To Design, Build and Test a Device to Assist in the Grooving Process of the Steel Pan Musical Instrument

Aaron O. Ameerali, Nadine Sangster, Prakash Persad, and Claron Mitchell

***Abstract*—The traditional method of grooving the steel pan is a manual forming technique, which involves the use of hammers and chisels or punches. This is a time-consuming and tedious process, which requires skill on the part of the sinker and depending on the individual, may take up to four (4) hours. The process lends itself to any method that may propose a reduction in time as well as minimise the tedium involved and human error that may be encountered.**

This paper presents the design and development of a device to aid in the grooving process thus allowing for more consistent instruments to be manufactured.

It was found that a pneumatic hammer with a modified chisel attachment worked well for the grooving process. Additionally the steel pan tuner was able to:

- **Stay in a straight line while grooving;**
- **Avoid hand injury, considering that the steel pan tuner is usually looking at the grooving line and not the hammer, or where he is hitting;**
- **Pound out the grooving track while still maintaining the note shape;**
- **Counter-groove depending on the type of steel pan and the material of the surface.**

***Index Terms*—Grooving process, pneumatic hammer, steel pan musical instrument, Trinidad & Tobago.**

I. Introduction

The Steel pan is one of the most important new acoustical instruments developed in the twentieth century. It is an instrument that produces a complex sound and its tone generation can be compared to cymbals and gongs [1], [2]. The Steel pan belongs to the group idiophones and has a definite pitch [3]. This instrument, which has its origins in Trinidad and Tobago in the early 1930's, can be considered the "most important new acoustical musical instrument to be developed in the 20th century" [4], [5]. Steel pan bands (which are widely known as steel bands) are increasingly becoming popular throughout the world, particularly in Europe and Asia. The instrument is quite versatile and can be used to play calypso, jazz, classical music and even rock.

In the past twenty years, there have been significant steps made toward standardising the steel pan [6], [7]. There are various types of pans (i.e. tenor, double tenor, etc.) and each has to be characterised separately. The basic features are generally stipulated for each type of the steel pan, namely, depth of bowl, length of skirt, layout and size of notes. However, the steel pan actually created depends on the individual (s) that makes the instrument and there would be variations in the precision of the characteristics. To minimise these variations, methods can be used to standardise the grooving process of the steel pan with the view of designing a mechanised device to form the grooves. Having such a device would increase the consistency of the instrument according to the characteristics of the surface and reduce the grooving time.

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Aaron Ameerali, Nadine Sangster, and Prakash Persad are with the Design and Manufacturing Engineering Department, University of Trinidad and Tobago, Boulder, O'Meara Industrial Estate, ARIMA, Trinidad and Tobago (e-mail: aaron.ameerali@gmail.com).

Claron Mitchell is with the BASc Design and Manufacturing Engineering Department, University of Trinidad & Tobago, Trinidad and Tobago.

II. Steel Pan Manufacture

Making a steel pan is next to impossible for a beginner. People practice for up to ten (10) years before being able to make a good quality steel pan. The steel pan, is a unique instrument, skillfully hammered from a 55-gallon cylindrical oil drum having a diameter of 57.8cm (22¾ inch), which has been carefully fashioned and tuned to produce musical tones. In the hand forming process, the flat surface of a 55 — gallon oil drum is sunk using a series of hammers, starting with a 3.6 kg (8 lb) sledge hammer and continuing with hammers of decreasing weight until the surface resembles that of a concave bowl. Notes are then marked and grooved out using a dull punch to avoid bursting of the surface (see Fig. 1-Fig. 3).

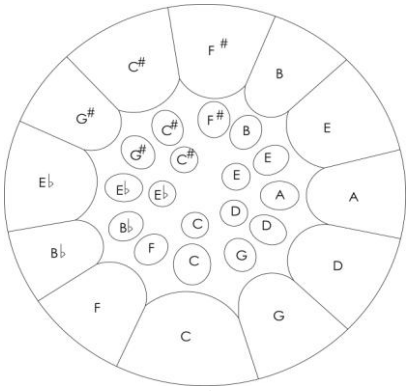

Fig. 1. Top view of a tenor steel pan.

