

## Novel mechanical Whistle Counter Device for Pressure Cooker

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**Abstract:** The domestic pressure cooker is one of the most essential cooking utensils used in kitchens worldwide. It ensures that the food is prepared in time, and still retains the nutritional value of the ingredients used. A major flaw associated with it is the fact that one has to keep an account of the number of whistles generated by the pressure regulator. Otherwise, the food turns out undercooked or Over-cooked and even leads to wastage of fuel. The problem becomes particularly acute for the hearing impaired. The device explained in this paper helpstokeep the track of number of whistles produced by cooker.

**Keywords:** Mechanical counter, pressure cooker, pressure regulator, slider, coupler, crank, rotating disc, bevel gears.

### I. Introduction

The pressure cookers are extensively used in household for preparing food. The pressure cookers have preference over the conventional cooking utensils due to the advantage of retaining the nutritive value and flavor of the cooked food and less time required for cooking and thus effecting considerable savings in time and fuel. The temperature inside the cooker is increased by increasing pressure inside the vessel. The vessel is completely sealed from all sides, increasing the pressure. This ensures that the water inside the vessel has to reach a higher temperature before it can get converted to steam, due to the additional pressure developed inside the vessel and thus reducing time consumed in cooking. The steam produced has a fairly high heat potential. When the pressure within the cooker /vessel increases beyond a certain limit, steam is let out using the steam regulator. This produces a whistling sound. The whistling sound produced in a pressure cooker indicates the status of the food being cooked.

It can be cumbersome to keep tabs on the number of whistles produced during the cooking process. The situation becomes particularly unsettling for the hearing impaired. The following device counts the number of whistles produced by the pressure regulator, thus, eliminating the above mentioned problem.

### NOMENCLATURE

- d – Diameter of the rotating disc
- t – Traverse distance of the whistle/dead load
- a – Distance between pivot point and link (connecting the disc)
- b – Distance between pivot point and link (connecting the whistle)

### II. Present Study

There is no such “mechanical device” currently in existence, which can be used to keep track of the number of whistles produced by the pressure regulator in a pressure cooker. Such counting devices will help eliminating the problems faced while using the humble pressure cooker, especially for the hearing impaired and thus, in maintaining the quality of food being prepared.

### III. Description of the device

The following innovation aims to alleviate the problems faced in house hold kitchens, pertaining to the usage of pressure cookers. It involves a counting mechanism which counts the number of whistles produced by the cooker (the number of times the weight is lifted) and helps in keeping tabs on the food being cooked.

A slider crank mechanism is a four bar mechanism used to convert reciprocatory to rotary motion and vice versa. The device is based on the first inversion of the slider crank mechanism. The shortest link is made the

crank (rotary motion). One of the adjacent links is made the coupler. The link opposite to the crank is made the slider (reciprocatory motion). A link that makes a complete rotation is called a crank. A link that reciprocates/rocks is called a slider. The assembly has been illustrated in the following diagram.

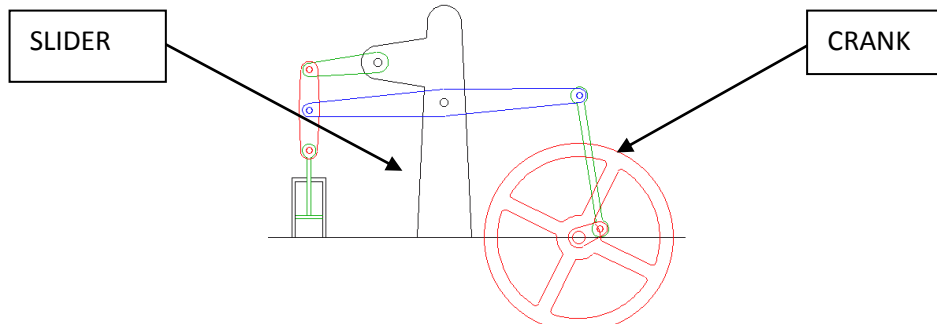


Fig. 1: Conversion of liner to rotary motion

The primary components used in the assembly are as follows:

1. An alloy steel rod connected to the pressure regulator, acting as the slider. It reciprocates.
2. An alloy steel rod connected to the slider, acting as the coupler
3. An alloy steel rod connected to the coupler, acts as a crank. It rotates
4. A rotating disc connected to the crank.
5. A mechanical counter
6. A shaft connecting the rotating disc and mechanical counter
7. Supports for the coupler, rotating shaft, rotating disc.
8. Bevel gears (miter gears, in this case), to transfer power between intersecting shafts. (perpendicular, in this case) Bevel gears have been used to connect the shaft connected to the rotating disc and the shaft connected to the mechanical counter. These shafts are so placed so that the counter is placed in such a position that it becomes easier for the user to view/read the output of the counter.
9. The slider, coupler, crank are inter connected using pin joints.



