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RESEARCH WORK OF RESOURCE FOR USING STRAIN GAGE TO DO CUTTING FORCE MEASURING TOOL

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Relative Transitions, Transfer Coefficients, Microvolt, Amplifier, Sensor.

ABSTRACT

Some measuring tools such as pressure gauges, weight gauges, and the grave of pressure gauges were made by using a Strain gage. Based on the principle of these measuring tools Strain gage is required to carry out the force of the lathe machine. That experiment is determined the power of measuring equipment how to increase electromagnetic current, voltage difference, and the magnitude of the resistance, depending on the relative dimension of the compressive strength of the material, and the relative displacement of the material compares to the change in resistance.

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Introduction.

In order to reduce the processing time of the metal processing plant that is necessary to optimize the cutting procedure. In order to optimize the force of the dynamometer that was used to determine the degree of impedance, the depth, the input, and the velocity. The equipment is used to measure force of cutting. Such as:

Mechanical dynamometer

- Indicator /micro strains/, - Gear

Electrical dynamometer

- Potentiometer, - Capacitor, - Induction

Mechanic and electrical dynamometer

- Piezoelectric, - Strain gage

The strain gage is selected by that is abundance and combined high-accuracy electromechanical sensors. Piezoelectric materials are not abundant and more expensive are required high accuracy for calibration.

II. Strain gage, past materials, electric mechanics calculations

A. Strain Gage

The 350 Ohm resistance of the BF350-4AA was designed for the axial and compression load. Due to goal was measured of compression load depending by cutting force.

Fig. 1 Strain gage for BF350-4AA of 350 Ohm

Table 1

Indication	BF 350-4AA
Frame material	Phenol
Reticular material	Константан
Resistance	350 Ohm
Accuracy	≤ ±0.1%
Conversion rate	2.00~2.20
Accuracy of conversion rate	≤ ±0.1%
Overcome strength	2%
Time	$\geq 10^7$(±1000)
Temperature	-30~+80
Downgrade of temperature effecting rate	9, 11,16,23,27

B. Electric Mechanics calculations

The force-measuring sensor consists of two different materials. This included d14 x 40 mm cylindrical is pasted on 45-grade steel material that is connected to the BF350-4AA resistance of Watson bridge Scheme. Overcome strength measure pressure strength. The compressive strength of the compressor is dependent on the sensor is relatively short and following it changes to the value of the electric resistance. Therefore, the formula has explained the correlation between the relative transition of resistance and the relative length.

$$\Delta R/R = GF \cdot \Delta L/L \quad (1)$$

Where:

ΔR – Content of resistance transition Ohm.

R – Non-deformity resistance Ohm.

GF – Rate of transition (GF = 2.0 – 2.2 Table.1)

ΔL – Absolute transition (shortening) mm.

L – Non-deformity shape of length

Table 1 Strain gage overcome is dependent by tensile strength that limits 2%, the maximum value of the tensile force is N = 307.72. However, the calculation of compression maximum load of the 45-dermal steel length of 40 mm in diameter of 14 mm might be calculated by the proportional strength of the termination voltage [σ] = 240MPa. N ≤ [σ]·A = 240 MPa·153.86 мм2 = 36,9 кN N≤36,9кN Therefore, the maximum value of the measurement of the force sensors is 30 CU, depending on the strength of the conductor and the calculation of the electric resistance.

ΔR=GF*ΔL/L·R=(0.6824÷0.7506) Ohm. The calculation of the voltage that is required to increase the resistance is shown on below theory ΔU=5,0 B· ΔR/R=(9749.0÷10723.9) mkV

If the measured value of 0.01 cN that is taken to obtain an accurate value of the voltage change calculated from the force of 0 kN. Therefore, it is necessary to increase the voltage of the microvolt that is calculated.

