

# DEVELOPMENT OF PNEUMATIC HAMMER

John Paulo R. Amon<sup>1</sup>, Kim T. Camagay<sup>2</sup>, John Carlo L. Manandeg<sup>3</sup>,  
Engr. Eduardo M. Manzano, ME<sup>4</sup>

College of Engineering, Computer Studies and Architecture, Lyceum of the Philippine University – Cavite

---

**Abstract:** The purpose of this study is to develop a new form of existing nail gun with more efficiency. The scope of this study is to develop a pneumatic hammer connected to an air compressor. The procedure in testing the efficiency of the pneumatic hammer underwent several trials. There were users who did the monitoring to check its efficiency, the result of using it, and the advantages and disadvantages of having this kind of device. The limitation of the study is on the wood that was used. Nail No. 4 was used in the study. This study is applicable only for men hence, they are the ones only allowed to operate the pneumatic hammer. This study is beneficial to the users and the students who will use the developed machine. The study may also be significant to the researchers who would like to further research on the development of similar equipment.

**Keywords:** wood, efficiency, air compressor.

---

## 1. INTRODUCTION

A nail gun is a type of tool used to drive nails into wood or some other kind of material. It is usually driven by electromagnetism, compressed air (pneumatic), highly flammable gases such as butane or propane, and for powder-actuated tools, a small explosive charge. Nail guns have in many ways replaced hammers as tools of choice among builders.

## 2. LITERATURE REVIEW

The use of simple hammers dates to about 2,600,000 BCE when various shaped stones were used to strike wood, bone, or other stones to break them apart and shape them. Stones attached to sticks with strips of leather or animal sinew were being used as hammers with handles by about 30,000 BCE during the middle of the Paleolithic Stone Age.

The hammer's archeological record shows that it may be the oldest tool for which definite evidence exists of its early existence. (Semaw et al., 2003)

If the handle is made up of wood, commonly hickory or ash, it is proven to be tough and long-lasting that can dissipate shock waves from the hammer head. If the handle is used is rigid fiberglass resin, the hammer is known not to dissipate the shock waves as well as wood.

It is hazardous to use hammer with loose hammer head because it can literally "fly off the handle", becoming a dangerous uncontrolled missile. Wooden handles can, often be replaced when worn or damaged; special kits are available to cover a range of handle sizes and designs, plus special wedges for attachment.

Some hammers have one-piece designs made primarily of a single material. One-piece metallic hammer may optionally have its handle coated or wrapped in a resilient material such as rubber, for improved grip and reduced user fatigue.

The hammer head may be surfaced with a variety of materials, including brass, bronze, wood, plastic, rubber, or leather. Some hammers have interchangeable striking surfaces, which can be selected as needed or replaced when worn out.

A **portable electric nailing gun** is operating from a power supply. The motor accelerates, which at the appropriate energy state is coupled through a mechanism to an anvil acting directly on the nail. The actuation is governed by a control circuit and initiated from a trigger switch. The stored energy delivered from the motor is coupled to the output anvil that drives

the nail. At least one position of the output anvil is sensed and once the nail is driven, the power is disconnected from the motor. This method uses a direct acting clutch and a harmonic motion nailing mechanism to reduce wearing and increase robustness of the nailer. Elastic elements are used to limit stresses during the impact periods. The electrical control circuit and sensors allow precise control and improve safety. The power supply is preferably a rechargeable low impedance battery pack. (Pedicini et al., 2003)

A **pneumatic nail gun** has a body, a nail magazine, an actuating device, a trigger assembly, and a push bar assembly. The body has a housing, a handle and a nail firing device. The actuating device is mounted between the housing and the handle. The actuating device has a channel, a piston rod, an O-ring, and a first spring to provide a restitute force to the piston rod. The trigger assembly is attached to the body and has an inner cap pivotally attached to the body, an outer cap slid ably attached outside the inner cap. It also has an actuating lever pivotally attached inside the inner cap and a second spring. Accordingly, the outer cap can be moved to a lock position to keep the nails from being fired unintentionally and keep the pneumatic nail gun safe when used. (Chen et al., 2004)

One of the newest nail gun machine to hit the market is the **combustion nailer**. These portable guns generate hammering power with internal combustion, the same force that keeps your car going. At most basic level, combustion guns are a lot like pneumatic nailers. They have a long blade attached to a sliding piston, which is moved by an imbalance in atmospheric pressure. The piston moves downward when there is greater pressure above it, and it moves upward when there is greater pressure below it.