There are basically twelve (12) steps involved in the making of a steel pan. These are defined as:

- Choosing the drum — Main considerations include gauge (thickness of surface material) and surface condition.
- Marking the drum — concentric circles drawn on the drum's surface to guide sinking.
- Sinking the drum into a concave bowl.
- Shaping and Smoothing of the bowl
- Marking the notes
- Backing — notes are hit from the underside of the drum to

give their arched shapes
- Grooving — separate notes with grooves
- Levelling — flatten grooves to level notes with each other.
- Cutting the drum — cut the length of the skirt depending on the type of Steel pan being manufactured
- Tempering — heating and cooling the drum to relieve stresses produced during cold working
- Tuning to obtain the correct pitch for each note
- Finishing by chrome plating

Fig. 2. Collection of forming tools.

The entire process may take up to two (2) days, (excluding time taken for finishing) out of which the grooving process can take up to four (4) hours.

Fig. 3. The grooving process.

III. The Grooving Process

Due to the fact that the grooving process is quite long and tedious, many efforts to accelerate this process have been made in order to reduce the human labour as well as to decrease the time taken to groove the notes.

The grooving process consists of marking, shaping and preparation for isolating the notes. The notes are sketched out with a marker and then these marks are hammered with a smaller hammer to make the note areas stand out. It should be noted that at this stage two distinct areas are mapped out: (1) the note areas and (2) the dead areas. The dead areas separate the notes from each other. This is the first step in isolating the notes. The second phase of note isolation is to groove within the dead areas. Grooving the pan is done with a small hammer and a small center punch as shown in Fig. 3.

At this stage care must be taken because it is easy to puncture the playing surface of the steel pan. Although the artisan's fingers must possess strength and skill throughout the whole construction process here it is especially important to apply a feather-light touch while grooving the pan. With one incorrect stroke of the hammer, the punch would burst through the playing surface thus rendering the instrument useless. Herein lies the need for a device to assist with the grooving process.

IV. Development of the Grooving Device

Based on interviews conducted with several steel pan craftsmen, considerations of the following were deemed important for developing a grooving device:

1) The device must be lightweight
2) The device must be easy to use
3) The device must be powerful enough to impact different steel strengths
4) The device should accommodate the different types of chisels for the different types of steel pans
5) The device should be easy to maintain
6) The device should be relatively inexpensive

The original tools used by a manufacturer consisted of a hammer and a rounded chisel to make the grooves as shown in Fig. 2 and Fig. 3. For this reason it was decided that a handheld pneumatic 'pistol' type tool would be suitable for the application based on these same elements, incorporating the use of a pneumatic hammer and a customised rounded grooving tool into the same housing. This would essentially allow both hands to use one tool.

The power to the tool is provided via compressed air, entering the base of the tool via a traditional pneumatic circuit. It then forces the tool to move forward and make contact with the steel surface. The spring at the end of the tool keeps the grooving tool in place and acts in such a way that the grooving tool oscillates between its position at rest and the spring, allowing for repeated hits on the surface of the steel pan. The spring also served as a safety measured to keep the grooving tool from flying out of the pneumatic tool and causing injury.

After acquiring the pneumatic pistol gun that would be used for the process, the next step was to machine a grooving tool that would be able to function within the gun itself. The grooving tool that was manufactured was to be used for the grooving of a Six Bass Drum. The significance of mentioning this is to emphasize the point that the different types of steel pans use different types of grooving tools, each having a different diameter head based on the intended diameter of the groove. Fig. 4 shows the completed grooving tool and the final assembly into the pneumatic pistol gun.

The final grooving tool had the following specifications:
- Chisel base length (to taper) – 31mm
- Taper to shoulder (from base) – 4mm @ 45^{o}

- Shoulder length – 4mm
- Shoulder diameter – 17mm
- Chisel length (from shoulder to head) – 120mm
- Chisel diameter (to taper) – 11mm
- Taper to head – 39mm @ 5^o
- Head diameter – 5mm

Fig. 4. Assembly into the pneumatic gun.

