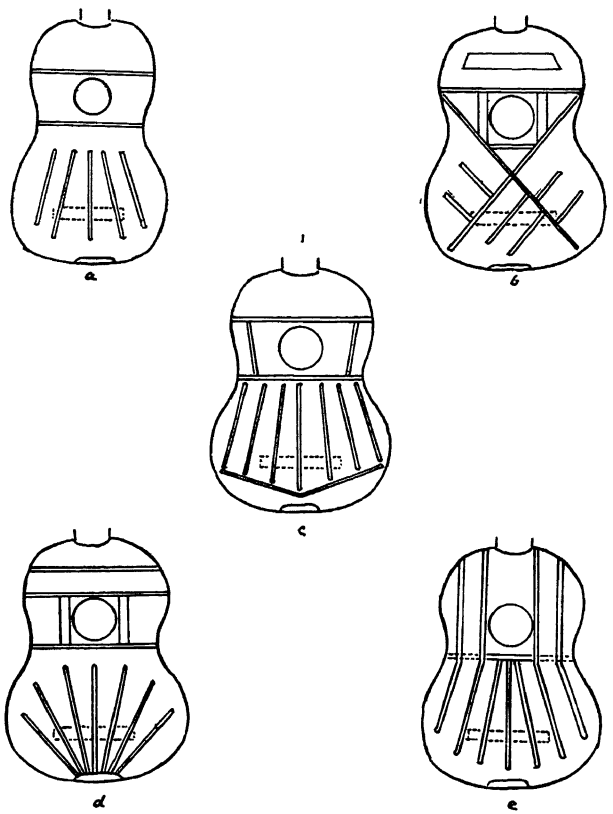


Fig. 19.—Diagrams of types of fan strutting used by famous luthiers. a. **Panormo ("in the Spanish style").** b. **Martin.** c. **Torres.** d. **Yacopi.** e. **Bouchet (the transverse bar is glued in the centre only).**

i.e. they have a perfectly flat face) the struts will have to be slightly curved as shown in Fig. 20. Each strut must have an identical curve so that the face of the guitar becomes evenly arched when they are glued in position.

(It will be found easier for the amateur guitar maker to build an instrument without an arched front.)

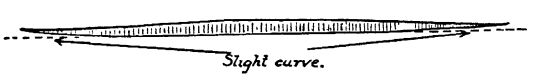


Fig. 20.—Diagram showing how each strut of the fan strutting should be slightly curved at each end if the guitar is to have an arched front.

The centre upright strut should be $8\frac{3}{4}''$ long with not more than $\frac{1}{8}''$ rise in the centre, being tapered off in a long feather edge to each end. The top of the strutting should also be rounded off in its entire length.

Each strut is fitted to the face of the guitar separately, being cramped from the sound-hole and the bottom edge of the face.

(If you make a guitar with an "arched" front the slight curve on each of the struts will, if fitted correctly, give a curve to the front in two directions—crosswise and lengthwise.)

Too much time cannot be spent on "finishing" this fan-strutting. Each should have a long feather edge to each end and be nicely tapered and rounded off down its entire length. All struts should be free from surplus glue and be glasspapered to a glass-like finish.

FITTING THE FRONT

When all this work has been completed satisfactorily the next job is to cut the recesses in the top linings to take the two main cross struts fitted to the face. Follow exactly the same procedure as you did for the fitting of the back.

At this point it will be wise to " recap." to see what we have completed so far.

We have the sides to which we have top and bottom linings, top and end blocks, fitted. We have the back, complete with cross struts in position and centre strut running down its entire length. The face of the guitar is finished, with soundhole cut out and purfling inlays surrounding it; cross struts, strengthening bars and fan-strutting in position. Both back and front of the guitar fall neatly and cleanly into position when placed on the sides in the mould.

All work has been carefully cleaned up. No surplus glue has been left and everything is nicely glasspapered to a perfectly smooth finish.

GLUEING BACK AND FRONT

Now we come to fixing the back and front to the sides—but before we can attempt this we must " seal " the grain of the top and bottom blocks. If these blocks are not thoroughly " sealed," when we come to glueing the back and front of the guitar into position the end blocks will soak up the glue like blotting-paper absorbing ink and our work at these points will not grip.

Thoroughly " size " both end faces of the two blocks with thin glue, going over them two or three times (or even more, if necessary) at intervals after each coating has had ample time to set hard. Sufficient coats of glue must be applied to form a " seal " to the pores of the wood and the job is only thoroughly done when a layer of glue forms on the surfaces of the blocks. When this happens the hard coating is rasped off to the actual level of the wood.

Before attempting to glue the back to the sides, first carefully go round the surface of the lining and edges of the sides with a roughing tool—taking care not to spoil the level surface. (A fine hacksaw blade can be used for this job.) Then, with a thin glue, lightly brush the two surfaces to be glued together—the edge of the back (keeping to a margin of about $\frac{3}{8}$" or $\frac{1}{2}$" from the edge and covering the area on the back to be glued) and the top surface of the lining and the edge of the guitar sides.

When this thinly - applied glue is thoroughly set, we can proceed to the actual fitting of the back to the sides. For this you will need a number of G cramps, large enough to be fitted over the outer edges of the mould, or the amateur guitar maker can improvise by making a number of hardwood clips as shown in Fig. 21.

These clips are made with the space between the jaws about $\frac{1}{2}$" more than the

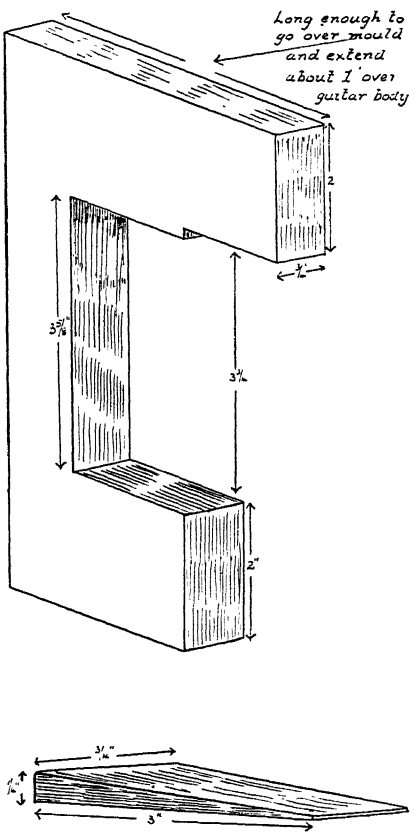


Fig. 21.—Details of an improvised cramp (to replace the more expensive G cramps) for use in fitting the back and front of the guitar to the sides. Below: **Details of a wedge, two of which are used in each cramp for " tightening " it when in position.**

