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DESIGNING AND DEVELOPING A SUPERFINISHING DEVICE WITH VARIABLE AMPLITUDE AND FREQUENCY FOR 18CrMo4 PARTS

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Abstract: Studying the classical superfinishing operation can be seen that it allows modeling of pressing pressure without additional costs. If desired frequency or amplitude modeling of the tool, the additional costs that appear are quite high. For these reasons I designed a superfinishing device to which the frequency and amplitude of the tool can be varied. The device is manufactured using a oscilomotor, to which we can adjust the vibration frequency using a microcontroller and stepper motor, and the amplitude is adjusted manually. This superfinishing device eliminates a special machine used for finishing the inner surfaces.

1. PRESENTATION OF THE SUPERFINISHING DEVICE

This superfinishing device is designed at a superfinishing device level, used with a normal/parallel lathe, where the parts with the bore can vary in size, and we can even use the same tool.

Instead of the lathe tool (if we use as a tool a parallel lathe) the finishing device is fixed in the carriage, being adjustable because of this, and manoeuvrable depending on the carriage movements.

Figure 1. Oscilo-motor mounted on the lathe

1.1.SHORT PRESENTATION OF THE LINEAR OSCILO-MOTOR

The oscilo-motor Figure 1 snaps into the lathe tool place, in the carriage of the parallel lathe using the stand (15) which can be observed in Figure 2. Movement that occurs in the coil (2) by its excitation is transmitted through the springs (18) which are fixed in the holder (21) of the upper lever (1) operating the abrasive tool (25) and by this we can obtain the vibration movement necessary for superfinishing the surfaces.

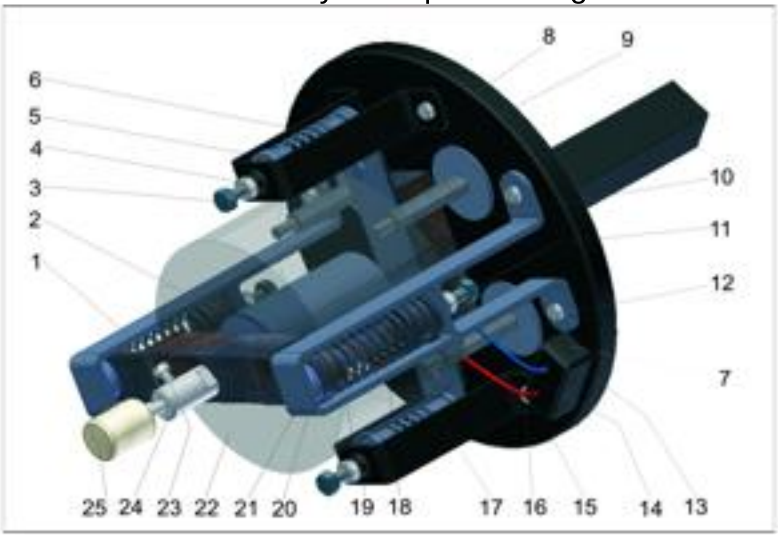

Figure 2. Linear oscilo-motor

1.2. PRESENTING THE FREQUENCY MODULATOR

The AC frequency variator makes the AC/AC conversion, which means that it modifies, with certain limits, the actual value of the fundamental charge, as a final result being able to control the dissipated power of the charge.

The AC frequency variator may be used in adjusting the light intensity of a bulb or the speed of an AC motor and beyond. In the above circuit is used to generate a pulsating electromagnetic field. There are traditional methods to modify the effective value of the AC voltage sine, like: periodic „cutting” of the sine, or controlling the number of periods per charge. The disadvantage of these AC/AC converters is the power factor (cos φ) obtained subunitary, even when using a purely resistive charge. They are also generically known as natural switching converters because the static contactor blocking is done at the natural zero crossing by the current.

Recently, are being studied topologies that allow cutting the sine with a very high frequency, of several kHz, the operation of this AC frequency variator being similar to the DC voltage variator. The advantage of this structure is a very significant improvement of the power factor, and fundamental, filtered appropriately, has the form of a pure sine. If, at classical models, the static contactor is a triac or thyristor, at the newest AC frequency variators this is being done with bipolar transistors (or MOS) and power diodes connected in a topology that allows current to pass in both directions. This static contactor is generically called Bidirectional switch (voltage and current). Converter control can be both analog and digital with a microcontroller. A very known AC frequency variator structure contains s diac and triac but, not infrequently, these components are not handy for the amateur electronist.

