

**DESIGN AND CONSTRUCTION OF A CUTTING FLUID TWO-WAY/MULTI-FEEDING
DEVICE FOR TURNING OPERATION.**

BY

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ABSTRACT

It is a well known fact that the application of cutting fluids (CF) during machining reduces the friction between the tool – work piece interface, temperature and prolong the tool life as compared to “dry” Machining. However, the CF effectiveness depends largely on the mechanism (method) of its application. i.e. whether it is the standard one way of feeding the CF or the two (multiple) ways of feeding. It was obtained that the two – way application of CF (gaseous cutting fluid) to the cutting zone was more effective than the normal one-way [5]. Likewise such method of application of cutting fluid has not been developed for lathe machining. These two reasons motivated me to developing such a device for lathe machining, specifically for turning process. The device can be used as a two-way or multi CF feeding

mechanism depending on the number of nozzles used simultaneously for the application of the CF to the cutting zone. The material used for the construction of the device is low carbon steel, except the nozzles that were made from brass. The device was tested as a two-way cutting fluid mechanism to apply CF (soluble oil) to the cutting zone during the turning of medium carbon steel material with a tungsten carbide cutting tool. The experiment was conducted on centre lathe machine model XL400. The result of the experiment indicated that the two-way application of CF is more effective in terms of the reduction in the tool wear and surface roughness as compared with the standard one-way application of CF. The values of surface roughness (R_a) and the Tool wear (λ) were $8.62\mu\text{m}$ and 0.12mm respectively for two-way application of CF as against $9.67\mu\text{m}$ and 0.14mm for standard one-way application of CF. In other words the surface quality was increased by 11% and the tool life was prolonged approximately by 14.3% with the two-way application of CF.

KEY WORDS: Cutting Fluid (CF); Two-way application; One-way application; Surface Roughness; Tool Wear; CF Feeding; Nozzle.

INTRODUCTION

It is a well known fact that lathe machining, turning in particular, is accompanied with high temperature as a result of a lot of heat generated [1-2]. High temperature causes a high rate of tool wear and subsequently may lead to its frequent replacement and poor surface finish of machined workpiece. Therefore, cutting fluids/lubricants (CF) are applied to reduce the temperature thereby prolong the tool life and improve surface finish.

The traditional method of feeding the cutting fluids (CF) is one (vertical) way. That is, the CF feeding device traditionally has only one nozzle through which the CF is fed to the cutting zone.

However, some other metal cutting machine tools possess a multi-CF feeding mechanisms. Example of such machine tools is the milling machine [3-4]. Investigation also revealed that two-way feeding of the CF to the cutting area is more effective in reducing the temperature of the cutting zone and cutting forces [5]. Hence, the reason for designing this two-way CF (multi-CF) feeding device.

