Aug. 25, 1953 T. R. DUNCAN 2,649,652

METHOD OF MAKING MELODY COMBS

Original Filed May 24, 1948

Fig. 1.

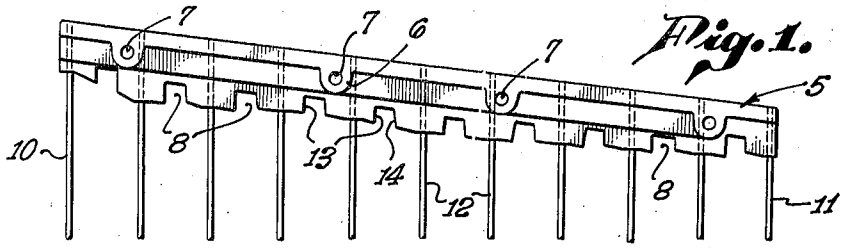


Fig. 2.

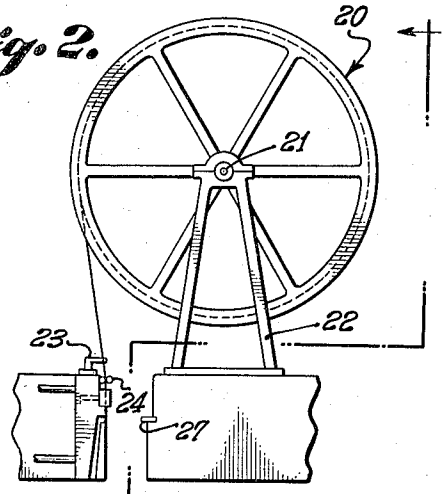


Fig. 3.

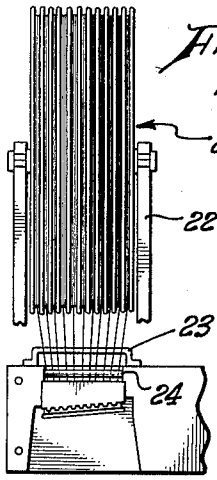


Fig. 4.

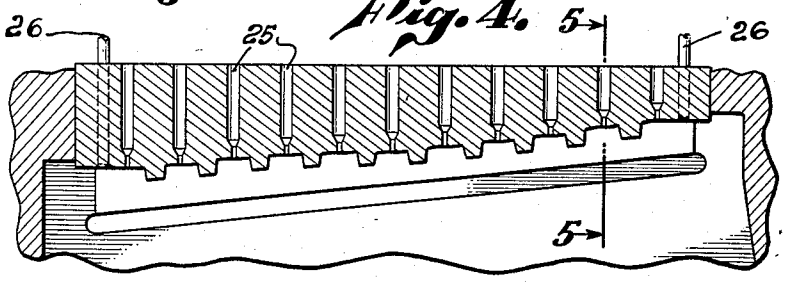
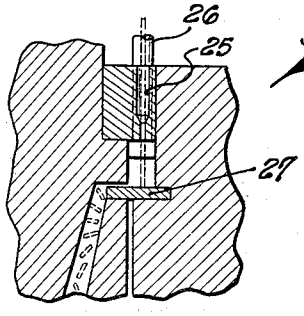


Fig. 5.



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METHOD OF MAKING MELODY COMBS

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2 Claims. (Cl. 29—169.5)

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My present invention relates to improvements in the method of making music box combs and is a division of my copending application for melody combs filed May 24, 1948, Serial Number 28,767, now Patent No. 2,504,666.

Since the teeth of Swiss combs are cut from solid metal plates, they are rectangular in cross section, and can therefore vibrate only as reeds, that is to say, only in one plane. By using round piano wires that can vibrate in any direction and anchoring such wires in a metal bar cast around them, and by using a metal such as a zinc alloy which shrinks tightly around the wires on cooling, I have found a music comb having much finer tonal qualities to result. The use of a cast metal which shrinks upon cooling is very important, because its tight grip on the wires permits a maximum of their vibrations to be transmitted to a resonator. When this bar is bolted to a simple resonator such as a strip of soft wood, a tone results that is similar to that of a pianoforte.

One of the important objects of this invention is to provide a method of producing music box combs of improved tonal quality at lower cost and operated by simpler machinery.

A further object is to provide combs of improved intonation. In Swiss combs the pitch of any note depends on how much metal is cut away. This involves the probability of considerable error. The cheaper boxes of this type are quite noticeably out of tune, while the more expensive ones appear to have a final hand tuning of many of the notes. To avoid such errors in tuning, round music wires were chosen by me, because they appear to be perfectly uniform in cross section. The pitch of any note can therefore be controlled by controlling the length of the wire.

Differences in the lengths of wires in my music comb are determined by notches or serrations provided in a cast metal bar. As the relative depth of these notches results from corresponding notches cut in a steel die, and as these can be machined with great precision, the lengths of the wires in the finished comb can be controlled to very fine degree of exactness. Therefore one of the principal advantages of this invention resides in the fact that care taken in machining one piece of metal will result in the production of a multitude of low cost combs, each possessing the most perfect intonation. My improved method of notching also controls shrinkage, resulting in a further advantage.

