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NEW TECHNOLOGIES FOR AUTOMOBILES HEAT EXCHANGERS

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Abstract: *This paper proposes a new idea of heat exchanger along with the corresponding manufacturing process, meant to mitigate the toxic potential of the consisting materials and also provide increased cooling properties, by comparison to the existing ones in the Romanian companies. The objectives of such a technology are a greater efficiency, lower consumptions of metal and energy, lower costs, higher quality and reliability.*
Key words: heat exchanger, cooling fins, tubes, expanding.

1. INTRODUCTION

One of the most important parts of an automobile is represented by the cooling system, as the efficiency of the cooling process will highly influence the working process of all the heating parts of the engine. The core of this system is represented by the heat exchanger, whose shape and materials will directly influence the efficiency of the cooling process.
There are two basic types of heat exchangers (radiators): down flow design and cross flow design. Both have top tubes where this super hot fluid enters the radiator and bottom tubes where the cooled fluid returns to the engine. Between the entering and the exiting, the coolant passes through smaller, thinner tubes, exposing it to cool air and lowering the temperature of the fluid. Outside of the core and on the other side of the hoses are two tanks, or reservoirs that hold either the hot or the cold antifreeze. The difference between the crossflow and the downflow is where these tanks are located. On the down flow heat exchanger design, the tanks are located at the top and bottom of the core. The super hot fluid enters through the top tank and trickles down through the tubes with the help of gravity and a water pump. On the cross flow heat exchanger design, the tanks are located on the sides of the radiator's core, allowing the pump to push the coolant across the core from right to left
A lot of expensive and sometimes toxic materials are usually part of a heat exchanger manufacturing process. Because the heat exchangers are vital parts for every vehicle equipped with an engine, we may assume that these parts are the result of a mass productio [3]. That is why the manufacturing procedures should be simple and suited for automation, also allowing interchangeable manufacture.
Any heat exchanger includes a variable number of tubes where the cooling fluid is circulating. They are usually manufactured of CuZn tape, tinned with a BPb29Sn alloy on both sides. The use of this alloy produces an impressive quantity of toxic lead fumes, affecting both the human staff health and the environment.

2. PROPOSED CONSTRUCTIVE VERSION

In order to meet the specified requirements our team proposed a new constructive version for a heat exchanger, to be used in automobiles, suitable also for mass production and respecting the characteristics we mentioned before.
The new constructive version is presented in Fig.1.
This proposed version, according to fig. 1 consists of two assembled basins (1), (2), the cooling body (3), radiator plug (4) and

two side holders (5). One of the novelties of this technology is the assembling between the cooling body and the basins, which is done by setting lap joints (see detail A).

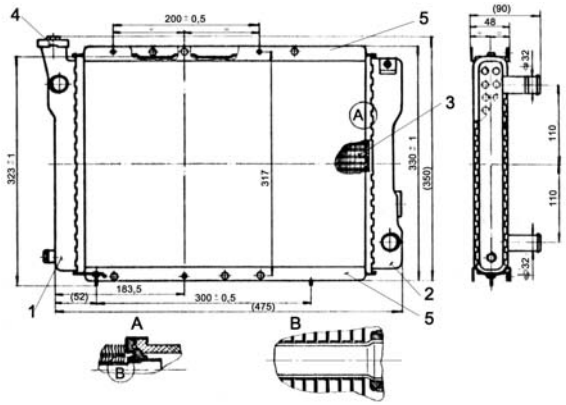

Fig.1 Proposed constructive version of the heat exchanger

Thus, a big quantity of soft solder containing lead (which is potentially very toxic, inflicting several professional diseases to the working staff) is eliminated and the heat exchanger loses considerable weight, while the procedure becomes less dangerous for people health and environment.

The cooling body consists of 32 cylindrical pipes made of aluminium alloy, displayed on two parallel rows and 412 cooling fins, also made of aluminium, assembled by expanding (see detail B).

The cylindrical tubes are manufactured by cold drawing and are cut to the required length. They can be made of aluminium alloy, but also of copper or even steel, according to the values required for the heat exchange. The pipes ends are bevelled using a special device in order to ease their entry through the cooling fins openings.

The cooling fins are manufactured on an automatic stamping machine specially designed to assure a rate of 60 products per minute and of course the suitable geometry for the optimum heat transfer [4]. The cooling fins geometry may be also subjected to transformations according to the beneficiary requirements, their geometry can be variable and the manufacturing equipments, easily adjusted, being suitable for automation and mass production. [1]

To be able to perform a comparison, we are compelled to say that the present technology uses tubes made of brass tape welded along the generator and covered on both parts with soft solder (tinned). Their weight is three times bigger than in the modernized version. The cooling fins are made of brass tape using a cam press, less efficient than the automatic stamping machine.

