DEVELOPING AN APPARATUS FOR OIL CHANGE IN AUTOMOTIVE INTERNAL COMBUSTION ENGINE

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SUMMARY

In this work the analysis of some aspects, that must be observed in the oil pumps selection for the automotive internal combustion engines automatic lubrification oil and filter oil change, is performed. A laboratory scale-prototype was designed and built to do this study. The pressure and flow rate of used oil from the carter and the new oil from the reservoir were measured. Furthermore the electrical and electronic control for the reliability and safety oil of the system were also evaluated.

INTRODUCTION

Nowadays there are two ways to replace the lubricant oil of the internal combustion automotive engines, because changes the characteristics of the oil. The first way consist of the oil outflow due to the action of the gravity through the hole in the internal cover of the crankshaft's box. After that is necessary to fill this place with the correct volume of new oil, usually by means the admittance door on the top of the engine. The second more or les used way consist of pumping the oil, usually through the gateway of the oil rod. Both methods have their inconvenients, e.g., it is necessary to take the vehicle to a garage and very often wait for a functionary and a place available. Moreover the cost is high, because the oil price in the gas stations is much more expensive than in the supermarkets for example. Another problem is the working hours of this places, usually day time, what is a problem for the people who work during theday. The big disadvantage of the second method is the impossibility to remove all the residual oil with the pump, notedly the solid parts usually found on the bottom of the crankshaft's box.

Whith the intention to offer a solution to minimize the problems, a decice was developed and built to perform the whole process of oil exchange completelly automatic. With this devices the change can be done by anyone inside in the vehicle, only pressing a start key of the system, avoiding the service and but other kinds of inconvenients. This device is very useful for heavy vehicles where the driver usually does the oil exchange. However, in many cases, due the inconvenece of the traditional method, the drivers don't at the right time and in other cases, due the high cost of the product, they commercialize it. With the device in question, all these problems could be avoided only pressing a start key. The commercialization would also be avoided because the oil would be kept in a locked recipient.

After the oil exchange we still have the filter problem because it must be also exchanged, and to find a solution for this problem a device was developed to provide to the driver this exchange without another kind of help. Therefore this introduces the development of two devices to avoid the problems to exchange the lubricant oil and the lubricant oil filter of the internal combustion engines. In other words, it means, thenceforward, became possible the driver exchange the lubricant oil and replace the lubricant oil filter.

EQUIPMENT DESCRIPTION

The prototype developed consists of various components, which perform the oil charge and the automatic replacement of the filter and the lubricant oil respectively. The figure 1 shows the elements conjoint desing which makes part of the device The prototype is basically composed by one volumetric machine and 3 tanks to keep temporarly the lubricant oil. One of these recipients represent the crankshaft's box of the engine and is located attached with the others by the pump, valves and flexible pipes made by EPDM, covered by one steel protectress brindle (Cr-Ni). The oil input and the output to the tanks is controlled by means of valves solenoid type. They were built to work with direct current and 24 volts of tension and they permit the fluid crossing just in one direction. The valves are located usually closed and their openess are controlled by one "reles" plug.

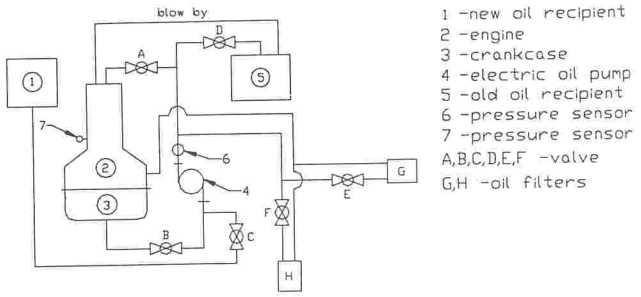

Figure 1 - Elements conjount

When the oil change is necessary, the gear pump is powered. The pump is conected with one direct current electric engine. The oil in the crankshaft's box is aspirated and pumped to one of the tanks which must be e-mpty. In the pump output can be found one fluid crossing indicator sensor. As soon as the pump is powered, the solenoids valves B and D located in the output of the crankshaft's box and in the gateway of the empty tank respectively must be kept closed.

