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DESIGN OF A RAPID CLUTCH USED FOR CYLINDRICAL PROBES FIXTURE IN FRONTAL COOLING EXPERIMENTS.

Pavel MUDURA, Tiberiu VESSELENYI
University of Oradea

Key words: quenching, clutch, frontal cooling, probe – thermocouple.

Abstract : In this paper a clutch device for a probe-thermocouple assembly is presented. The probe is previously heated in order to perform quenching tests by cooling it's front surface with a liquid stream. This device ensures the coaxiality of the probe with the liquid jet and compensates the thermal contractions during the cooling of the probe.

1. INTRODUCTION

At industrial cooling in order to harden a certain steel product, a major role is given to the quenching liquids. It follows that in order to optimize the cooling operation, as considering the results of hardening as well as considering the costs, the specific characteristics of the quenching liquid must be known. These characteristics must be found out during experimental tests. In the last decades, as a method, which is used in this experiments, the cooling curves (temperature – time, and cooling speed - time) method had been choose. This method requires registration of temperature variation of a point inside the probe, previously heated till the austenite temperature, during the cooling of the probe with a certain liquid. The cooling operation can be done by immersion of the probe or by cooling the front surface of the cylindrical probe. The last method eliminates the disadvantages of immersion, coexistence of different phases of probe cooling on the immersion direction. The registration of temperature during this rapid cooling is made by data acquisition using a computer system.

2. DEVICE DESIGN CONSIDERATIONS

The designed device has the role to allow previous heating of the probe in an electric oven of a cylindrical probe, and then the cooling of this probe in order to register the temperature variation during the cooling process in a point inside the probe at a certain distance from the front surface.

In order to place this method at the basis of quenching liquids characterization and evaluation tests, the method has to fulfill the following characteristics:

a) *Reproductability*, which means that during a certain amount of tests made in the same conditions, the same results will be obtained. This needs the use of stabile phenomena and if it is the case the use of standard liquids, which allows verification of probe quality and calibration.
b) *Representativity,* which means that the test results, has to put in evidence the analyzed phenomena as well as possible.
c) *Sensibility,* is the characteristic of the method to respond to the slightest change of any parameter which influences the measured quantity.

d) *Correlation,* which is the characteristic of the method to determine the specific parameters of the liquid which allows a better link with other characteristics of the method (liquid type, liquid temperature, and so on)

e) *Operativity,* suppose the shortest time between the liquid probe prelevation and obtaining test results.

f) *Standardization of test*, which consists the documentation of all the quantities and operations which ensures the reproductibility of the test, regardless of the operator or the place where the test is made. The standard test must be as simple as possible and the perturbations have to be controllable (for example instable calefaction must be eliminated).

As a result, of the above mentioned issues, for the design and development of the clutch the following will be considered:

a) cooling of probe will be axial;

b) the probe has a cylindrical shape and must have a large enough diameter in comparison with the thermocouple, to avoid heat exchange distortions. So dimensions of the probe has to be Φ25x25;

c) the clutch will allow a rapid change over of the probe in order to avoid due time between taking out of furnace and start of cooling process;

d) the clutch has to ensure the coaxiality of the probe with the liquid jet;

e) the clutch will allow the adjustment of distance between the probe frontal surface and the liquid jet outlet nozzle;

f) After the transfer of probe from the furnace to the clutch, this must allow the triggering of the liquid jet start in 7 seconds.

3. FIXTURE DEVICE FOR FRONTAL COOLING EXPERIMENTS PROBE.

3.1 Probe – thermocouple assembly.

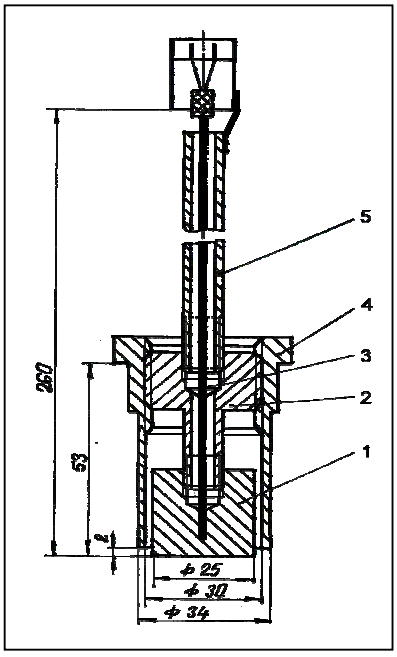

Fig.1 Probe - thermocouple assembly

This assembly has the goal to maintain the contact between the probe and the thermocouple during the heating and cooling of the probe and to ensure a uniform heating of the probe, to decrease the probe heat loss during the cooling through the contact surfaces, which are not washed by the quenching liquid.