In the new version, in order to assemble the cooling body (pipes and cooling fins), they will be set inside a case and the tubes, whose diameter is smaller than the cooling fins openings are easily introduced through the orifices.

The cooling body should be strengthened not only for mechanical purpose but also to assure the suitable contact between the pipes and cooling fins, so that the heat transfer takes place according to the required parameters [6]. The strengthening is achieved by help of an expanding device (see fig.2).

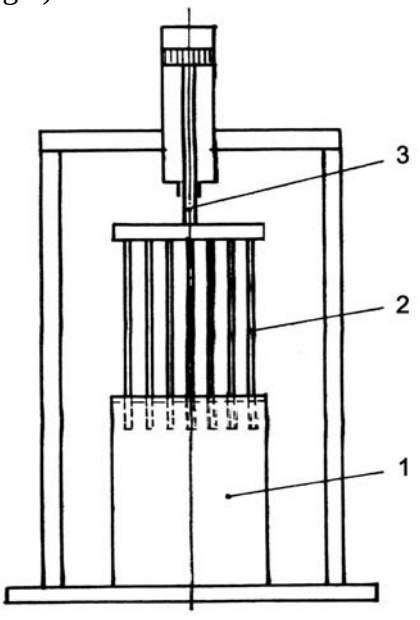

Fig.2 Expanding device for cooling tubes

The device uses some press rods with ball shaped ends, powered by a hydraulic motor. The rods are forced through the pipes (tubes) gradually enhancing their diameter and fixing them to the fins.

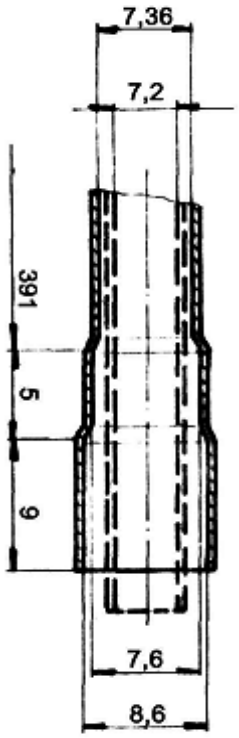

Fig.3 Tubes shapes during the gradually expanding process

Both ends of the pipes are expanded according to the shape presented in fig.3, in order to assure the assembly with base plates. The base plates are manufactured by cupping on an automatic press.

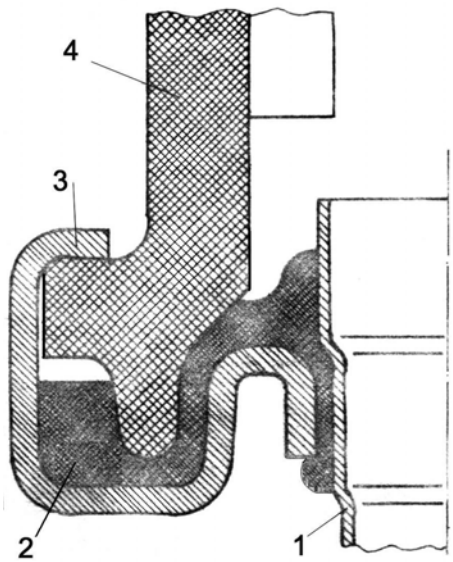

Fig.4 Cross section of the joint between the basin and the heat exchanger body

The basins can be made of plastic, coming with all the plugs and connections already made by casting. Thus, we eliminate a lot of soldering procedures necessary if the material used is brass and the connections are attached afterwards. The basins are then attached to the cooling body by setting lap joints. The cross section of the joint is presented in fig.4, where (1) is the expanded pipe, (2) the rubber profiled water proof sealing, (3) the base plate, (4) the basin. The assembly should be perfect now.

3. CONCLUSIONS

As stated before, the heat exchangers together with the cooling system are one of the most important components of the automobile, with the purpose of reducing the influence of the high temperatures developed in the combustion process. Considering the present state-of-art of the automobiles, running still on the basis of burning fuels [5], the production of heat exchangers should be implemented based on the idea of mass production.

For this reason, a solution that avoids the use of potential hazardous materials would have a beneficial influence upon the environmental protection and also on human health quality, objectives that are clearly stated by all the EU documents concerning research and technology.

By comparing the present technology with the modern one we can find the following advantages of the new solution:

- Reduced consumption of materials
- Less labour
- High manufacturing efficiency
- Three times lower weight
- Better heat transfer
- Less toxic working conditions

All these benefits lead us to the conclusion that the proposed technology might bring a new impulse to the manufacturers and researchers in the field to continuously pursue the idea of improvement for a new quality of life and technology.

4. REFERENCES

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