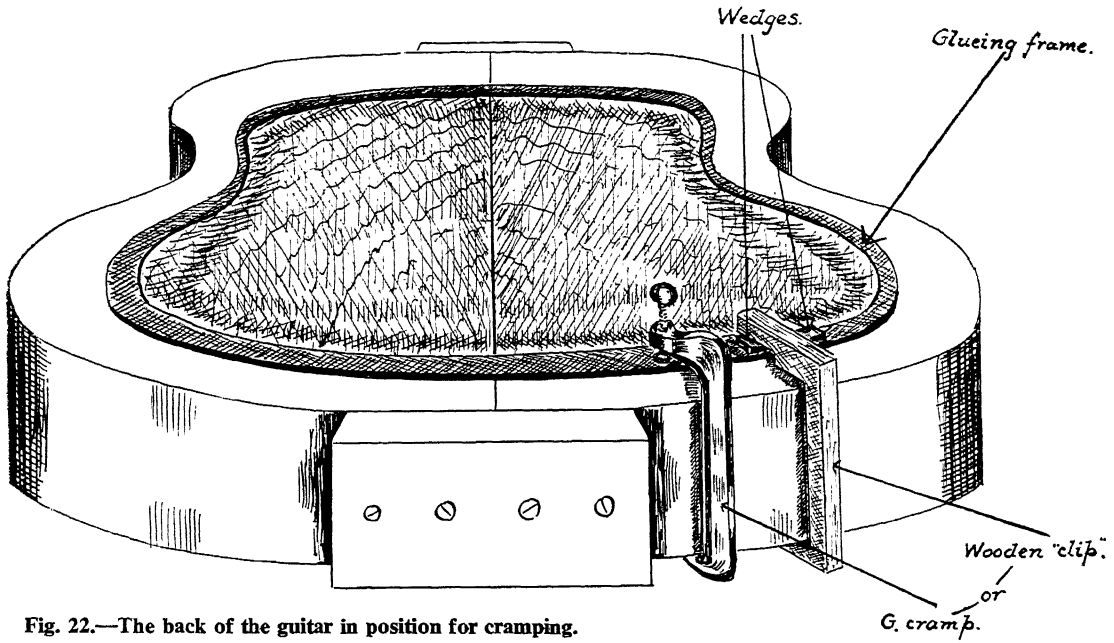


Fig. 22.—The back of the guitar in position for cramping.

depth of the mould *plus* the thickness of the guitar back.

In use the clips are placed in position and then two previously-prepared wedges (as shown in Fig. 21) are used to tighten them. (See Fig. 22.)

As the glueing of the back to the sides is quite a "major" operation it will be wise to see that everything needed for the job is at hand before starting it.

Your requirments will be: a pot of very hot not-too-thick glue; a small clean glueing brush; a thin steel knife blade (an old table knife will do); two long-tongued G cramps with an opening of 4″ or more; and at least two dozen of the prepared clips (mentioned above) and four dozen of the small wooden wedges.

You will also need a "glueing frame" and this is illustrated in Fig. 23.

This can be cut from thick cardboard, 3-ply wood or even hardboard. The shape of the guitar is marked on the material (using the guitar mould as a template) and then it is cut to shape by allowing about $\frac{1}{2}$″ each side of the outline of the guitar.

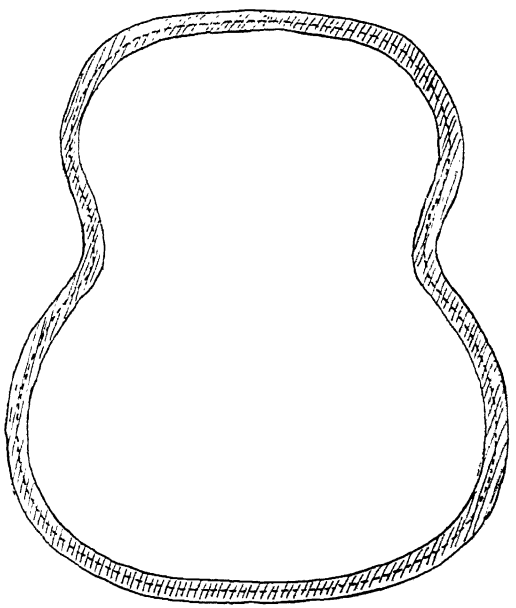


Fig. 23.—"Glueing Frame" for use when fixing back and front of the guitar to the sides. This frame is made from hard cardboard, 3-ply wood or hardboard.

FITTING THE BACK

Everything readily to hand, we can proceed to fit the back . . . with the sides still in the mould. If the fitting of the back is attempted with the sides *out* of the mould, the finished guitar will surely be out of shape.

First brush a thin coat of glue over the surfaces of the blocks and all round the top surface of the linings. Next place the back in position, seeing that the cross struts fall easily into place in the recesses cut in the linings. Then, having previously warmed over a gas flame the glueing frame, put this on top of the back and fix two large G cramps in position; one over each of the end blocks.

Working from each of these clamps, proceed round each side; placing a wood clip in position as you go. Particular care should be taken at the waist on each side.

The thin knife blade dipped in *hot* water and slid between back and sides can be used to revive the glue in any place.

The above operation should be done as quickly as possible but without undue haste, otherwise the glue will begin to set and become too hard to grip.

If the glued surfaces have been prepared correctly it should not be necessary to add any more glue.

Finally, when it is certain that the back has been secured all round the sides and that all the wedges holding the clips are tight, take a clean rag and, after dipping it in *hot* water and having wrung it out tightly, wipe all round the inside joint of the back and sides to remove any surplus glue squeezed out by the cramping. If you have followed the instructions carefully, very little surplus glue should appear.

The completed assembly should then be put on one side on a level surface for from four to six hours (or more) to allow the glue to set properly.

When the time comes, the face of the guitar is fitted in a similar manner to the back and when this operation has been finished, and time allowed for the glue to set, the body can be removed from the mould and surplus wood overhanging the sides can be trimmed off with a chisel or very sharp knife; care being taken to keep the finished edges of both back and face in perfect line with the sides of the instrument.

THE NECK

The body of the guitar can now be laid aside and we start to make the neck of the instrument.

