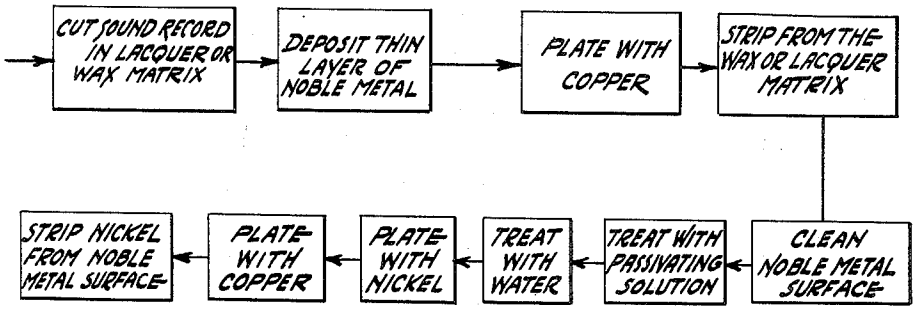
Nov. 21, 1950 E. P. RUGGIERI 2,530,842

MANUFACTURE OF METAL TO METAL DUPLICATIONS

Filed April 12, 1949

Fig. 1.



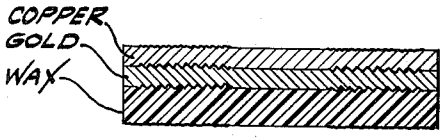


Fig. 2.

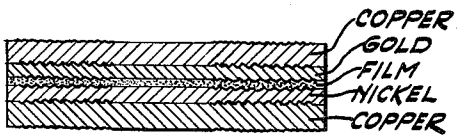


Fig. 3.

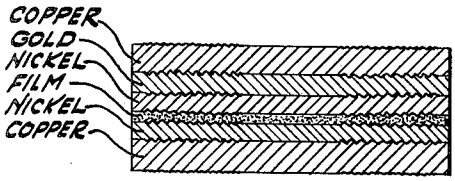


Fig. 3a.
PRIOR ART

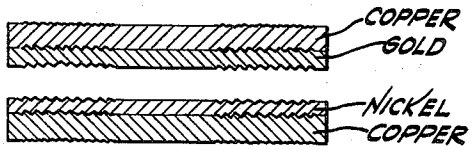


Fig. 4.

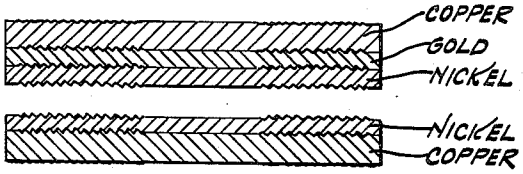


Fig. 4a.
PRIOR ART

INVENTOR.
Ernest P. Ruggieri
BY
C. D. Cuoka
ATTORNEY

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MANUFACTURE OF METAL TO METAL DUPLICATIONS

Ernest P. Ruggieri, North Arlington, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application April 12, 1949, Serial No. 87,062

5 Claims. (Cl. 204—5)

1

This application is a continuation-in-part of application, Serial No. 649,725, filed February 23, 1946, now abandoned.

The present invention relates to improvements in the art of making exact metallic reproductions of irregular surfaces. More particularly, it relates to an advance in the art of making the master molds and master matrices used in the manufacture of phonograph records.

In the long continued striving to make phonograph records as nearly perfect as possible, many expedients have been tried and much real progress has resulted. Most records are made out of compositions comprising various synthetic resins and fillers. In some types of records, no filler is used. Due to the various process steps which are carried out in the making of the dies from which the records are molded, despite constant vigilance and care, the original sound track becomes modified and much surface noise and blurring of tonal quality appears in the finished record. This tendency has become even more of a problem since the introduction of so-called "fine groove" records having up to 275 grooves per inch.

If the original sound track as it is cut in the wax or lacquer matrix were able to be reproduced on the finished record, exactly as it is cut, the record would give fourth a perfect reproduction of the sound recorded on the matrix. Actually, as the public well knows, this has never been accomplished. The present invention, however, goes a long way towards solving the problem and enables records of greatly increased fidelity to be produced. Essentially, the invention comprises a method of reproducing the original sound track in much more perfect form than ever before attained. This is brought about by improvements in the record making process which eliminate some of the conventional steps hitherto thought essential and yet which lowered the quality of the finished product.

