The exhast valve with ceramic deposition simulation reaction and that of entirelly made from ceramic

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Abstract:*Studyng the internal combustion engines tendencies and direction it is noticeable that the major effort must be directed towards finding new constructing and energetic solutions aimed to improve the thermic efficiencig and implicitly to diminish fuel consumption.Generally speaking there are two ways of approading for the ceramic materials usage in combusion chambers arhitecture.*

As it is known the components of the thermic engine which are in contact with the gases from the combustion chamber, ar exposed to cyclical variations of temperature.

Fig.1. *Valves whith ceramic covering*

From this reason the ceramic components wich are used to produce the valves baset on ceramic covering (fig.1) or for that wich are composed entirelly of ceramics ore exposed to thermic shocks.

For a checking-test regarding the components in a similar-test it is necessary that the minimal and the maximal valves of the experimental cycle temperature to be set in a way in wich it can stimulate as accurately as it’s necessary the real conditions from sparc ignition engine.

In the case of measuring the temperatures in different parts of the checked elements during the termic shock test, interesting results can be obtained regarding the thermic boundery limit monolithical ceramic components.

For checking the ceramic covering and that of the exhaust valve made by ceramics atest has been issued based on thermic shocks on these components.

The surface of the exhaust valves plate exposed to the tests has been heated with oxiacetilenic flame till it the combustion chamber's temperature after they had been exposed to a fast cooling process of the temperature through accelerated cooling process made by the use of a ventilator. Cooling and heating periods have been measured by the use of a cronometru.

In fig.2 it is presented the thermometers way of instalation on the exhaust surface with ceramic covering on its plate, in order to optain same infos regarding the reaction of ceramic covering as a thermic limit.

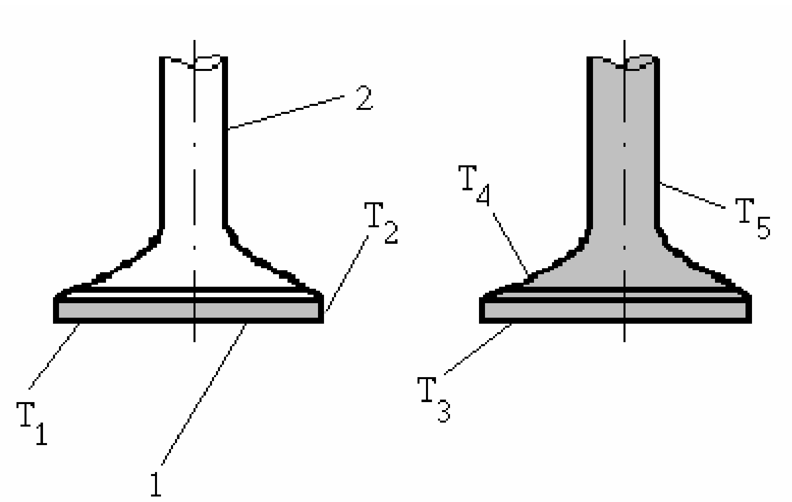

Fig.2. *The thermometers way of instalation in case of valves with ceramic covering and that of entirelly made of ceramics*

As we can see thermometer T_1 is installated directly on the ceramic covering straturm surface in order to optain infos about temperature variations during the experiments. Thermometer T_2 is introduced in a hole made into the metallic material of the valve surface close to the ceramic surface in order to optain corect infos about the ceramic insuranity's degree and about the valve's body temperature evolution – imediatelly limited to the insulator straturm.

For getting the same kind of infos regarding the entirelly ceramic made of exhaust valve, thermometers have been set as in fig.2.

This time it is obvios that thermometer have been placed on the material's surface taking into account the omogen piece and not the bimetallic one

There T_3 thermometer has been placed on the plate's surface which constitutes the combustion chamber's wall.Thermometer T_4 has been placed on the conic surface of the plate and thermometer T_5 in the contact area between the plate and the stick of the entirelly ceramic made of valve.