A still further object resides in providing vibrating members each of which has a uniform

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cross section throughout its length whereby tuning is effected merely by regulating the length of the member. This feature reduces the margin of error to a fraction of that obtaining where the entire tooth is cut from a solid metal plate in which inevitable variations in both thickness and length tend to multiply errors in tuning. Further, by reducing the determination of length to the most exact measurements that can be machined in a piece of tool steel, a more perfect tuning is achieved by machine methods than could be accomplished economically by hand methods.

Other objects, advantages and features of invention will hereinafter appear.

Referring to the accompanying drawings which illustrate preferred embodiments of the invention considered as a new article of manufacture,

Figure 1 is a plan view of the complete comb considered as the article.

Figure 2 is a fragmentary, somewhat diagrammatic, side elevation of a die including in the view a battery of reels from which the tooth-forming wire is supplied to the die.

Figure 3 is a section on angular line 3—3 of Figure 2.

Figure 4 is an enlarged, longitudinal midsection taken through the notched tuning die bar, a subjacent portion of one of the die forming parts being included in the view as well as a fragmentary portion of the ejector bars.

Figure 5 is a section taken on a plane indicated by the line 5—5 of Figure 4.

Referring in detail to the drawings, the elongated comb body 5 is made of a bar of die-cast zinc alloy, the preferred ingredients of which will be hereinafter disclosed. As to its thickness, or side-to-side dimensions, said comb body is of a uniform dimension from end to end, except for a series of slight, partly circular bosses 6 concentric about bores 7 extending transversely through the comb and used in securing it to a resonator board. But as to its breadth there is a progressive, intermittent decrease of dimension of the comb body, so that it may be said, in general, to taper from one end to the other.

This taper has been called "intermittent" because of the approximately rectangular notches 8, which are located in one edge of the comb body and are spaced apart from each other in a series extending longitudinally of the comb.

A series of resonant, round piano wire teeth are provided consisting of a long end tooth 10, short end tooth 11 and (in the illustrated embodiment in Figure 1) nine intermediate teeth 12. Said teeth are all gripped tightly within the

zinc body 5 extending from edge to edge thereof. The aforesaid notches 8 are shown located midway between adjacent teeth, one reason for this being to aid in equalizing the shrinkage of the cast zinc alloy in relation to the individual teeth 12.

In order to save material and provide for the desired progressive variation in the lengths of the teeth of the comb, said teeth, while being maintained parallel to each other, are all shown somewhat inclined in relation to the long axis of the comb body or bar 5. When the comb is positioned as in Figure 1, the edge portion of said bar 5 opposite to its tooth-carrying edge is inclined in relation to a plane extending at a right angle to the axis of each of said teeth.

In order to control more perfectly the shrinkage of the die cast bar to prevent bending or fracturing of the wire teeth and also to facilitate the withdrawal of said bar from the mold, the straight opposite side portions 13 and 14 of each of said notches are slightly inclined in such a manner as to widen the mouth of each notch. At one side of the mid-length of the comb said notch sides 13 are inclined to provide a draft of one per cent whereas the opposite notch sides 14 of the same notches are inclined to provide a draft of five per cent. At the opposite side of the mid-length of the comb said notch sides are inclined to the same extent but in the reverse direction in relation to the length of the comb, this being done for the reason the shrinkage is toward the mid-length of the comb.

Whether the invention is embodied in the form herein described or other modification, the following instructions regarding the method of casting the body portion of the comb and regarding the metallic composition thereof may be followed in the manufacture thereof to give the best results.

The following metallic composition has been successfully used in the manufacture of the comb:

Aluminum	3.5–4.5%
Copper	2.5–3.5%
Magnesium	0.02–.10%
Iron	0.100% maximum
Lead	0.007 maximum
Cadmium	0.005 maximum
Tin	0.005 maximum
Zinc	Remainder to total 100%

Some solidification shrinkage is essential, as the metal must grip the wires firmly when the casting has cooled, and when the above preferred composition is used a desirable amount of shrinkage results. But the shrinkage must be controlled until the casting is ejected from the die, otherwise the shrinkage of the metal will bend the wires. Bending the wires at the base alters the tone and causes the tone to waver up and down in pitch.

Turning now to the method of making the comb herein described, I provide a series of reels 20, preferably thirty-six inches in diameter or larger so that there will be a minimum of bend in the wire, each wound with a predetermined size of wire, mounted side by side on a shaft 21 and placed on a frame 22 above the die-casting machine.

The ends of the wires are sharpened to remove any burr and are then fed downward through a guide plate 23, thence between friction rollers 24 into appropriate holes 25 in the die.