The device is presented in the figure 1 below

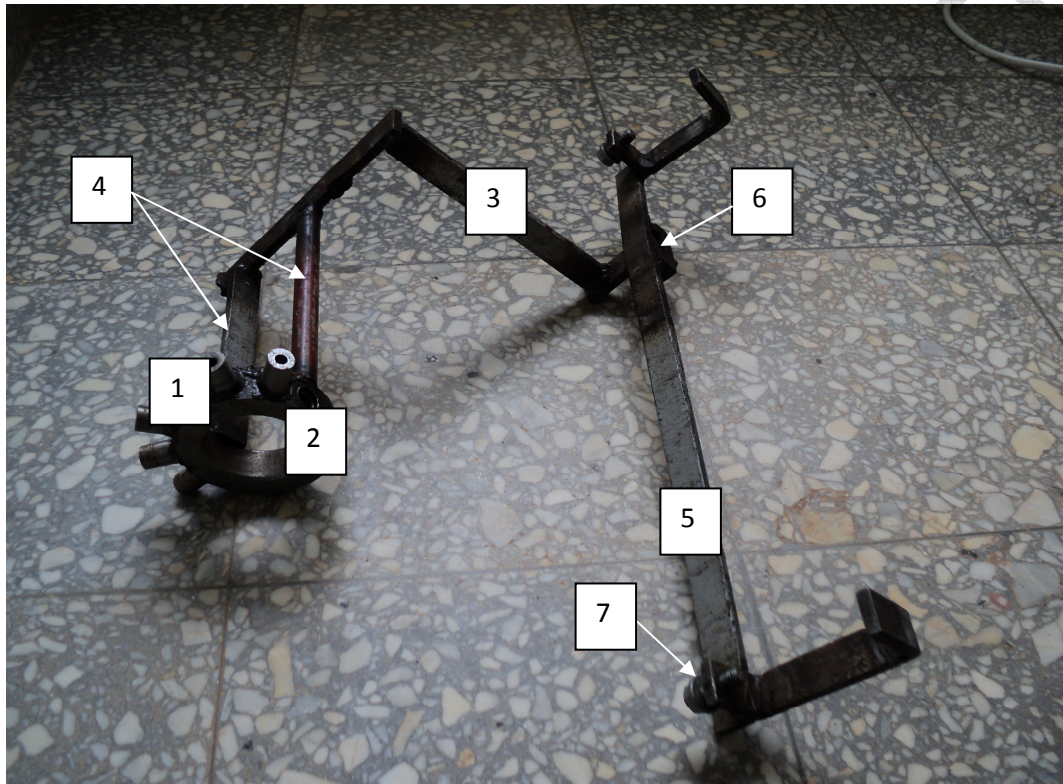


Figure 1 Cutting Fluid multiple feeding device for Turning Processes.

1 - Nozzles, 2 – Nozzle Holder, 3 – L – Shape Hanger, 4 – Bars (connecting the nozzle holder to the hanger), 5 – Base of the hanger, 6 – Flange (movable along the hanger base), 7 – Bolts, Nuts and Washers

MATERIAL AND METHOD

The material selected for the design and construction of the device was low carbon steel. The reason for this choice was that low carbon steel is readily available and comparably cheaper than other materials. Moreover, it will serve the purpose for which it is meant for. i.e. feeding the cutting area with CF. The material used for the nozzles was brass. The outlet and inlet diameters of the nozzles were 3mm and 6mm respectively. The bolts, washers and nuts were standard parts purchased. The nozzles were attached to another brass material of cylindrical shape using epoxy. The hanger was made from low carbon material

DEVICE CONSTRUCTION

The various parts (components) of the device were constructed individually by different operations and then assembled by means of welding. The main components are the nozzles, the nozzle holder (the cylindrical part to which the nozzles were attached to and through which the cutting fluids was passed to the cutting zone), the hanger and the device base.

- **The nozzle** was turned on lathe machine. One end was made conical while the other remained cylindrical. The hole was made in the nozzle by first drilling it on a drilling machine with a drill of 3mm diameter. The hole was made through the whole length of the nozzle (i.e. a through hole), and then a blind hole of 6mm was drilled. The nozzles were made of brass and were positioned at an angle 30° from each other. The nozzles are as presented in fig.2
- **The nozzle base (holder)** is the cylindrical component of the device which has 77mm outer diameter and 55mm internal diameter. Both the outside and inside diameters were turned on lathe machined with carbide cutting tool. Thereafter it was drilled to a diameter of 3mm hole. Fig. 2
- **The hanger and the Base** (fig.3) were made from low carbon material on which the nozzle base was welded to. The hanger and the base were screwed to the lathe machine with the help of bolts, nuts and washers.