As we can see, it has been tried to egalise approximatirelly the distance between those three thermometer on a perpendicular direction on the plate's surface exposed at heating in order to point out the temperature variation whith in the caremic valve during thermic shocks tests.

For obtaining comparative infos about the two ways of exhaust valves construction- temperatures have been measured during the cyclic test observing the resistance of thermic shocks and graphically represented considering the time.

Table 1. Values of time,and temperature cooling and heating for the ceramic covering valve

Nr. crt.	**Time**, s	T_1 ,°C heating	T_2 ,°C heating	T_2 ,°C cooling	T_1 ,°C cooling
1	0	160	280	510	650
2	10	310	285	490	550
3	20	430	300	470	340
4	30	530	340	440	260
5	40	580	395	395	250
6	50	600	420	330	210
7	60	620	480	310	180
8	70	630	490	270	170
9	80	640	495	250	160

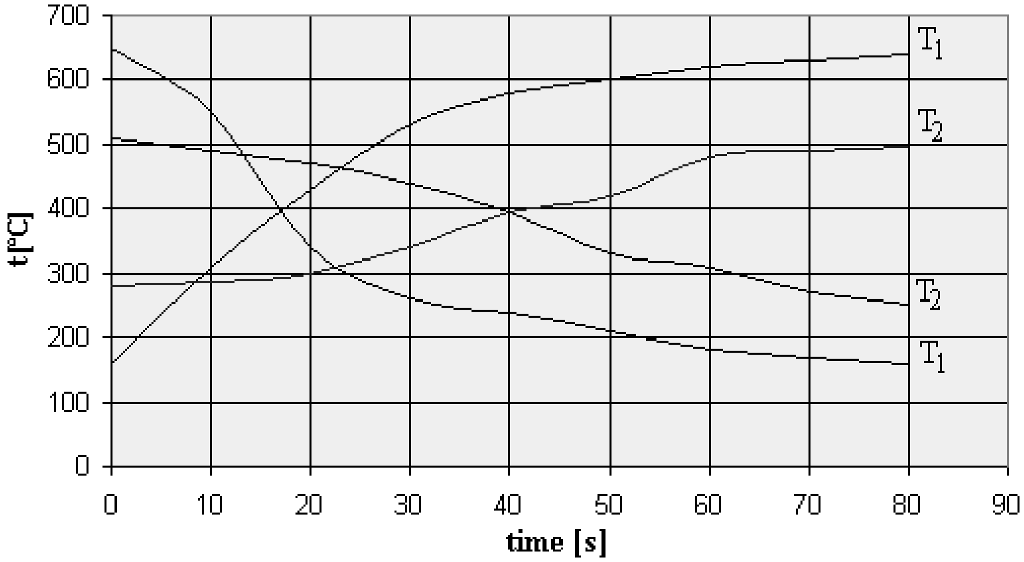

Fig.3. *Temperature variation considering the time for the ceramic covering valve*

Fig.3 represents the temperature variation curves during the thermic shocks tests, in the measuring already set points T_1 and T_2, for the exhaust valve whith ceramic covering on the plate.

Fig.4 represents the variation curves of the temperature during the thermic shocks tests, in the measuring points T_3, T_4 and T_5 for the entirelly made of ceramic exhaust valve.

Table 2. Values of time,and temperature cooling and heating for the enterilly made of ceramic exhaust valve

Nr. crt	Time,s	T_3,°C heating	T_3,°C cooling	T_4,°C heating	T_4,°C cooling	T_5,°C heating	T_5,°C cooling
1	0	115	720	200	345	50	305
2	10	310	550	203	310	100	190
3	20	490	390	205	300	120	50
4	30	560	280	230	270	170	35
5	40	650	250	250	235	200	30
6	50	680	230	280	210	220	25
7	60	690	200	300	200	250	23
8	70	700	170	310	180	280	20
9	80	720	100	312	175	305	18