III. To size strain gage and increasing scheme

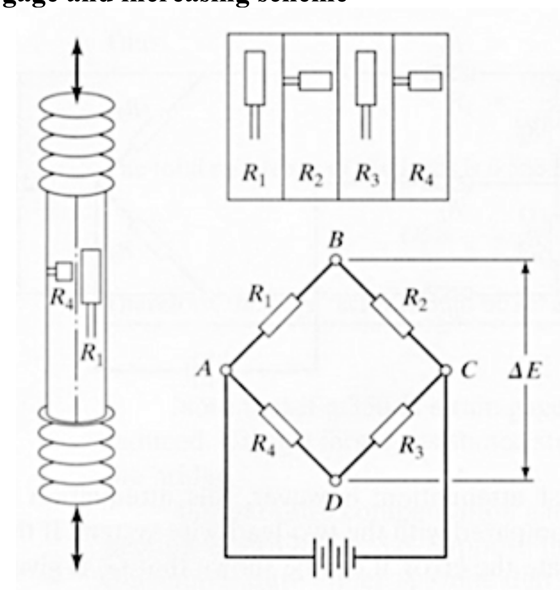

Fig. 2 The seat of strain gage /Watson bridge/

Fig. 3 Sensor of cutting force

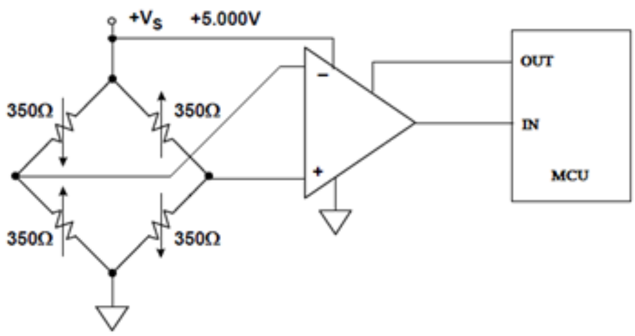

Fig. 4 Increasing scheme

Using all of the mentioned, the carriage has been used for the measurement of the measuring block and the cutting force.

IV. Test of force sensors

The sensor was tested by force of up to 30 kN at the "Steel sample Testing Laboratory" at "Darkhan Metallurgical Plant".

Fig. 5. The touchpad is pressed on the SJ-400 press

Fig. 6. Compressor chart

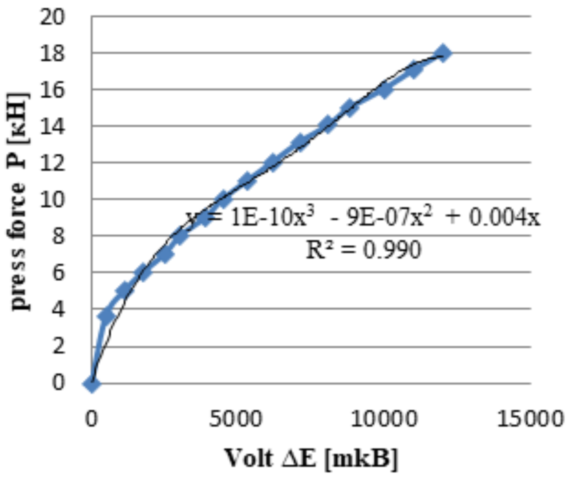

Fig. 7. Reference of press force and volt

The formula for calculating the force depends on the value of the microvolt is as follows.

$$P=10^{-10}\cdot\Delta E^3-9\cdot10^{-7}\cdot\Delta E^2+4\cdot10^{-3}\cdot\Delta E \quad (2)$$

V. Location and calculation of sensor and cutting tool

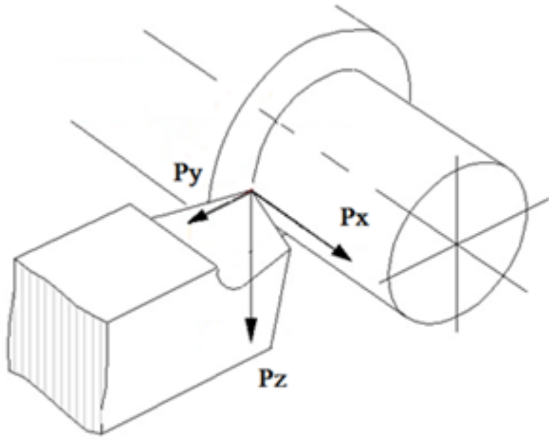

Fig. 8 The forces formed during the development of the lathe

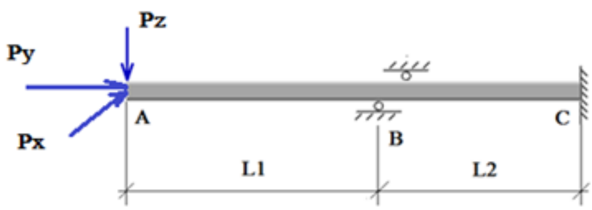

Fig. 9 The diagram of measuring tool for cutting force / P- cutting force, A- point of cutting force, B-sensor, C- pricking joint, L1 - Distance from the sensor to the cutting power/

In the future, we are aiming to measure the three forces simultaneously. However, first, it was only to measure the Pz power alone. Therefore, Figure 10 is shown that is the other side of Figure 9.