The difference between pneumatics and combustion models is the source of the pressure imbalance. Just like your car, combustion guns have a reservoir filled with flammable gas. An electronic control mechanism releases a little of this gas into a combustion chamber just above the piston head. A small fan in the combustion chamber vaporizes the gas, mixing it up with the air particles.

The design has a double trigger mechanism. To hammer a nail, you need to pull down the trigger and press the barrel up against the surface at the same time. Pressing the barrel down pushes back a metal valve around the main cylinder. This controls the gas intake and exhaust the cycle of the gun. (Harris, T. 2002)

### Synthesis

The project development of pneumatic hammer is based on an existing device (pneumatic nailers that can nail up to 2.5 inch or no. 2 nail), which is modified to improve its capability up to no. 4 nails and effectiveness. Since the pressure is high if an air compressor is used, the researcher came up on this study to lessen the time consumed by the users. The combination of a pneumatic device and an air compressor is more convenient based on the related studies referred to.

## 3. METHODOLOGY

The research methodology requires gathering of relevant data from the specified documents and compiling databases in order to analyze the materials and arrive at a more comprehensive understanding in the development of pneumatic hammer. The researchers developed pneumatic device with the use of an air compressor to present and share the convenience and advantage it could offer to its possible users.

This study was conducted during the first and second semester of the school year 2015-2016. Lyceum of the Philippines University – Cavite served as the locale of the study in terms of testing the device. Procuring the materials for the device was done in other areas of Cavite.

The following were the materials used to construct the machine:

- Air Compressor
  - Specifications:
    - Output: 1 hp
    - Volt: 220V
    - Pressure: 120 PSI
- Pneumatic hammer
  - Piston rod (Diameter = 8mm)

- Piston rod Mallet (Diameter = 25.4 mm)
- Piston casing (25.4 mm)
- Handle (5 inches)

**Sources of Data**

Data were gathered from the result of testing and evaluation of the developed machine. The findings herein were recorded and tabulated in a developed score sheet. Testing and evaluation of the pneumatic were done by the researchers themselves with the guidance of their adviser.

**Design Methodology**

To determine the efficiency of the pneumatic hammer, the following methods were systematically executed:

1. Selection of materials and sizes of materials;
2. Trial and testing of the device;
3. Calculation of pressure in nail numbers 1 to 4;
4. Specifications of the wood used; and
5. Comparing the efficiency of the development of pneumatic hammer to related studies.

**Procedure**

First, the air compressor was opened and the required pressure was set up. The air-hose was then connected to the pneumatic device. Afterwards, a nail was inserted to the clip/clamp, getting it ready for nailing. Next, the wood to be nailed was targeted. Lastly, to start the process of nailing, the trigger is to be pulled wherein the nail was injected into the wood.

**Research Instruments**

The gathered data were based on the performance of the developed device. The efficiency of the pneumatic hammer is nailing nails into the wood was determined. Likewise, the flaws of the device while using it were noted.

**Testing Procedures**

The pneumatic hammer was first introduced in the Lyceum of the Philippines University. This device underwent several trials. Identified research participants were asked to evaluate the developed device in terms of efficiency. They were also asked to state the advantages and disadvantages of using the device

**4. RESULTS AND DISCUSSION**

**Testing of the Conventional Hammer**

This test was performed to determine the effectiveness of the conventional hammer when used to nail nails to a lumber. In here, a user used the conventional hammer to punch a nail into good and coco lumbers.