For this you will need a piece of hard rosewood, walnut or maple (or other suit-

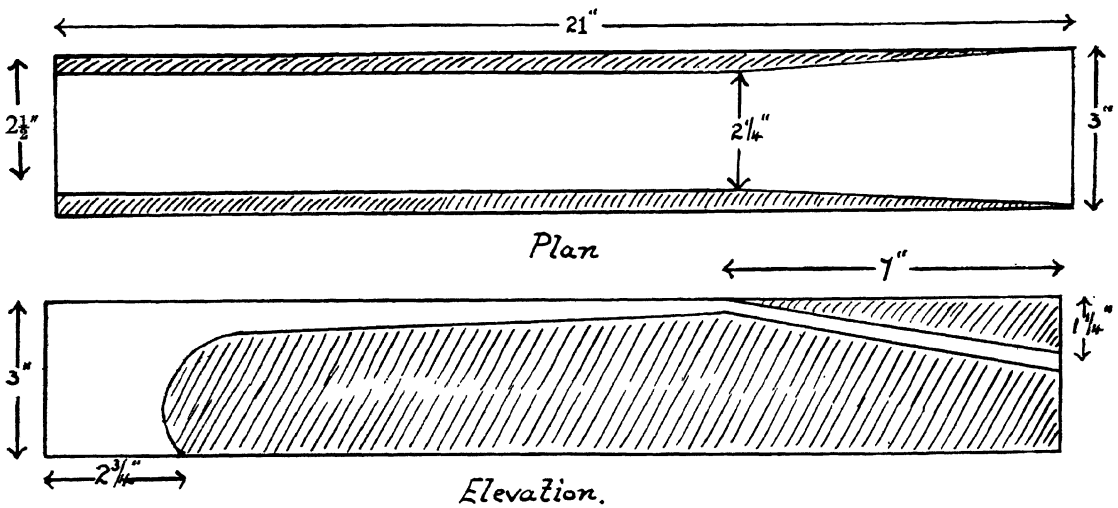


Fig. 24 (a).—Details of the guitar neck, cut from a solid piece of timber.

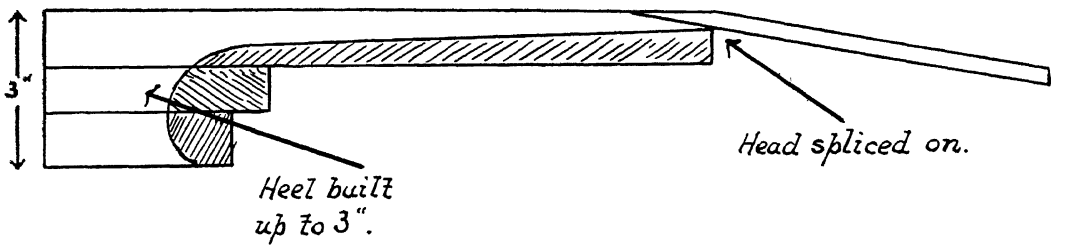


Fig. 24 (b).—Using timber "built up" to give the required bulk at the heel and slant at head.

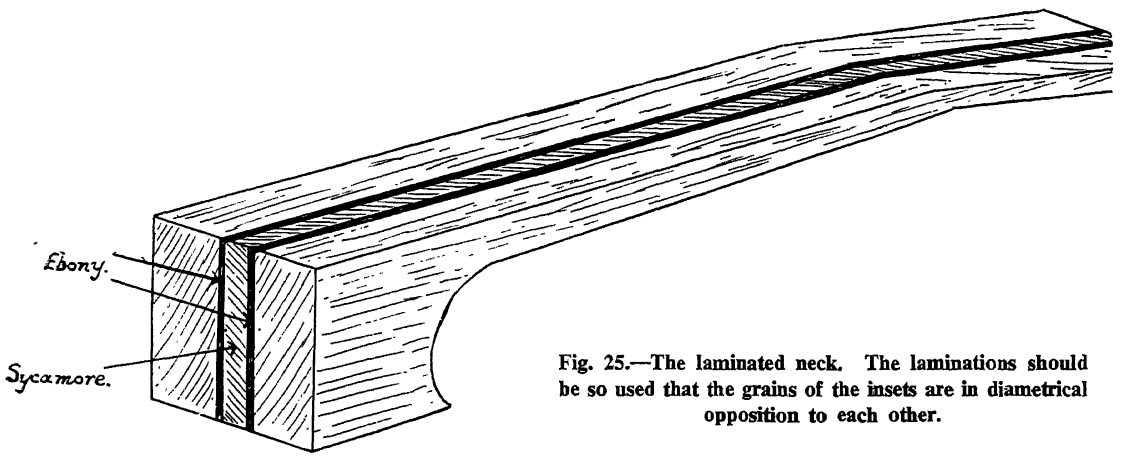


Fig. 25.—The laminated neck. The laminations should be so used that the grains of the insets are in diametrical opposition to each other.

able wood), 21″ long, 3″ wide and at least 3″ deep.

It is best to carve the complete neck from one piece of timber but this, as will be seen, results in a lot of waste. First-class luthiers always cut a neck from the solid timber but the cheaper-made guitars often have a built-up neck, from three or more pieces. Both methods are shown in Fig. 24 (*a* and *b*).

An additional refinement is to splice the entire length of the neck. This not only gives added strength (preventing any subsequent warping or twisting of the neck) but also gives an additional "finish" if contrasting woods are used. (See Fig. 25.)

Once the rough shape of the neck has been cut out (or built up) the next step is to shape it roughly with a drawknife or rasp. (Refer to Fig. 24 (*a*) for the measurements of the *finished* neck and allow about $\frac{1}{4}$″ margin over these measurements.)

The head of the neck is cut to its finished shape (see Fig. 26) and faced with ebony (or rosewood). The sides of the head having been finished "square," the holes for the machine-head rollers are drilled out. (It is impossible to give measurements for this operation. The guitar maker will have to be guided by the machine-heads he has purchased. The only measurement that can be given is that the holes to take the rollers should be about 1/16″ to $\frac{1}{8}$″ more in depth than the length of the rollers.)

These holes should be drilled at *right angles* to the sides of the head of the neck.