Pz to measure the power , so it is necessary to determine the reactions of YZ flat.

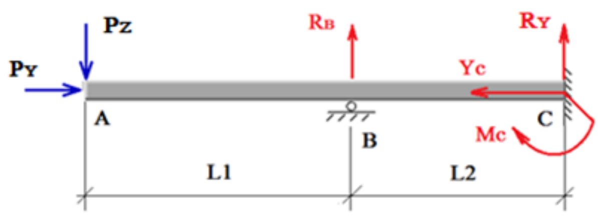

Fig. 10 Reaction force

The quantity of R_B is determined by the measurement value of the detector or strain gage formed on the B pillar. Therefore, the force P_z is determined by the 3-moment equation when R_B force is clear.

$$P_z= R_B/(1-L_1/2L_2) \quad (3)$$

VI. Measurement of cutting force

The measurement block is contained a microcrystalline amplifier and Arduino Mega. The value of the measurement is transmitted via a USB cable to the computer directly using formula 3.

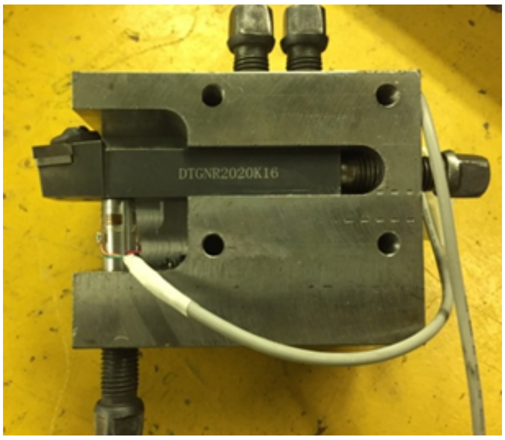

Fig. 11 Cutter setting the carriage

Fig. 12 Measuring block

VII. Result experiment of practice

Cutting conditions parameter; depth; t= 7mm, feed; s=0.35mm/rev, n=200 rev/min, material is steel, billet of diameter; d=30.25mm, cutter mark DTGNR2020K16

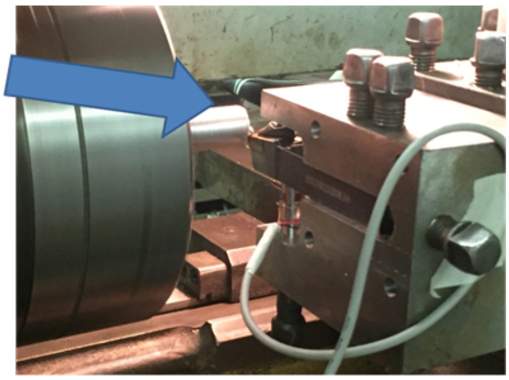

Fig. 13 Turning metal the lathe turn

Fig. 14 Measuring the cutting force

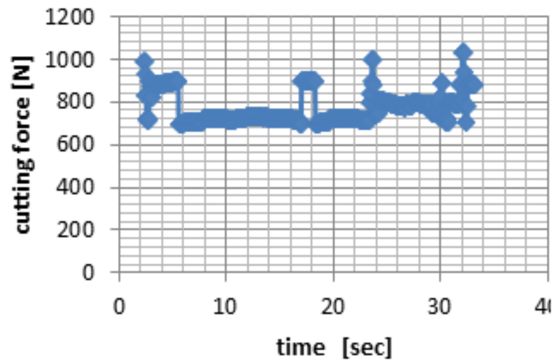

Fig. 15 Reference of cutting force and time

Conclusions.

1. It is possible to have the power measurement on the results of the survey.

2. Compare the results with theoretical calculations and catalogs and check the exact difference values.

3. It is necessary to define the accuracy and error rates.

4. The study is aimed at further measurement and the goal of measuring the two remaining axes.

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