The probe – thermocouple assembly is presented in figure 1 and is composed by: the cylindrical probe (1), link body (2), thermocouple (3), probe cover (4), support tube (5).

3.2 Fixture device of the probe – thermocouple assembly

This device will have to make a good fixture of the probe – thermocouple assembly, ensuring the probes position against the liquid jet so that the probe can be cooled on the frontal surface.

The fixture device of probe – thermocouple assembly is shown in figure 2 and is formed by the upper plate (1), the lower plate (3), positioned by the joints (2). The upper

plate sustains the swallow tail guides (4), on which the fixing jaws (5), operated by the button (8), using the levers (6). The lower plate is supported by the nozzle (9), which is fixed on the collector (10). the liquid jet can be stopped by the stopper (11)

The fixing jaws which are supporting the probe by means of the cover, has a symmetric movement and makes a good grip due to the spring (7). In this way the contractions of probe cover can be compensated during the cooling, the probe remaining in the same coaxial position against the liquid jet.

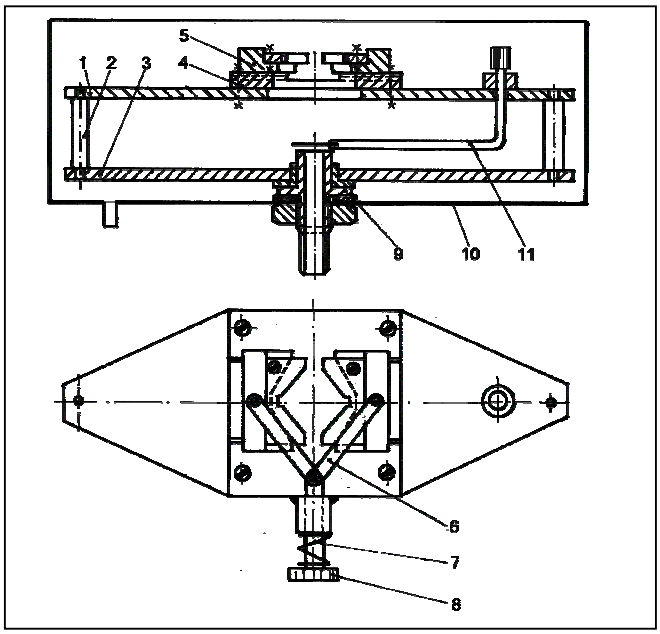

Fig. 2 Fixture device design.

The picture of the probe-thermocouple assembly is shown in figure 3.

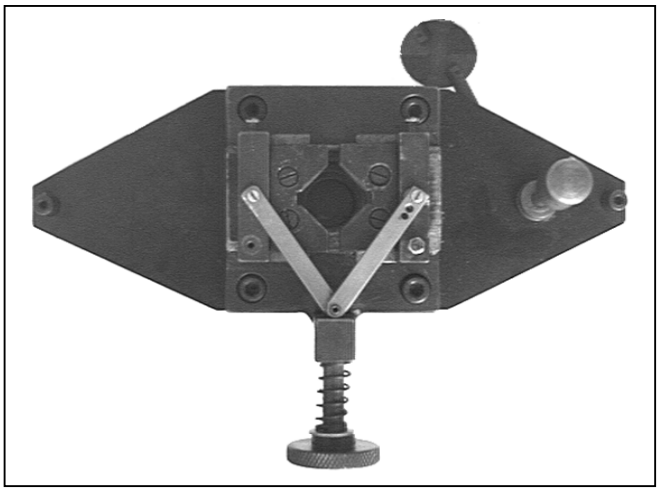

Fig. 3 Fixture device photografy.

4. CONCLUSIONS

The developed clutch, contribute to the realization of frontal cooling of a cylindrical probe and to the acquisition of temperature variation during the cooling process, using a thermocouple and computerized data acquisition. In this, it contributes to a good reproducibility of the realized experiments: ensures coaxiality between the probe and water jet compensating the contraction of the probe during the cooling process, allows the adjustment of distance between the liquid outlet nozzle and the probe's frontal surface, allows the shutdown of liquid jet before fixing the probe –thermocouple assembly; allows a rapid changeover of probe-thermocouple assembly reducing the jet triggering due time to minimum.

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