Next mark out the roller slots on the face of the head—and these are best cut by first drilling several holes slightly smaller in dia-

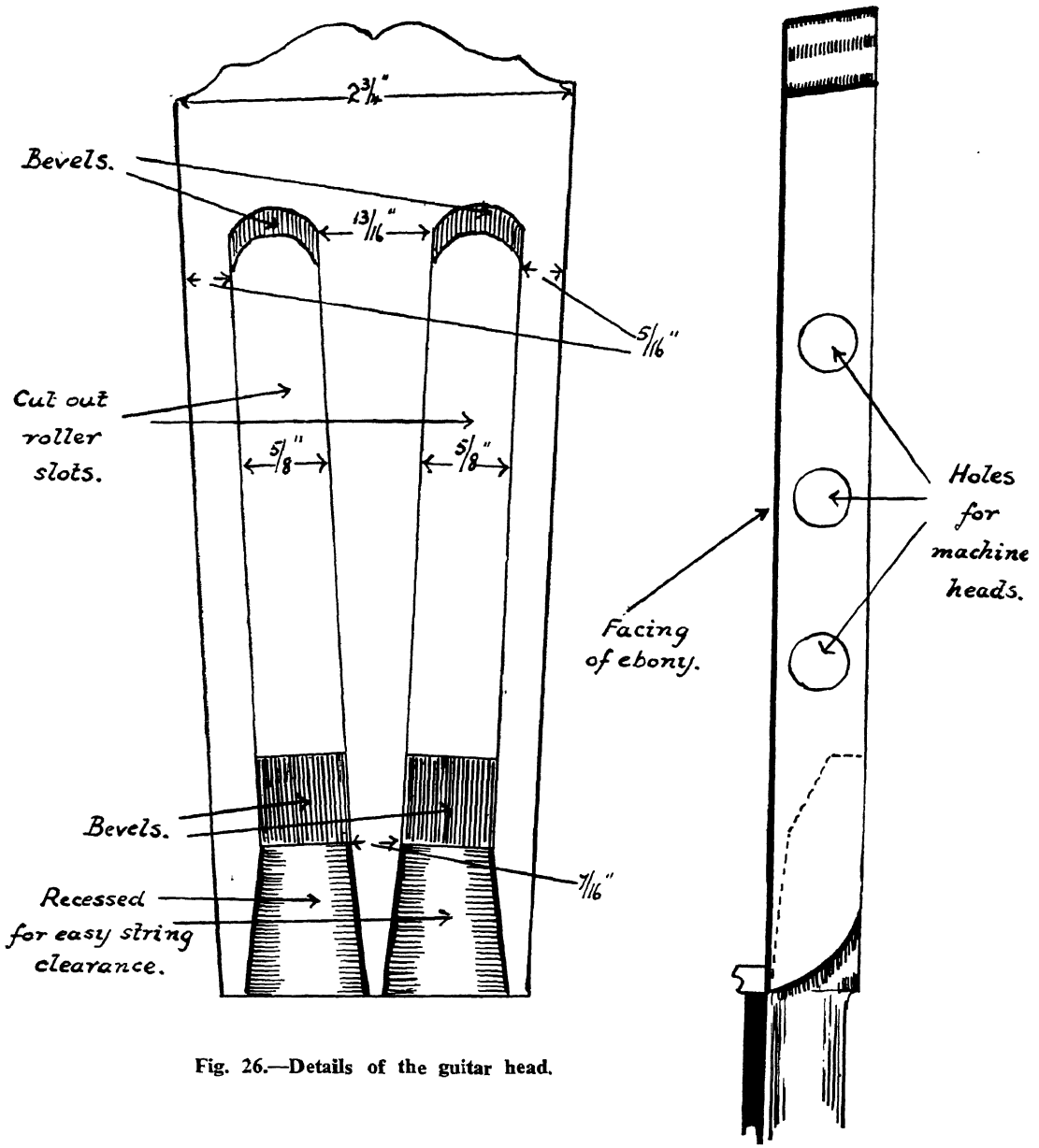


Fig. 26.—Details of the guitar head.

meter than the width of the roller slots, finishing off the slots with a sharp chisel or fretsaw. The " walls " of the slots should be at right angles to the face of the head.

The head can, of course, be shaped to any pattern fancied—every luthier has his own particular idea about the shape of his guitar head, just as violin makers choose their own particular scroll for their instruments—but an important point to watch is that when the strings are eventually fitted they should not foul each other on their way to the machine-head rollers. In other words, each string should go to its own particular roller and, in so doing, be clear of its neighbouring string(s).

THE FINGERBOARD

After the face of the neck has been planed perfectly level, the next step is to prepare the fingerboard which will later be glued on to the neck. This is best made of ebony—but the amateur guitar maker may have to compromise with a hard rosewood or walnut —or, as is used on some of the cheaper imported guitars, black-stained pearwood.

The finished fingerboard will be 17½" long by ¼" thick; 2⅛" wide at one end and about 2½" wide at the other. Care should be taken in preparing both sides of the ebony (taking great pains to see that the fingerboard is perfectly straight throughout its entire length) and, when this is done, mark a centre pencil line down the better side.

Now we come to the marking of the fret positions—and a lot depends upon this operation, for if it is not done correctly the finished guitar will not play in tune.

Great care must be taken over this work.

It would be wise to first mark the fret positions on a narrow strip of zinc or aluminium and, when this is completed, the markings can be transferred to the centre pencil line on the fingerboard with a fine-pointed scribing tool.

THE FRETS

There are several methods of deciding the positions for the frets but the simplest, for the amateur guitar maker is what is known as the 17.835 rule.

In this, one takes the instrument's scale length (in our case, 25⅝"—the distance from nut to bridge) and, having marked this distance on our strip of zinc or aluminium it is divided by 17.835, which gives the position of the first fret—the fret nearest to the nut. Then the distance from the first fret to the bridge is again divided by 17.835 —and this gives the position of the second fret. Then the distance from the second fret to the bridge is again divided by 17.835—and this gives the position of the third fret; and so on until all the fret positions are marked.

As a check, the *twelfth* fret should be exactly halfway between nut and bridge, and the *seventh* fret two-thirds of the distance from nut to 12th fret.

When measuring scale length we take the distance from the inner edge of the nut (i.e. *the side of the nut nearer the fingerboard*) *to the inner edge of the bridge saddle* (i.e. *the edge nearer the soundhole*).

Having transferred our markings correctly to the centre line on the fingerboard, we can now return to the neck of the guitar.

Marking the inner edge of the nut in its correct position on the neck, we use the zinc markings of the fret positions to find where the twelfth fret will be. (This should be 12 13/16" (*i.e.* half of our scale length of 25⅝".) This is the point where the neck will join the body of the guitar.

Prepare a dovetail at the end of the neck, tapering to the base (see Fig. 27) and cut the corresponding tapered slot in the top block of the body. This dovetail joint should allow the neck to fall slightly (*i.e.* the neck at the nut should be slightly (about ⅛") below the level of the guitar face) and constant checking should be done with a straightedge to ensure that this "set" of the arm is correct.