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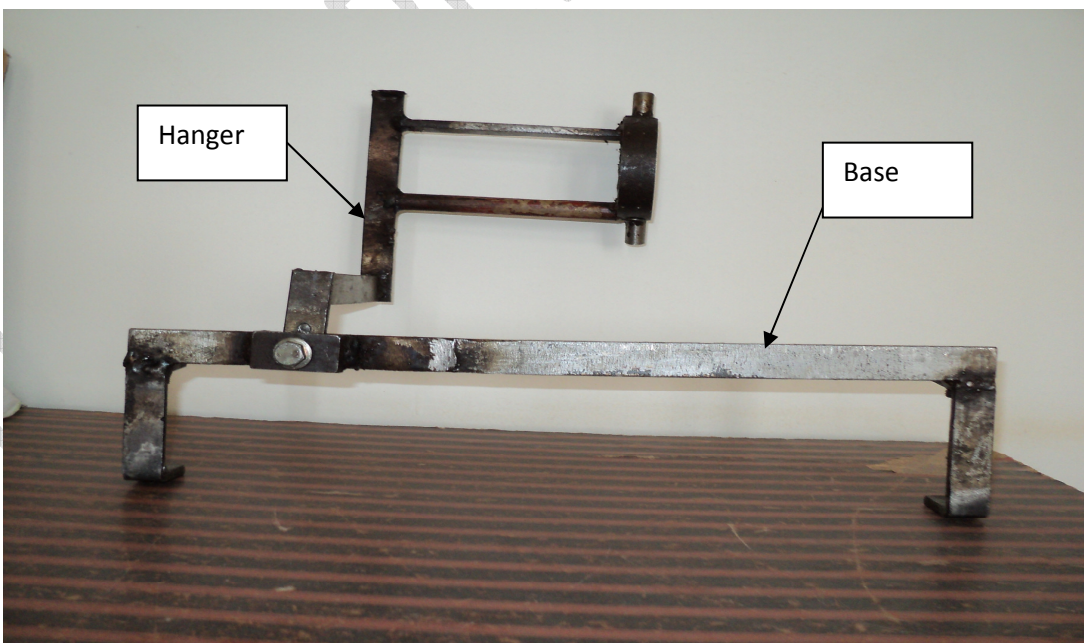


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Fig. 2 – Nozzles and Nozzle holder

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Fig. 3 The Hanger and its Base

DEVICE COMPONENTS' DESCRIPTION

As earlier said the main features of the multi CF feed mechanism are the nozzles, the Hanger and the Base.

The nozzles (1) are the openings through which the CF is fed to the cutting zone. The nozzles are positioned at specific angles to each other in the following order 30° , 60° , 90° , 120° , 150° and 180° respectively. The **nozzle** was turned on lathe machine. One end is made conical while the other remained cylindrical. The each hole was made in the nozzle by first drilling it on a drilling machine with a drill of 3mm diameter. The hole was made through the whole length of the nozzle, and then a blind hole of 6mm diameter was drilled

The hanger and base (3 & 5) were made of low carbon steel. The hanger was welded to the base which was fixed to the tool post with the aid of bolts and nuts. For easy adjustment of the nozzle hanger to facilitate cross (transverse) movement of the nozzle, a groove was bore on one side of the hanger base (5)

TESTING OF DEVICE

The efficiency of the device was tested on lathe machine. The experimental set up was as shown in fig. 4.