It is, then, an object of the present invention to provide an improved method of duplicating a surface having irregular contours.

Another object is to provide a method of more perfectly reproducing on a metal surface an original surface having fine variations in surface contour.

Another object is to provide an improved method of making master molds and matrices used in the sound record making industry.

Another object is to provide an improved method of making a metal duplication of a sound record master faced with one of the noble metals.

2

Still another object is to provide an improved method of separating a metal surface, faced with a noble metal, from a nickel replica which has been electroplated against said noble metal.

These and other objects will be apparent and the invention will be better understood from the description of the invention which follows and from the accompanying drawings, of which,

Fig. 1 is a block diagram illustrating the various steps in the process of the invention.

Fig. 2 is a cross-section view showing the several layers of metal electroplated on the wax or lacquer matrix to form a record master.

Fig. 3 is a cross-section view of the record master, as made by the improved process, removed from the wax or lacquer matrix and having several layers of metal plated against it to form a master mold.

Fig. 3A is a cross-section view of a similar article made by an older process.

Fig. 4 is a cross-section view of the record master and master mold stripped apart, both parts being made as in the new process.

Fig. 4A is a cross-section view similar to Fig. 4 but showing the same parts made by an older process.

The first several steps as shown in the block diagram of Fig. 1 are old in the record making art. As has been conventional practice, the sound track is recorded on a wax or lacquer matrix. The sound track is then thinly plated with gold, either by chemical deposition, or by one of the other well known processes such as cathode sputtering or evaporation. The thin film of gold is next backed up with a thin plating of copper and then a heavier plating of copper. The next steps are to separate the gold surface from the wax or lacquer and then thoroughly clean the residual matrix material from the face of the noble metal. The resulting product constitutes what is known as a gold faced record master having on its surface an exact negative of the sound track which was cut in the matrix. This gold surface could be used to mold records but it is relatively soft and soon would be worn so badly that an entirely new recording would have to be made. However, if it could be used for a large number of pressings it would be ideal from the standpoint of making high fidelity recordings since its sound track is an accurate replica of the original recording even though in negative form.

In one of the methods used heretofore the cleaned gold surface was subjected to a mechanical polishing operation which removed much of

the gold and inevitably damaged the fine modulations of the sound track. As illustrated in Fig. 3A, the polished surface was then electroplated with nickel and the nickel was either coated with a separatory medium or otherwise treated so that a further plating of nickel could be superimposed temporarily. This second layer of nickel was later backed up with copper and the copper-nickel combination separated from the nickel plated master as shown in Fig. 4A. The second nickel plated matrix constitutes what is known as a master mold. From this, by a similar process, a nickel faced pressing die is made which is used to stamp out the actual sound records sold on the market.

The most objectionable part of this older process lies in the step of having to polish the gold plated master and nickel plate over it to form a suitable top surface which can be stripped easily from the surface of the master mold. As previously mentioned, the polishing operation causes blemishes in the gold surface. Then, too, what is equally objectionable is that the nickel plated over the gold has a relatively rougher surface facing away from the gold which does not follow the fine modulations of the gold surface with the desired precision.

The present invention is in the nature of a discovery which eliminates the above objections and, for the first time, provides a satisfactory process of enabling the gold surface of the record master to be used without hard polishing and further nickel plating. In the improved process, the gold surface is separated from the wax or lacquer and the residual material removed by suitable solvents as before. The grooves are then preferably cleaned electrolytically with a solution of trisodium phosphate and tetra sodium pyrophosphate, thoroughly rinsed in water, washed for about 15 seconds in 15 per cent sulfuric acid (by volume), again rinsed in water, and the gold plated master is then treated with a solution of a strong oxidizing agent for a short time. This oxidizing agent may be any one of a number such as sodium dichromate or one of the permanganates, such as sodium or potassium permanganate, but is preferably potassium dichromate.

The chemical or physical modification of the gold surface which occurs as a result of the treatment is not thoroughly understood; therefore, it is not desired that the invention be limited to any particular theory of what takes place at the metal surface. There is evidence to indicate that a very thin film of oxide is deposited from the treating solution. There is also evidence that some physico-chemical modification of the metal surface occurs which may be responsible for the results obtained. At any rate, the gold surface is rendered inactive, that is to say, it is passivated to the extent that it can easily be separated from a nickel layer later electroplated on top of it.