Fig.2: A mechanical counter

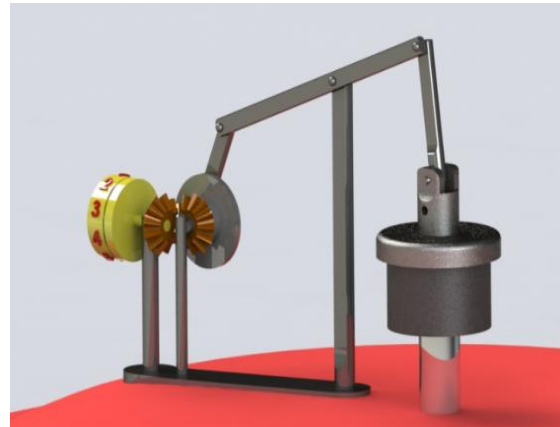


Fig.3: CAD Model of the device

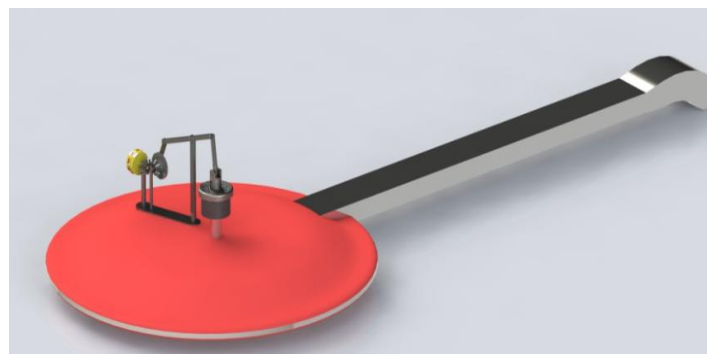


Fig. 4: Device mounted on a cooker top

#### IV. Working

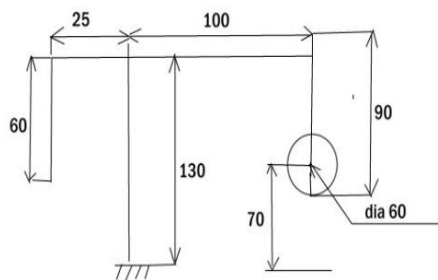
As the pressure in the cooker rises it exerts a force on the regulator/dead weight, making it to traverse from the bottommost point to the topmost point. The link will move the rocker arm and correspondingly the other link will move down leading to a 180 degree rotation of the disc. As pressure is released the whistle falls down to its initial position and the disc covers the remaining 180 degree of rotation.

Thus a complete 360 degree rotation is made by the disc when the whistle travels back to its initial position. The disc is connected to a mechanical counter by means of bevel gears. The number of rotations is equal to the number of times the cooker whistles. So each rotation of disc is calibrated on the counter and the reader will read out the number of rotation made, accounting for the number of whistles made by the cooker.

Since the displacement of the regulator/dead weight “t” is of the order of a few millimeters. This needs the use of a crank with diameter of a few millimeters. Since it is very difficult to manufacture bevel gears of comparable dimensions, a bigger gear needs to be fixed on the crank. This requires the use of a bigger crank in order to generate the required torque to rotate the gears. This is achieved by placing the pivoting point of the connecting rod closer to the whistle end resulting in larger displacement on the disc end. Thus appropriate diameters of the disc and gears can be selected for fabrication.