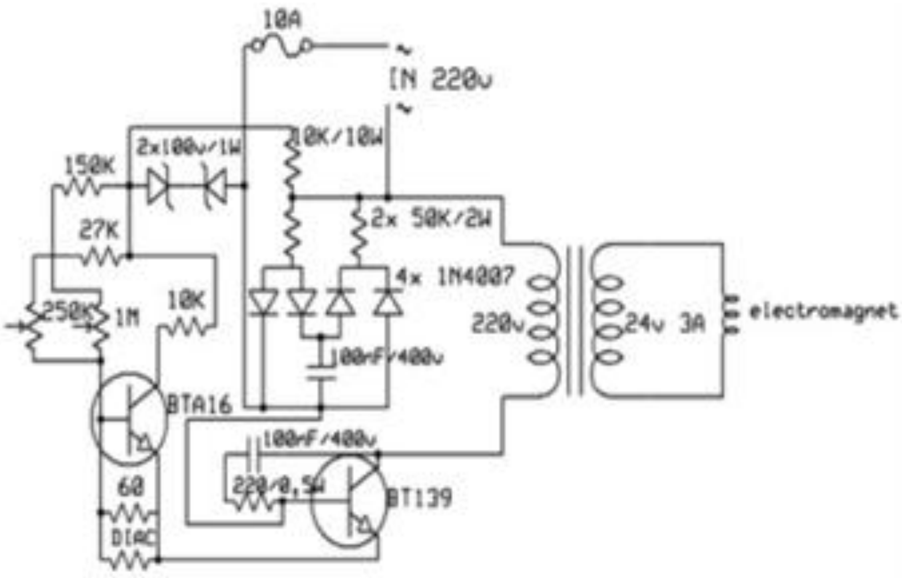

Figure 3. AC frequency variator

2. RESULTS

Applying this method to parts made of 18CrMo4, the following data, presented in Figure 5 has been obtained.

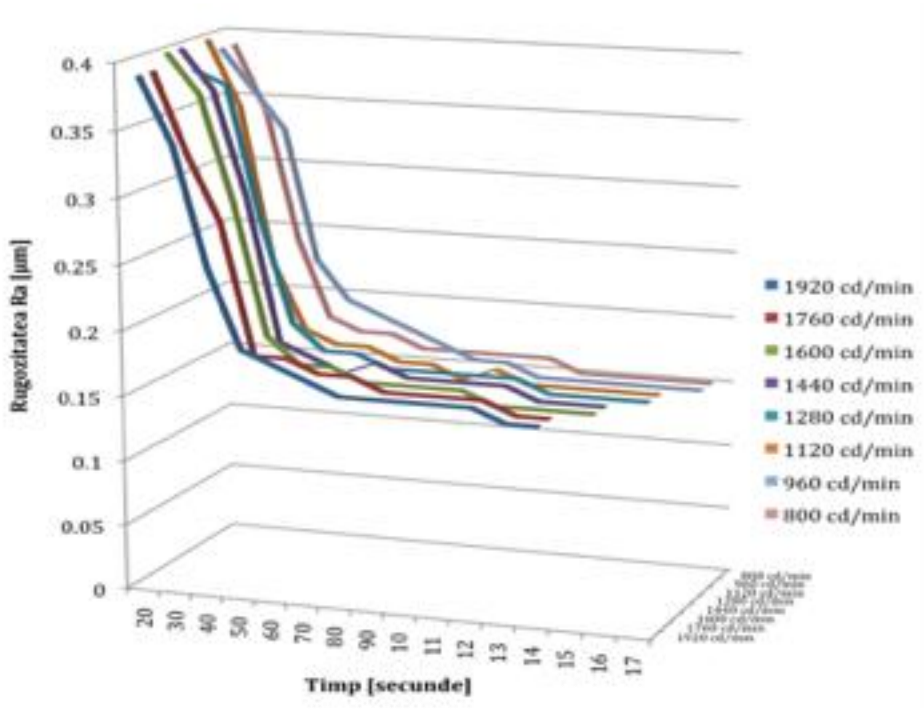

Figure 4. Time variation of the Ra roughness using different frequencies for superfinishing the 18CrMo4 steel

The method is recommended for obtaining roughness lower than Ra = 0,4 µm, large bearing surfaces, to remove the superficial damaged surface layer obtained from previous operations (fine lathing, grinding). This method allows obtaining very low roughness and improves the quality of surface finished before, with the following effects :

- improved wear resistance of the surface because the contact is on the base metal layer (or, at least, very close to it);

- striations are deleted, and therefore reduces the coefficient of friction between superfinished surfaces being in contact, relative motion;

- the abrasive bars used as tools, do not form new faces on the processed surfaces on the contrary, removes some of those left to rectify.

When choosing a right vibrofinishing process and the characteristics of the abrasive bars a long process of cutting away all the defect layer on the workpiece surface can be provided. Noting that the defect layer thickness should not exceed the maximum size variation, the addition of processing is recommended to be 0.01 to 0.025 mm in the first superfinishing stage and 0.003 to 0.008 mm in the last stage.

3. CONCLUSIONS

After the analysis made we can observe the following:

- the necessary equipment for superfinishing is not very complex, when some relatively simple devices are available, the processing is possible in any structure;

- we obtain very small roughness surfaces necessary for many parts of the car industry;

- applicability of this method provides the major advantage of the possibility of mounting the whole installation on universal machine tools, such as the parallel lathe (universal) in the first place, universal drill, horizontal boring and milling machine, etc.; the process facilitating adaptation to the conditions of the current manufacturing SME's, which contrubute effectively to the process of domestic automobile industry.

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