After the treatment with the oxidizing agent, the filmed gold surface is treated with water for a short time. This is to "set" the passive surface and to rinse off excess passivating agent. The treatment is preferably accomplished by subjecting the plated master to a water spray for the required time interval.

After the passivating treatment has been completed, a master mold is made, as in previous processes, by successively plating on nickel and copper and then stripping the nickel surface away from the surface of the record master. But the difference in results is striking since the nickel surface, which has now been plated directly against the gold, is still a faithful copy of the original recording.

The concentration of the dichromate solution does not appear to be particularly critical. It is preferred to use for the passivating solution a potassium dichromate solution having a concentration of 2.22 grams/liter; however, concentrations of as low a .22 gram/liter have been successfully used. Similarly, much more concentrated solutions can be used but there appears to be no advantage derived and the excess oxidizing agent is simply wasted. Substantially the same concentrations can be used in the case of other dichromates or the permanganates.

The preferred time of treatment with the oxidizing solution is about 15 seconds but this may be varied considerably. A time period as low as 5 seconds appears to be sufficient and times at least as long as 45 seconds have been used.

The time of treatment and temperature of water in the rinse tank which is used after the passivating treatment are both critical but may be varied somewhat. It is preferred to dip for about 15 seconds at a temperature of about 45° F. However, it has been found possible to obtain good results by using water temperatures as low as about 35° F. and as high as about 100° F. The optimum treating time varies inversely with the temperature used. At 100° F., the treating time is not longer than about 5 seconds, while, if a temperature of only 35° F. is used, treating times of up to 3 minutes may be used.

If the water rinse is conducted for too long a time, or if too high a temperature is used, the passivating film usually becomes too thin in spots and, during the subsequent nickel plating operation, electrodeposited metal strikes through to adhere directly to the gold surface. It then becomes impossible to separate the gold and the nickel surfaces without damage to both.

On the other hand, if no water rinse treatment is used, or if carried on for too short a period of time at low temperatures, the passivating film appears to be too thick, the parts usually separate during the subsequent nickel plating step and plating solution penetrates between the gold and the nickel surfaces, etching the nickel. If no water rinse treatment is used at all, this separation may occur at least nine times out of ten.

Although a spray rinse treatment of the filmed parts is preferred for the water rinsing step, it is possible to accomplish the same results with a dipping process.

Although the process has been described in connection with a gold faced record master, other noble metals such as silver and platinum may be used with equally good results. The time and temperature range for the water rinse treatment is the same for these two metals as for gold.

There has thus been presented an improved method of making metal to metal duplications which has particular value in the sound record industry. Comparison of records made by the old and new processes leaves no doubt as to the importance of the improvement. Tonal quality is brighter and clearer and surface noise is practically non-existent. Moreover, the cost and time of record manufacture have been actually reduced since a plating operation and a polishing operation have been eliminated.

I claim as my invention:

1. In a process of making master molds used in the manufacture of disc sound records, the steps of passivating a metal replica of an originally recorded sound groove by treating said replica with an aqueous solution of a strong oxidizing agent from the class consisting of alkali metal dichromates and permanganates, said metal having a surface of one of the class consisting of gold, silver and platinum, rinsing said passivated surface with water at temperatures of 35° to 100° F. for from about 3 minutes to about 5 seconds, electrodepositing a coating of nickel on said passivated surface and then stripping said nickel coating from said passivated surface.

2. A process according to claim 1 in which said oxidizing agent is potassium dichromate.

3. A process according to claim 2 in which the concentration of the potassium dichromate solution is about 2.2 grams per liter.

4. A process according to claim 3 in which said metal replica has a silver surface.

5. In a process of making master molds used in the manufacture of disc sound records, the steps of passivating a metal replica of an originally recorded sound groove by treating said replica with an aqueous solution of potassium permanganate having a concentration of at least 0.22 gram per liter, for from 5 to 45 seconds, whereby a passivating film is formed on the surface of said replica, said metal replica having a surface of a metal from the class consisting of gold, platinum and silver, treating said filmed surface with water at a temperature of from 35° to 100° F. for from about 3 minutes to about 5 seconds, electrodepositing a coating of nickel on said filmed surface, and stripping said nickel coating from said filmed surface.

ERNEST P. RUGGIERI.

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