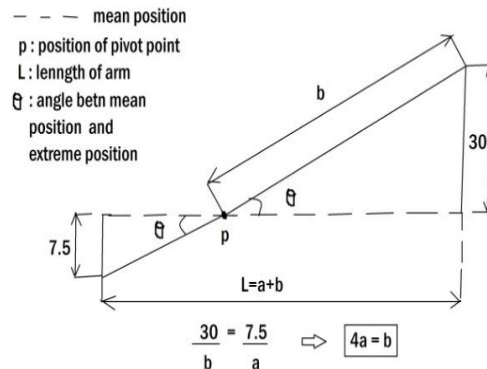
#### Calculation of dimensions of various components used

Mathematically, total distance traversed by slider/piston = 2 x (radius of the crank), Hence, the distance covered by the pressure regulator from the bottommost position to the topmost position and back to the bottom most position = 2 x radius of the crank In order to prevent the reverse motion of disc, the diameter of disc “d” is kept slightly less than the displacement “t”.



all dimensions are in "mm"

Fig.4: dimensions of all links and parts



all dimensions are in "mm"

Fig.5: to determine the position of pivot point

#### V. Thermal Analysis Of Cad Model

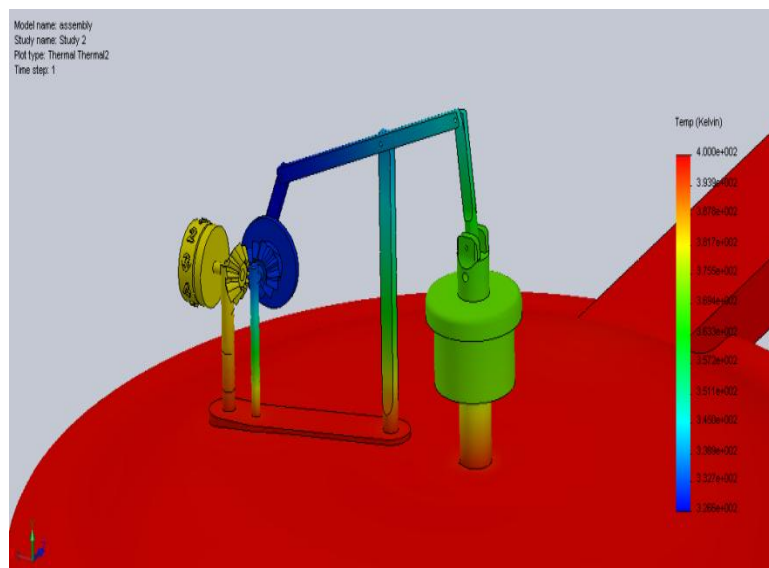


Fig. 6: Thermal analysis

The temperature in the interior part of a pressure cooker can reach up to 130 degrees Celsius. Continuous exposure to such temperature can affect the working of the slider crank mechanism and also the mating of the bevel gears due to thermal expansion. Thermal analysis was performed in Solid Works 2013 to evaluate the temperatures attained by each component so that suitable materials can be chosen.

For the analysis the interior temperature of the pressure cooker was assumed to be 400 degree Kelvin, thermal conductivity of stainless steel taken as 17 W/m-K and the convection coefficient was assumed to be 7.9 W/m<sup>2</sup>K between steel and air, 5.7 W/m<sup>2</sup>-K between cast iron and air etc. The temperatures were found to vary between 400K to 326K among the components. Accordingly the choice of materials used for links and the counter were modified.

#### **VI. Issues Involved In Working Of Model And Fabrication, And Their Solutions**

1. The device needs to constantly work under high humidity and pressure (kitchen conditions), thus there are fair chances of rusting of components. In order to prevent it, the components and links are made up of aluminum or alloy steel.
2. Resetting of counter: Once a cooking cycle is completed, the counter needs to be reset to 0 value, this can be done by removing the whistle and rotating the counter in anti-clock wise manner. This will set the counter to 0.
3. Chances of jamming of mechanism: The working condition involves emission of oil and food particles from the cooker, coagulation of such particles can jam the moving or rotating parts. Thus the device is well prevented inside a casing, having a window for read out.

#### **VII. Benefits Of the Device**

1. Eliminates the chances of missing the whistle count, thereby preventing the food from under cooking or over cooking
2. Helps the hearing impaired people to cook food.

#### **VIII. Summary**

Thus every time the pressure in the cooker increases the force imparted at the regulator end is transmitted along the different links in the assembly. The displacement is magnified as it reached the crank and the translational input is converted to rotary motion. The number of rotations so produced is computed using a mechanical counter. This gives a fair idea about the status of the food being cooked, thus eliminating the troubles entailed in keeping a check on the conventional pressure cookers used in regular households.

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