The "set" of the neck can be checked as follows:

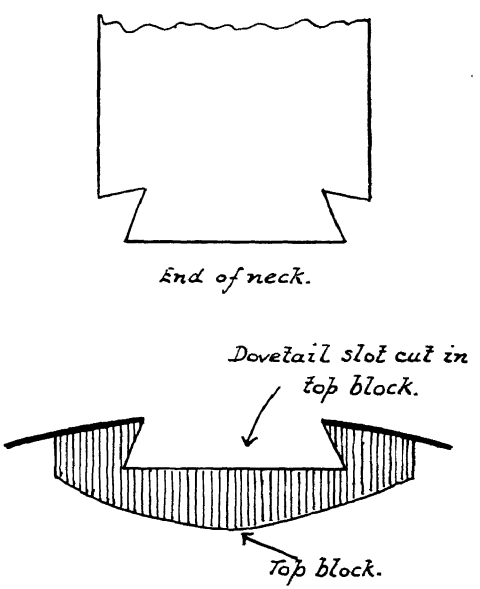


Fig. 27.—The dovetail at the end of the neck (above) and the corresponding dovetail slot in the top block of the guitar body.

Place a $\frac{3}{8}$" high flat piece of wood on the face of the guitar where the bridge will eventually be fitted—this position can be ascertained by measuring the distance from nut to where the neck joins the body and marking this same distance (from where the neck joins the body) on the face of the guitar.

Another small piece of wood $\frac{3}{8}$" high placed where the nut will be fitted will give the second point for testing. Hold the straightedge or a taut piece of string between these two pieces of wood and the clearance above where the neck joins the body should not more than $\frac{3}{8}$". When the fingerboard is finally fitted to the neck it will give a final string clearance at the twelfth fret of about $\frac{1}{8}$".

The dovetail groove in the top block and the dovetail on the end of the neck are chiselled away, little by little, until the correct set of the neck is secured.

During this operation, constantly check that the centre line of the neck follows the centre join of the guitar face.

The neck should be bedded down to within a little more than $\frac{3}{8}$" of the back of the guitar, to allow for a piece of ebony to be glued on to "finish" the base of the heel.

When you are certain that (a) you have a good dovetail joint; (b) the centre of the neck follows the centre join of the guitar face; (c) that the "set" of the neck gives the correct string clearance where the neck joins the body—you can then put the neck on one side and proceed to the fitting of the banding and purfling to the front and back edges of the guitar body.

FITTING THE BANDING

The fitting of banding and purfling to the front and back edges of the guitar body is an operation for which you need a cutting gauge first set to $\frac{1}{4}$". With this tool, cut away the edge of the front of the guitar to a rebate (see Fig. 28). This rebate should be about the thickness of the sides of the guitar—not more.

When this rebate has been made true with a small chisel and cleaned up, a band of sycamore or other hard wood of contrasting colour to the sides of the guitar is fixed in with glue.

It might be found easier to bend this banding into shape first on the bending iron.

When it is fitted to the guitar it can be kept in position whilst the glue is setting by binding tape or soft string *across* and *right round* the body of the instrument.

Two lengths of banding will be re-

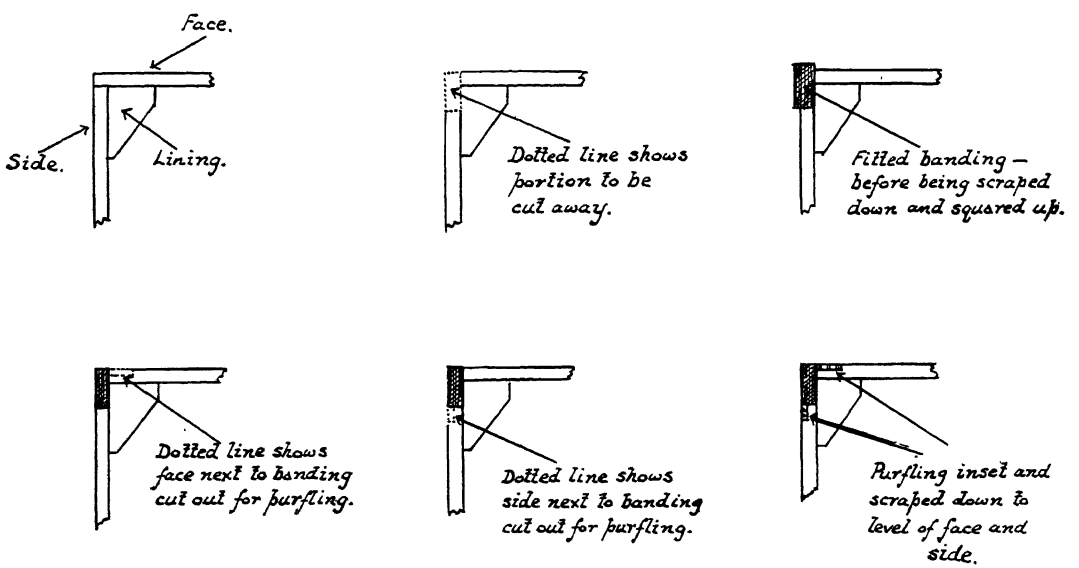


Fig. 28.—Details of the method of fitting the banding and purfling to the front and back edges of the guitar.

quired and the work of fitting should be done *from* the sides of the dovetail slot cut in the top block to the end of the instrument, where a neat join is made.

It is *not* advisable to use plastic banding on a Spanish guitar.

Proceed to band the back of the guitar in a similar manner.

It adds a nice appearance to the front of the instrument if a band or two of purfling is inserted inside the banding on the face and below it on the sides. This purfling—which can be two or more bands of contrasting woods as shown at (a) and (b) in Fig. 29—is inset to about one third of the thickness of the face and sides.

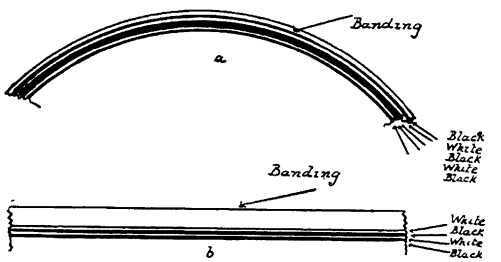


Fig. 29.—Showing how a band or two of black purfling (which adds to the appearance of the guitar) can be fitted inside the banding on the face and below it on the sides.

Before attempting to fit this purfling the banding must be finished off square with side and face to enable the cutting gauge or scratcher to have a true guide.