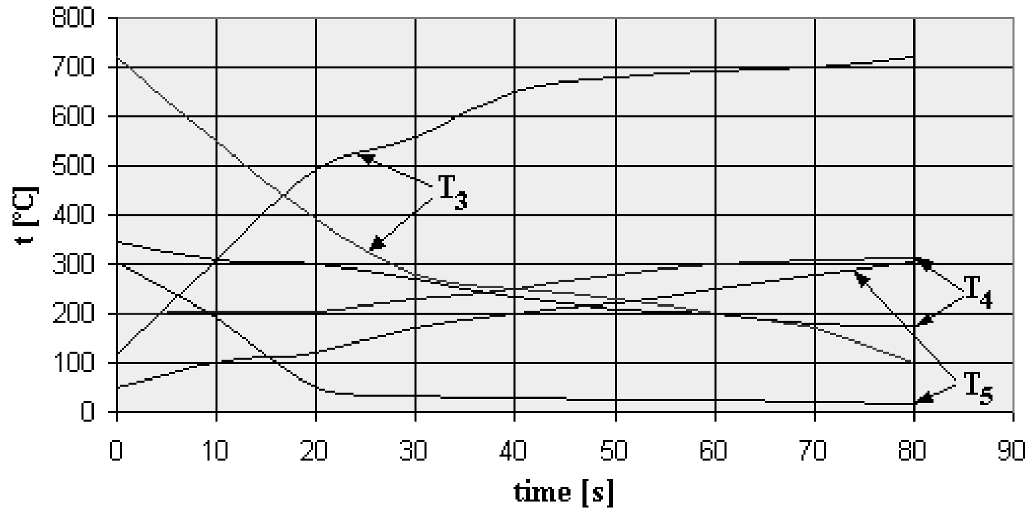

Fig. 4. *Temperature variation considering the time regarding the enterilly made of ceramic exhaust valve*

Conclusions regarding the exhaust valve reaction used as the thermic insulator of the combustion chamber

1.Thermic conductivities of the valves with insulator ceramic aplication are more diminished than the thermic conductivity of the metalic conventional valve,the difference between valves'conductivities with it's plate covered with ceramic and that valve made enterely by ceramic being very litlle.This feature will have a very diminished influence at the heat lost from the combustion chamber but it will protect the plate's surface of the convetional metalic valve against corosion or erosion processes at which it is exposed because of the combusted gases.

2.The specific heat of entirelly ceramic made valves is higher that of a metallic valve while the valve with the plate covered by ceramics is less than of a conventional valve,contraryto the impression according to which the ceramic straturm deposed on the plate should confere to the valve a higher specific heat.

3.Regarding the exhaust valve with it's plate covered with ceramic material, a very huge temperature variation is produced, a variation of the temperature of the insulator ceramic straturm (about 500^0C) in a very short time (60s) both at the heating and the cooling processes.This fact is good for the evolution of the combustion process from the engine, because the insulated surface of the valve's plate which constitutes the combustion chamber's wall will be heated very quickly during it's functioning time, this component of the exhaust valve will have a temperature variation which will follow the temperature variationof the gase with in the combustion chamber, facilitating the adequate function of the engine's processes.

4.Opposed to this evolution the metalic material's temperature variation close to that of a insulated ceramic straturm is more diminished (about 200^0C in 60 s) reaching a maximum of 150^0C more diminished than the maximum of the tmperature reached in the cermic straturm.This fact can be explained through the thermic limitation point oppsed to the heat propagation with in the valve because of the ceramic straturm which protects the valve against thermic entollments and it's blockage.

5.Regarding the exhaust valves made entirelly of ceramic, the maximum temperature reachedat the plate's surface which constitutes the combustion chamber's wall, is with almost 100^0C higher than that of the valve withit's plate covered by ceramic.This confirms the thermic insulator's proprety of the ceramics offering the valve the capacity to function in very good conditions in the withouf the danger of blockage.

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