During the winding operation, or just before the wires enter the die, they can be lubricated with an oil that volatilizes below 700 degrees F.; or that will burn below that temperature, such as castor oil. Such lubrication helps to prevent wear on the die, and helps to seal the space around the wires, preventing flash.

The aforesaid rollers 24 fit the various sizes of wire and are slightly braked to prevent the wires from being blown out of the die by the pressure of the metal. Ratchets instead of braking could be used.

When the wires have been fed into the holes 25 in the mold, the die is closed and molten metal is injected around them. When the metal has solidified, the die is opened and ejector pins 26 push the casting downward and out of the die, pulling the wires from the reels with it; an appropriate distance.

As the die closes again a shear 27 cuts off the wires, letting the comb fall into a trough or box. The cutting knife of this shear forms a closure for the lower part of the die cavity, hence the wires are in a correct position for the next die-casting cycle.

The temperature of the die is carefully controlled by water or air cooling, being kept low enough to prevent annealing of the wires.

Die temperatures as low as 125 degrees F. and as high as 400 degrees F. have been used.

At 125 degrees F. the die does not fill well unless metal pressures in excess of 85 pounds per square inch are used. Pressures greater than this tend to cause flash around the wires.

Temperatures to 400 degrees F. do not appear to anneal the wires, if the casting is ejected promptly from the die.

Pressures as low as 40 pounds per square inch have been tried but do not seem to give a casting solid enough to produce a good tone from the wires. The best pressure seems to be 45 to 85 pounds per square inch. The best temperature seems to be 125 degrees–350 degrees F. (cold side) and 175 degrees–400 degrees F. (hot side). This produces a solid casting free from flash and does not anneal the wires enough to effect their tone.

Commenting further on metals which it is possible to use in casting the comb base, almost any metal that could be injected into the die cavity could be used in the casting thereof. Copper or brass would serve if the die temperature were held low enough to prevent annealing of the music wires, and if the pressure were not so great as to cause too much flash around the wires. Lead produces a duller tone, but this can be compensated for by using a more sensitive resonator. Nickel-babbitt gives a better tone than lead but that material is too expensive. Zinc or the commercial alloys of it, particaularly the alloy hereinbefore specified, seems to be the best material available at present for the following reasons:

Low cost; lower melting point; capacity for being injected into a die that is cool enough to avoid annealing; lower pressure making it possible to inject the metal into a cool die as low as 45 pounds per square inch pressure. (This means there will be virtually no flash around the wires.)

Zinc has a fairly hard crystalline structure, yet is relatively low in tensile strength. This hardness is good in that it produces a brillant tone. The weakness in tension is an advantage, in that thin sections of flash around the wires

are not strong enough to prevent the wire from vibrating. The music wire is so much stronger than the zinc that it loosens itself from any flash at the first vibration. This fact makes a small amount of flash tolerable.

Zinc shrinks upon solidifying. This is an advantage in that the cast base firmly grips the music wires. This enhances the brilliancy of tone, and thus permits the use of more convenient resonating materials; as for instance "poly-styrene" (plastic) instead of white pine or spruce wood.

In controlling the solidification, shrinkage must be reckoned with in terms of the length of comb base, the diameter of the wires; the number of wires per square inch of length of comb; and the positioning of the wires in relation to each other.

If solidification shrinkage is not controlled damage to the wires may result. Thus if the wires are of large diameter at one end and small at the other, the shrinkage stress will be loaded on the small wires. The larger wires tend to hold the casting, compelling the shrinkage to be shifted toward the small wires which will bend to let the casting move. As this bending must occur between the steel die and the rigid zinc casting it becomes a shearing stress. The tone of the small wires is ruined. They may even break off at the base the first time they are vibrated.

If the wires are close together at one end and far apart at the other a similar result occurs.

If there are enough wires, and if they are close enough together the wires alone could control the solidification shrinkage. Or if the wires are spaced farther apart but are of sufficient large diameter they will resist the shearing stress.

Since the soldification shrinkage is in itself an advantage to the tone of the comb, it is better to control it in the design of the die itself, to prevent its affecting the tone of the wires except as desired. Notches are therefore placed along the comb. These can be placed on the sides

or between the teeth. If placed on the sides they can be of any size or spacing sufficient to control shrinkage. If placed along the edge where the teeth occur, they must be spaced to accommodate the spacing of the teeth.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of making a melody comb consisting of wires individually connected at one end to a base and having free ends projecting from said base to form pluckable teeth, said method comprising the steps of moving wires from lengths thereof, said wires being moved into spaced substantially parallel relationship in a common plane, stopping the moving of said wires at a predetermined station, restraining said wires from further movement out of said station, casting a metal base intimately and firmly around a portion of said wires at and adjacent said station, forcing said base, with said wires embedded therein, away from said station in the direction of said moving and substantially in the plane of the axes of said wires while thereby simultaneously pulling additional wire for a predetermined distance, and severing portions of said wires along a similar common line at said station to repeat said method.

2. A method, according to claim 1, including the additional step of forming a molding chamber at said station when performing said severing step.

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