PURFLING

Set the cutting tool to exactly the same width as the purfling it is proposed to inlay and go round the edge of the guitar; cutting a neat channel in the face just inside the banding. Do the same with the sides, cutting the neat channel just below the banding.

Brush some thin glue into the channel (seeing that it covers the bottom and the two walls) and then gently press the purfling in with the blade of the table-knife slightly heated over a gas flame. If the channels have been cut correctly, only gentle pressure will be needed to " bed down " the purfling.

After the glue has had time to set, the purfling should be scraped down to the level of the face and sides and finally smoothed off with fine glasspaper. The corner of the banding can then be neatly rounded with fine glasspaper.

GLUEING THE FINGERBOARD

We can now glue the fingerboard to the neck, having first successfully glued the latter into the body.

Here it might be mentioned that the fret slots are cut *after* the fingerboard is fitted to the neck. If they were cut *before* fitting the fingerboard the slots in the wood would cause it to buckle and make it difficult for glueing.

The fingerboard not only covers the face of the neck but extends over the front of the guitar up to the top arc of the soundhole so, before attempting to glue the fingerboard in position, mark that part of the guitar front that will be covered and roughen it slightly.

Well warm both sides of the fingerboard before glueing it (using very strong glue for this work) and, when it has been placed in position on the neck (making certain that

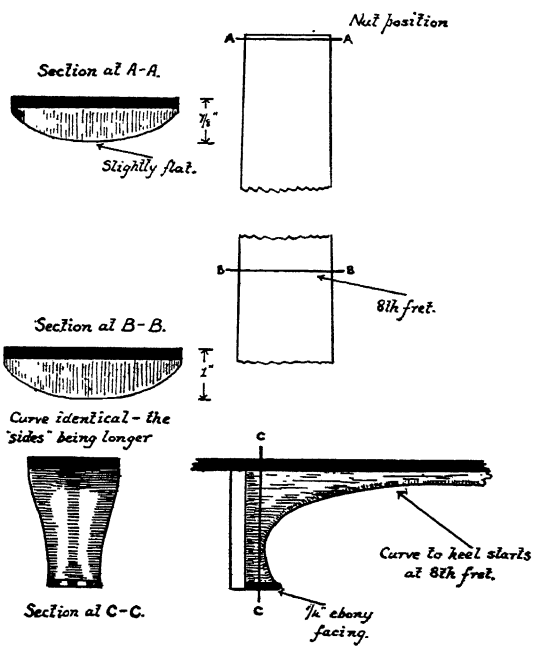


Fig. 30.—Diagram giving details of the guitar neck.

the marked twelfth fret comes exactly where the neck joins the body of the guitar), hold it in position with several G cramps throughout its length. By using a piece of leather or wood, the same width as the fingerboard, over its entire length, cramp marks will be avoided.

Inside the guitar, under the overlapping part of the fingerboard, use another piece of wood to enable another G cramp to be used to hold this part of the fingerboard in position whilst the glue is setting.

When the glue is set the shape of the neck can be finished off with rasp and glass paper. Details are given in Fig. 30.

CUTTING THE FRET SLOTS

Now we come to the actual cutting of the slots to take the fretwire.

These slots must be at right angles to the *centre line* of the fingerboard.

Making sure you are cutting at right angles to the centre line, cut the slots on the previously marked positions, using a small fine-toothed " Gents " saw and cutting about 1/16" deep.

Fretwire is supplied in " T " section and, if you have a choice, choose nickel-silver wire rather than brass. Before attempting to fit the fretwire it will be necessary to serrate the upright of the " T." This can be done by gently tapping it, with the edge of an old file or the chisel-end of a small hammer, with the wire held against some hard surface—an old-fashioned flat iron with its handle gripped in a vice will be found to be ideal. Care should be taken with this operation—just enough pressure being given to the blows to burr the edge of the upright of the wire. If the fretwire is hit too hard the " playing surface " will lose its even contour.

Most luthiers run a little thin glue or painter's knotting along the upright of the wire before inserting it into the fret slot. This does not, in any way, make the wire " hold " better but it can prevent any possible vibration of the fret when the instrument comes to be played.

It might be found easier to cut the fretwire into the required lengths before inserting it in the slots. If you proceed in this manner, cut the lengths of wire a fraction of an inch longer than needed and lay the lengths out in order on a piece of wood placed on the bench beside you as you prepare them. The luthier uses a long length of wire, and after tapping one fret in position, files it off at the required length.

FITTING THE FRETS

When fitting the fretwire, first run the glue or knotting along the upright and then tap it home with a small hammer; taking great care to see that the blows are evenly distributed along the entire length of the wire. If you err in this respect you will find the wire will have a tendency to buckle at the ends.

When all the frets have been successfully fitted, the ends are first filed flush with the fingerboard (taking care not to take off wood from the sides of the fingerboard) and then carefully rounded off with a small flat file, held in a lengthwise direction, so that each fret end is finished off at the same angle. (See Fig. 31.)

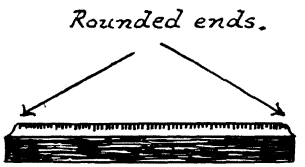


Fig. 31.—After all the frets have been fitted the ends of each fret are rounded off.

Now check the fretting by placing a steel straightedge along the fingerboard. If any one fret is higher than its immediate neighbour it should be bedded down by gently tapping it with the hammer. If any faults in fretting cannot be corrected in this way,

Checking the fretting.

take a large flat file, lay it on the surface of the frets and pass it from end to end of the fingerboard. If this takes off any appreciable amount of metal from any fret (or frets), these particular frets should be rounded off with fine emery cloth to restore their correct contour.

A final finish can be given to the whole fingerboard by rubbing all the frets—from end to end of the fingerboard—with fine emery cloth placed over a small block of wood.

Where the ebony fingerboard overlaps the soundhole of the guitar, cut this away to the arc of the soundhole. If preferred, the end of the fingerboard can be bevelled off with fine glasspaper.

To complete the fingerboard, fit small ivory dots in the upper edge (*i.e.* the bass-string side) midway between the 4th and 5th frets; midway between the 6th and 7th frets; and midway between the 8th and 9th frets. These are a guide to the " positions " when playing the guitar. (See Fig. 32.)