V. Testing and Evaluation of the Grooving Device

Four (4) steel pan craftsmen were called in to test the device and compare its performance against the traditional had forming method. The pneumatic gun was connected to an Industrial Air 30 gallon compressor. A regulator was also added to the line in order to measure and adjust the flow rate of air into the tool. When all connections were secured, the compressor was turned on and then tested by the craftsmen.

Fig. 5. The clamp used to hold the template in place for marking the notes.

Initially, the regulator was set to the maximum setting of the pneumatic gun i.e. 90psi, and then adjusted to settings of 60psi, 40psi and 20psi. At each value, the device was tested on the steel pan.

Fig. 6. Grooves made at 20psi.

At the highest value of 90psi, the device was relatively difficult to control while holding it against the pan, but as the value was decreased, it became easier to control. At 20psi, the device was easiest to control, while it still carried out the intended function.

After rigorous testing by the four (4) craftsmen, the device worked well and was able to groove the steel pan. Initially there was a little too much "chatter" on the grooving tool while in the gun, and it was difficult to control at the higher pressures. Adjustments on the regulator corrected this problem and a suitable pressure of 20psi was adopted for grooving purposes. Fig. 5 and Fig. 6 show the template in place and the groove made by the device.

VI. Conclusion

The entire concept of this project revolved around taking traditional methods of carrying out particular tasks in industry, and in an effort to bring up to date with modern times and methods, incorporate newer technologies to speed up the process, while maintaining the overall efficiency of the process, if not improving it. It is also in an effort to reduce the risk involved with the current methods employed by the "specialists" of such an industry.

The final design incorporated the use of a machined grooving device, a compressor, and a regulator. The regulator played an integral role in the operation of the tool, as it allowed for the adjustment of air flow into the tool. The value of this was important as it was a means by which any tuner would be able to decrease or increase the strength at which the device makes contact with the surface of the steel drum, a quality that may prove useful when grooving different thicknesses of steel. For the grooving of the bass drum a pressure of 20psi was found to be adequate for the grooving process.

The device performed well and achieved the task of grooving the steel pan. The more noteworthy accomplishments were that the craftsmen were able to:

- Stay in a straight line while grooving
- Avoid hand injury, considering that the steel pan maker is usually looking at the grooving line and not the hammer, or where he is hitting.

Based on the overall feedback from those involved, the device showed a promising future in terms of modernizing an older tradition.

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Aaron Ameerali was born on July 4, 1978 in Trinidad and Tobago. He received his MPhil degree in mechanical engineering from University of the West Indies in 2004. He is a senior instructor in the design and manufacturing unit at the University of Trinidad and Tobago, O'Meara Campus. He is currently pursuing a Ph.D. degree in the area of developing a robotic device for applications in the manufacture of musical instruments in the idiophone class. Mr. Ameerali's research interests include mechatronics, innovative manufacturing technologies, ergonomics and rapid prototyping.

Nadine Sangster was born on October 21, 1977 in Trinidad and Tobago. She received her PhD degree in mechanical engineering from University of the West Indies in 2008. She is an assistant professor in the design and manufacturing unit at the University of Trinidad and Tobago, O'Meara Campus. She has a PhD degree in mechanical engineering from University of the West Indies. Her research interests are fuzzy logic and its application to complex plants and the use of smart technologies in agriculture and mechatronics with an emphasis on advanced manufacturing technologies.

Prakash Persad was born on October 19, 1954 in Trinidad and Tobago. He received his PhD degree in mechanical engineering from University of the West Indies in 1981. He is currently a professor of mechatronics and the programme professor of the design and manufacturing engineering unit at the University of Trinidad and Tobago. His research interests are in the areas of artificial intelligence, wave powered devices, entertainment, cultural and sporting robotics and the synergy between science and religion.

Claron Mitchell received his BSc degree in manufacturing and design engineering from University of Trinidad and Tobago in 2010.

Engineering Mechanics and Its Application