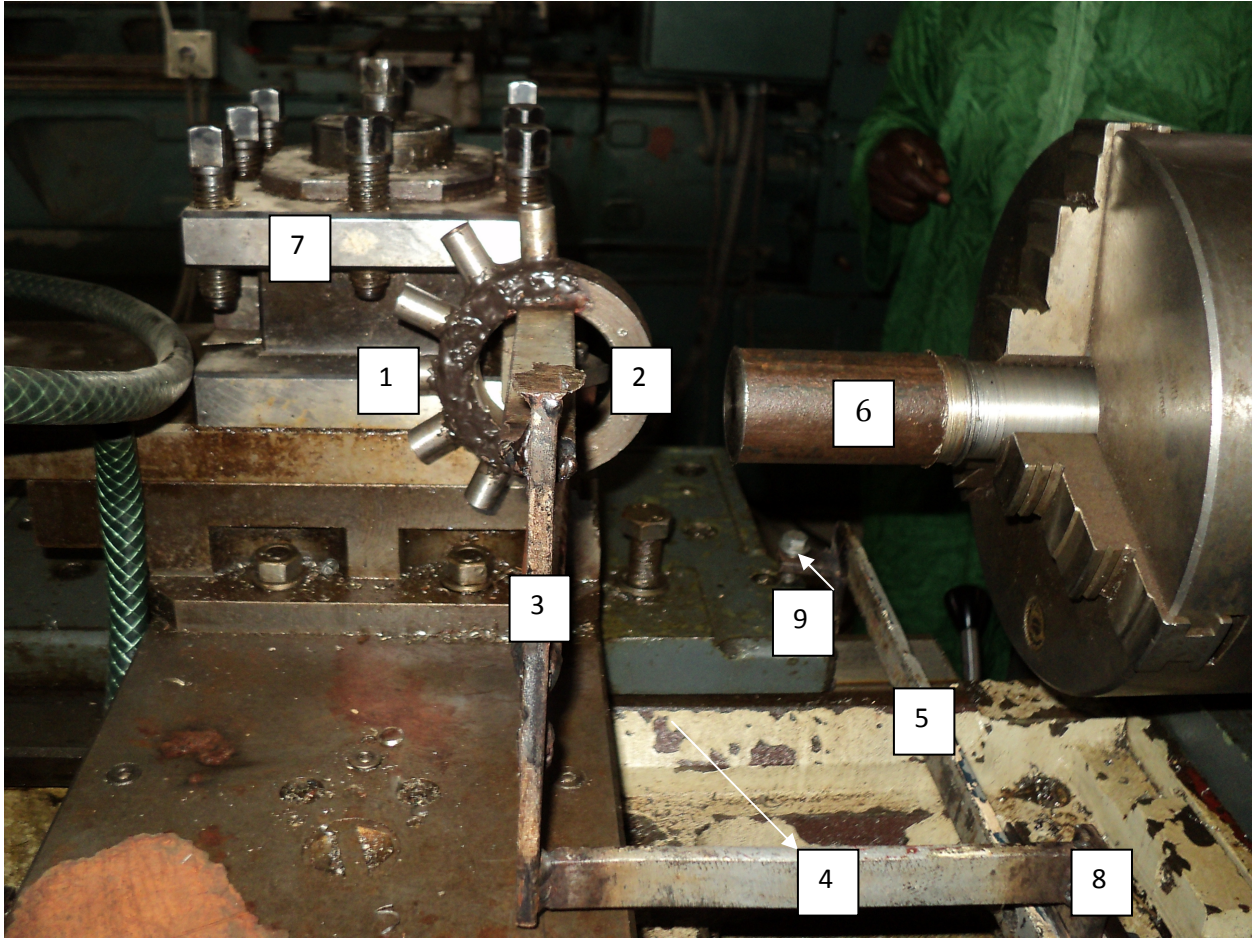


Fig. 4 Experimental Set Up

1 – Nozzles; 2 – Nozzle holder; 3,4 – L-Shape Hanger; 5 – Hanger Base; 6 – Work piece; 7 – Tool Post; 8 – Flange; 9 – Bolts and Nuts

The experiment was conducted under the following conditions: Cutting Speed (Spindle Speed) = 180 rpm, Depth of cut = 1.5mm, Feed rate = 0.75mm/rev, angle of CF feeding = 30°.

The results are presented in tables 1 and 2 below.

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Table 1 – Results of Normal (One-way) application of CF

Serial	Time, min	Temperature, °C	Surface Roughness (Ra), μm	Tool Wear (λ), mm
1	20	28.30	8.73	0.08
2	40	30.60	8.75	0.10
3	60	33.20	12.37	0.12
4	80	32.10	10.51	0.16
5	100	26.40	7.63	0.19
6	120	32.30	10.03	0.23
AVERAGE		30.48	9.67	0.14

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Table 2 – Results of Two-Way application of CF

Serial	Time, min	Temperature, °C	Surface Roughness (Ra), μm	Tool Wear (λ), mm
1	20	26.70	7.37	0.06
2	40	28.10	8.01	0.08
3	60	27.10	8.54	0.11
4	80	26.70	8.56	0.13
5	100	27.00	9.60	0.15
6	120	27.10	9.64	0.18
AVERAGE		27.11	8.62	0.12

RESULTS AND DISCUSSION

The result of the experiment indicated that the two-way application of CF is more effective in terms of the reduction in the tool wear, surface roughness and temperature as compared with the standard one-way application of CF.