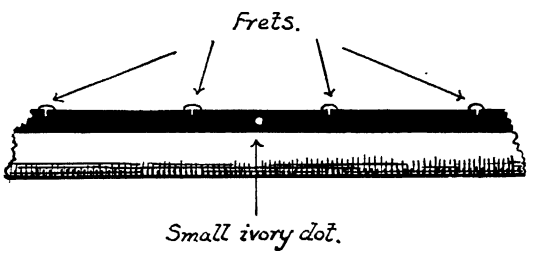


Fig. 32.—Small ivory dots are inserted in the upper edge of the fingerboard between the 4th and 5th frets; the 6th and 7th frets; and the 8th and 9th frets. These act as position guides when playing the guitar.

FITTING THE MACHINE HEADS

You are now ready to fit the machine heads.

Various types of machine heads can be purchased, and having bought the best you can afford—with bone (or plastic) rollers—you may find they have inside rivets slightly protruding from the plates holding the rollers. These will have to be countersunk into the wood so that the machines fit flush to the sides of the head.

The machine heads should fall easily into position without any forcing of the rollers into their holes. The rollers should settle into the centre spine of the head to a depth of about 1/16″ or $\frac{1}{8}$″. If they are too short a shaving from the outside edges of the head can remedy this.

Do not screw on the machine heads yet.

The bridge and nut having been made (full details are given in Figs. 33 and 34) we are now ready to polish the guitar, but before this is started the whole instrument should have a final cleaning up, and for this you will need various grades of glasspaper ranging from Fine $1\frac{1}{2}$ to Fine 0.

Glasspaper all the darker wood first (wiping away the resultant dust as you go along) for if you, say, clean the face of the guitar first you will find that dust from the darker wood will (however careful you may be) have stained the face and then you will have that job to do over again.

POLISHING

Before the bridge is fitted it is necessary to varnish or French polish the whole of the instrument—*except* the face of the fingerboard!

Before starting to polish the instrument, lightly mark the correct position for the bridge on the face of the guitar and glue a piece of thin paper over the area to be occupied by the bridge. (When the polish is hard, this piece of paper is stripped off and the bridge glued on. Temporary internal struts or stays are placed inside the guitar under the bridge so that the necessary pressure can be applied whilst the glue is setting).

Although the amateur guitar maker is unlikely to produce the high gloss " piano finish " of the skilled french-polisher, with a little patient practice he can produce excellent results. It might be advisable to start by using an odd piece of wood to practice on. When fairly proficient, the actual guitar can be polished.

It might be desirable to stain the wood of the back and sides of the guitar and if this is to be done the appropriate stain (obtainable from hardware shops) should be added to the filler.

" Filler " can also be purchased from hardware shops—but thinned down " Alabastine" may be used.

The surface to be polished must be absolutely smooth.

Rub the filler into the wood with a clean rag, working *across* the grain, and when the filler is perfectly dry, rub down the surface with fine glasspaper; working this time *with* the grain.

Finally, rub the surface with a hard pad of cotton material on which has been dropped a little linseed oil. The guitar is now ready for the actual polishing.

Bottles of french polish can be purchased from appropriate shops—and the guitar maker should see that he purchases *clear* polish.

For the operation of polishing you will need some cotton-wool and a few pieces (about 9″ square) of clean white cotton or thin linen.

Pour a little of the french polish on to a piece of cotton-wool and wrap this in one of the squares of cotton or linen— twisting the surplus cotton to give a hold on what is called the polisher's " rubber." Holding the rubber between thumb and first two fingers, go over the whole surface to be polished with overlapping strokes, using fairly light pressure. Keep the circular motion moving all the time and be sure you are covering every portion of the surface being polished.

This process should be repeated three or four times, re-charging the rubber with polish as necessary.

It is important that the amount of polish used each time becomes less and less with subsequent coats and the pressure on the rubber gradually increased. It is also important that the rubber is moving all the time it is on the guitar surface. If the rubber is inclined to "stick" in use, apply a spot of linseed oil to the surface of it.

Once the whole surfaces to be polished have been given one "coat," put the rubber away in an airtight tin for future use. Allow the polish to harden overnight and then rub it down with flour-grade glasspaper following the grain of the wood all the time.

Two or three further applications of polish can be applied at intervals, using the same procedure as described above.

When all this work has been completed the final and critical operation—known in the trade as " spiriting-off "—has to be done. For this you need a new rubber and, instead of polish, you apply a few drops of methylated spirit to the cotton-wool.

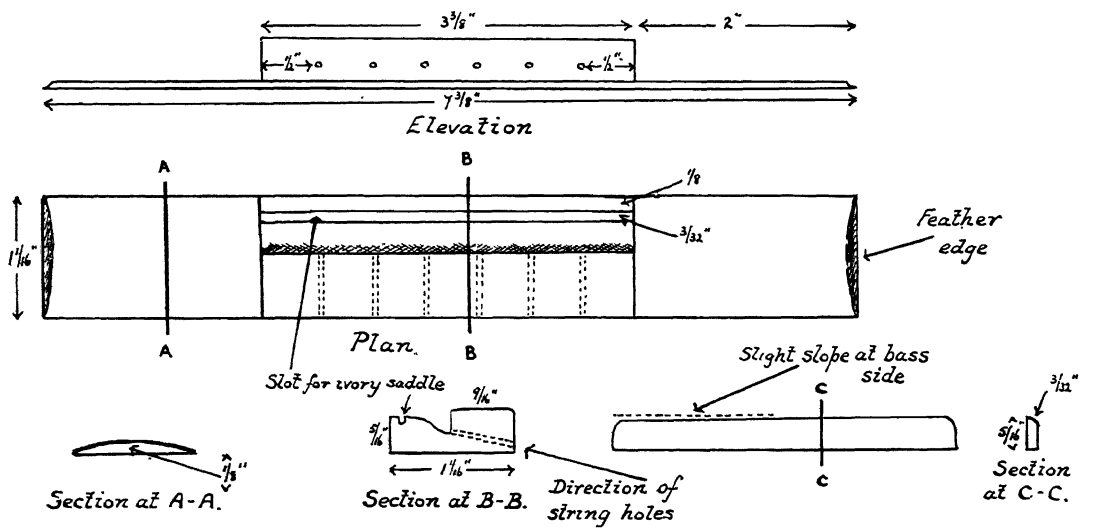


Fig. 33.—Details of the guitar bridge (made of rosewood or ebony) and its ivory saddle. N.B.—The bridge saddle is NOT slotted for the strings.

Apply the rubber with light, even strokes—first of all going over the guitar's surface with large figure-of-eight motions and then from end to end of the grain. It is important that the whole polished surface be covered in this latter operation.

If you apply too much pressure in the spiriting-off you will undo all the work you have put into the polishing. If it is done properly, the instrument will acquire a finish of which you will be proud.