**Table 1 (For a good lumber)**

TRIALS	NAIL NO. 1	NAIL NO. 2	NAIL NO. 3	NAIL NO. 4
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	X
4	✓	X	✓	X
5	✓	✓	X	✓
6	✓	✓	✓	✓
7	✓	X	✓	✓
8	X	✓	✓	✓
9	✓	✓	X	X
10	✓	✓	✓	✓
EFFECTIVENESS:	90%	80%	80%	70%

Table 2 (For coco lumber)

TRIALS	NAIL NO. 1	NAIL NO. 2	NAIL NO. 3	NAIL NO. 4
1	✓	✓	✓	X
2	✓	✓	✓	✓
3	✓	✓	✓	X
4	✓	✓	X	✓
5	X	✓	X	✓
6	✓	X	✓	✓
7	✓	✓	✓	✓
8	✓	✓	X	✓
9	✓	✓	✓	X
10	✓	✓	✓	✓
EFFECTIVENESS:	90%	90%	80%	70%

### Testing of the Pneumatic Hammer

This test was performed to determine the effectiveness of the pneumatic hammer when used to nail nails to a lumber. In here, a user used to pneumatic hammer to punch a nail into good and coco lumbers.

Table 3 (For a good lumber)

TRIALS	NAIL NO. 1	NAIL NO. 2	NAIL NO. 3	NAIL NO. 4
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	X
5	✓	✓	✓	✓
6	✓	✓	✓	✓
7	✓	✓	✓	✓
8	✓	✓	✓	✓
9	✓	✓	✓	✓
10	✓	✓	✓	✓
EFFECTIVENESS:	100%	100%	100%	90%

Table 4 (For coco lumber)

TRIALS	NAIL NO. 1	NAIL NO. 2	NAIL NO. 3	NAIL NO. 4
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	✓
5	✓	✓	✓	✓
6	✓	✓	✓	X
7	✓	✓	✓	✓
8	✓	✓	✓	X
9	✓	✓	✓	✓
10	✓	✓	✓	✓
EFFECTIVENESS:	100%	100%	100%	90%

## 5. CONCLUSION

The researchers have proven that the design of pneumatic hammer is ergonomic based on the anthropometric measurement. Such motion was found true upon asking industrial engineering students and Ms. Jelyn Rodriguez, an industrial engineering professor.

The design of the pneumatic hammer is proven to be successful based on the data gathered upon testing it. The developed machine is said to be more efficient than the conventional one. Other factors may have affected the results of this study. These factors should be taken into consideration on the conduct of other studies pertinent to it.

The researchers concluded that nailing using pneumatic hammer lessens the exertion of force needed to finish the operation. It was concluded that a pneumatic hammer is a device that is available for all users because it is easy to be used.

## 6. RECOMMENDATION

The researchers observed that the nail holder is causing hassle when a nail is being loaded in it. Hence, it is recommended that more appropriate and operable design of the nail holder be done. Likewise, the developed model of the hammer is significantly heavy causing the user to use it with less accuracy. The researchers recommend to find ways on how the weight of the device could somehow be lessened.

## REFERENCES

- [1] Frank, M., H.C. Schönekeß, F. Jager, Heinz Hertel, Axek Ekkernkamp, and Britta Bockholdt. (2012). Temporary cavity created by free-flying projectiles propelled from a powder-actuated nail gun. Retrieved from <http://link.springer.com/article/10.1007/s00414-012-0742-2> on 22 February 2016
- [2] Harris,T.(2002). Nail gun mechanism. Retrieved from <http://www.grainger.com/category/air-hammers/pneumatictools/pneumatics/ecatalog/N-agx> on 23 February 2016.
- [3] Pedicini, S. C. and J. Witzigreuter. (2004). Electrical motor driven gun, from <http://www.google.com/patents/US67055003> on 26 February 2016
- [4] Semaw., K.G. Adler, C. M. Yusop, and J. J. Andrews(2003). Untitled. Journal of Human Evolution 45 (2003) 169-17).

## APPENDIX - A

### Specifications of Air Compressor

Air Compressor Specifications	
Output	1 HP
Volt	220 V
Pressure	120 PSI