The values of surface roughness (Ra) and the Tool wear (λ) were $8.62\mu\text{m}$ and 0.12mm respectively as against $9.67\mu\text{m}$ and 0.14mm for standard one-way application of CF. In other words the surface quality was increased by 11% and the tool life was prolonged approximately by 14.3% with the two-way application of CF.

The average temperature was reduced from 30.48°C to 27.11°C. i.e. the temperature was reduced by 11% using the two-application of CF device.

Throughout the experiment the two-way application of CF maintained its effectiveness over the one-way application of CF by all the parameters (Temperature, Tool Wear and Surface roughness). The only exception was at 100 minutes of turning where the one-way application of CF had a little advantage over the two-way application of CF in terms temperature and surface roughness.

CONCLUSION AND RECOMMENDATION

Conclusion

There is no doubt that the two-way application of cutting fluids device is more efficient than the standard one-way application of CF device. This is certified by obtained results. In other words the cooling as well as the lubricating effect of the two-way application of CF is higher than the one-way application.

Recommendation

Further research should be carried out on use of more than two nozzles simultaneously for application of CF to the cutting area.

Modification of the present multiple/ two-way CF feed Mechanism

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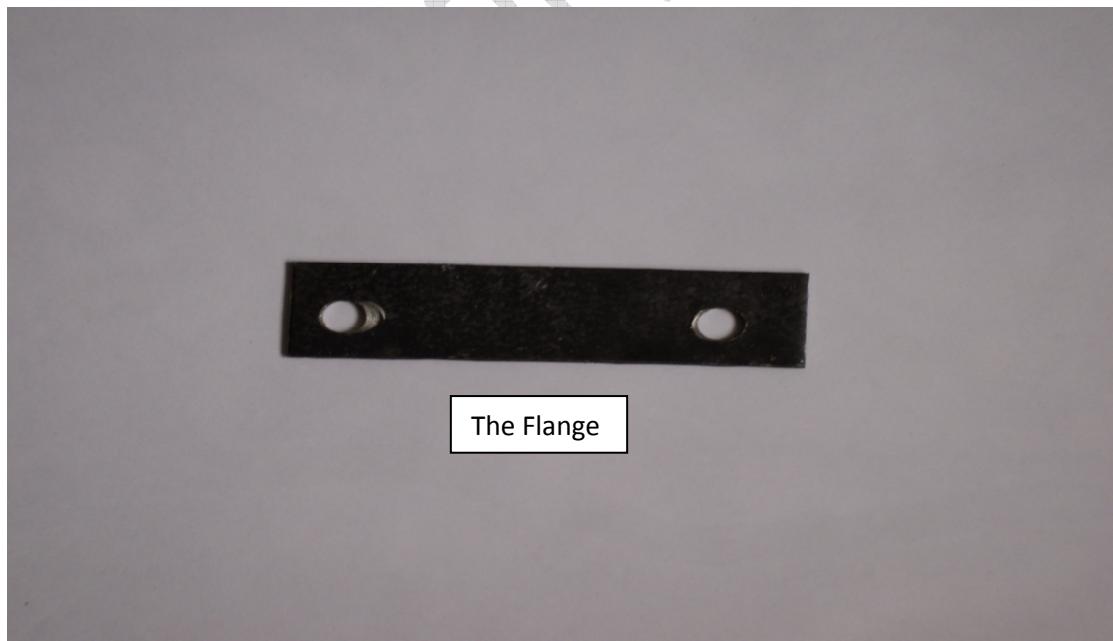


Fig. 5 The Flange