The polishing of the instrument should be done with the greatest of care for careful polishing will not only enhance the appearance of the instrument but successful "sealing" of the woods will add to the tone of the guitar.

POSITION OF BRIDGE

When polishing has been completed to the maker's satisfaction, the bridge and nut can be glued into position—and here I give a tip which, to my knowledge, has never before appeared in print.

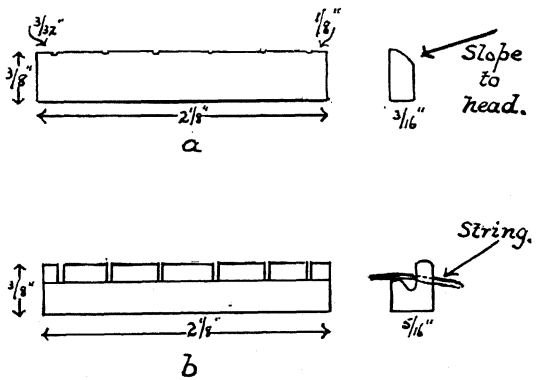


Fig. 34.—The nut—made from ivory. (a) The conventional nut. (b) The new Essex-Roccia nut.

Before fitting the nut, *cut away from the top of the fingerboard* (reducing the distance to the first fret) a width of wood equivalent to the clear height of the nut. As the height of the nut above the fingerboard is $\frac{1}{16}$" the first-fret-to-nut distance will be reduced by $\frac{1}{16}$".

A long technical reason could be given for this slight modification in scale length but, in brief, the reason is to compensate for the displacement of the sounding length of the strings when stopped by the left-hand fingers.

Checking the string "action" for height of bridge saddle.

The bridge is glued into position as previously described—great care being taken to ensure that it does not move while being cramped into position.

Before stringing the guitar the final job is to fit an end knob.

A hole is drilled into the bottom block through the end (see Fig. 35). The end knob is usually turned from a piece of ebony and one can be purchasd for a few shillings,

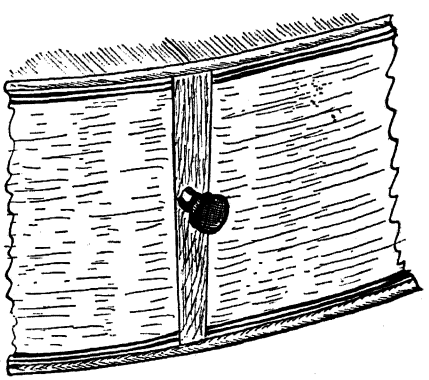


Fig. 35.—The ebony end knob, fitted to the base of the guitar.

if the amateur guitar maker does not possess a lathe.

The purpose of the end knob is to prevent damage to the guitar at the base of the instrument and for attaching a sling, if the guitarist wishes to play standing.

It should be emphasised that the end knob is not glued in; the hole in the end block being made so that the knob can be pushed home tight.

Having fitted the machine heads, we are now ready to fit strings to the guitar—and gut and silk-covered, or nylon and nylon-covered, strings should only be used on the Spanish guitar. *Never* fit plain wire or wire-covered strings!

How the strings are fitted to bridge and machine head is shown in Fig. 36.

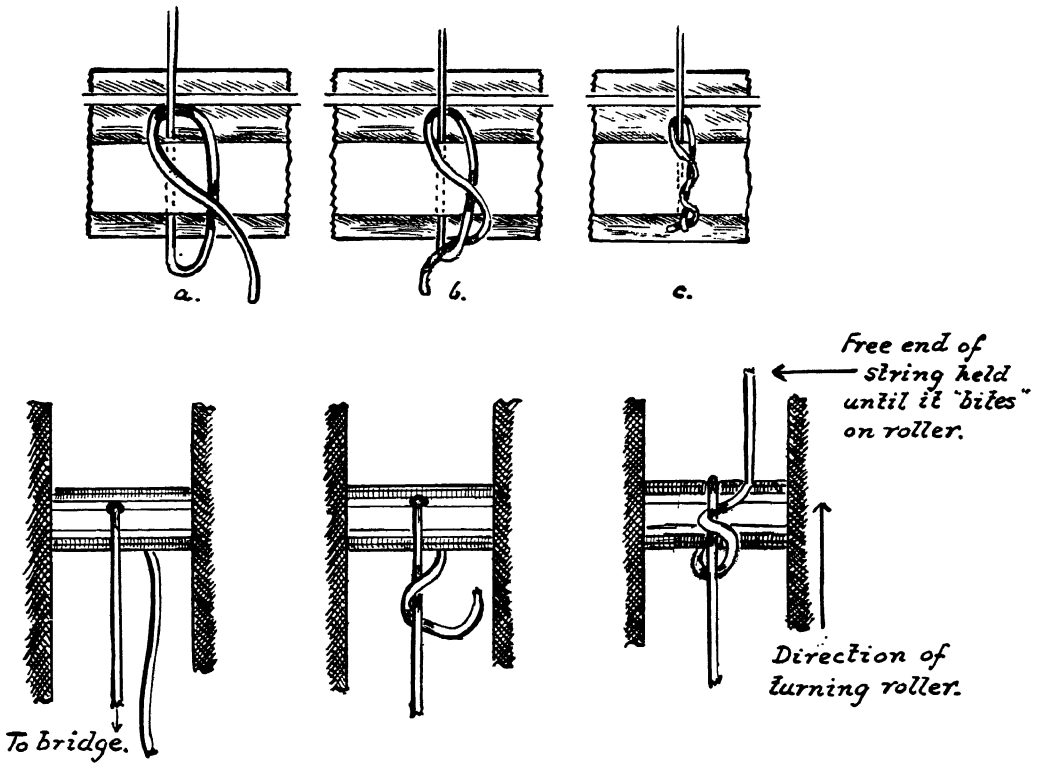


Fig. 36.—The method of fixing the strings. Above: **How the strings are affixed to the bridge.** Below: **How they are attached to the machine-head rollers.**

Whether you study the guitar as a solo instrument or as an accompaniment to the voice, it is wise to produce the best results of which the instrument is capable. The guitar is probably the most satisfying musical instrument ever conceived by man—it responds perfectly to the player's mood, being pensive or cheerful at will—and, as such, is worthy of serious study. Printed literature (tutors, books of studies, solos, duets, etc.) abound and no student of the instrument need ever be short of worthwhile music to play—no matter what degree of ability he has reached. The Clifford Essex Co. will be pleased to send you a folder of leaflets relating to the Spanish Guitar in which will be found details of tutors, albums, solos and accessories. It is free on request.

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