Inside the tank of the new oil and used oil can be found two sensors to indicate the oil maximum and minimum level in each tank powered by one floating frame located inside a perforated pipe. After the crankshaft's box becames ampty the

valves B and D are closed and the valves A and C are opened, allowing the new oil flow in the cylinder head cover. The six valves A,B,C,D,E and F can be replaced by three solenoid valves with three ways. As can be seen on figure 1 the oil filters G and H are located attached to the crankshaft's box by pipes conected by two solenoid valves. At the necessary moment of the filter replacement, one of these two valves is properly powered by one "relais". Together one blow-by pipe can connect one of the tanks to the engine head . The figure 2 shows the full device

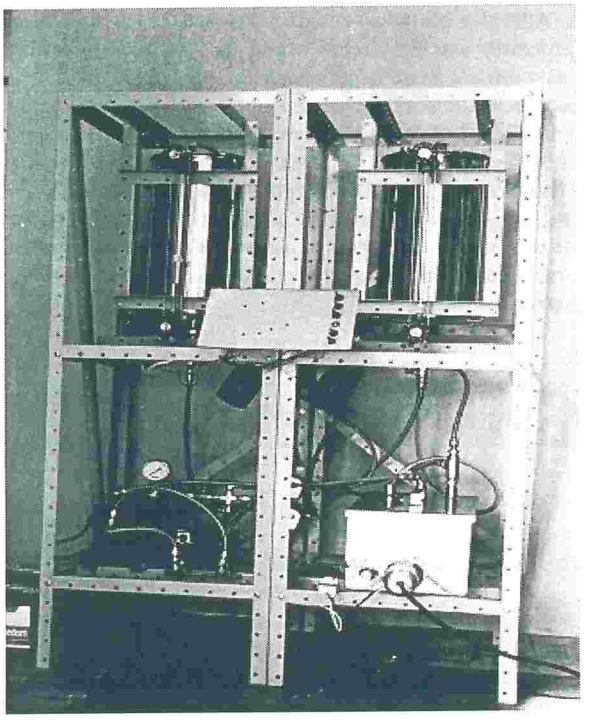

Figure 2 - Photo of the System

When the installation of the oil filter exchanger device become necessary, must be built and installed a set of flanges fastened in the usual filter place attached in the engine block. In this place must be connected the flexible pipes linking to another supporter, where will be installed the used and the new oil filters.

In order to permit the oil level visualization in the two tanks (new and used oil) is installed level finders built with "pirex" glass pipe. In the oil connection lines to the two filters also can be found crossing oil finders. The oil tank bottom position of the prototype (the crankshaft's box oil) can be found an electrical resistance, to heat the oil up to appropriate temperature level. The electrical resistance is controlled by one thermostat with temperature regulation gaps around 1 °C. In the three recipients can be found gloves, which are destined to the input and the output of the temperature sensors.

PUMP CHOICE

Now we are going through some criterious which were took in consideration to select the lubricant oil pump, by Pohlenz (1975) recommendations and Spengler (1976). Without any doubts, after the water pumps, the pumps has been using to oils and petrol derivatives are the best commercialized group, therefore the choice becomes very easy. Is necessary, at the same time, analyse the safety aspects and not only the technical aspects.

Respecting to the cost, we can select the positive displacement pump type in function of the viscosity and the velocity of the fluid mass flow necessary. For fluids with viscosity up to 700 CS is possible to use centrifuge pumps, which allow high volume of fluid pumped. In our case the best type of pump relate to the cost aspect is with rotor gear type, even if this kind of pump is not recommended to high flow of fluid and mass, anyway this is not our case, which will be at maximum 20 liters in a heavy vehicle. Based in this arguments we have chosen the pump showed on the figure 3.

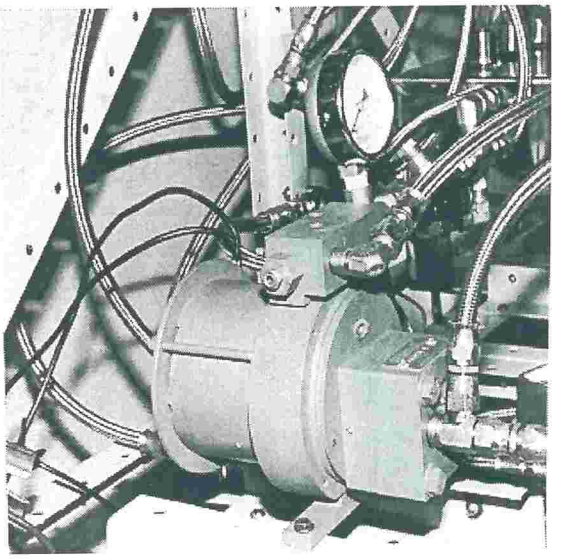

Figure 3 - Photo of the Pump

As we know the pump is a volumetric machine and then it must be equiped with a pressure relief valve. Together with this valve can be found a system to control the many levels between the atmospheric pressure up to 6Mpa. In the sally of the pump there is one manometer and a system to avoid the oil crossing, with these devices is possible to improve the time and mass flow conditions for a large range of pressures. In another words it means the possibility to forecast the charge loss through the oil pipes. The advantage to get more pressure in the pump output is because when one tank is completely empty, the engine current must change and this change can be the sign to the microcontroller show the need to turn off the pump and the solenoid valves. The pump model chosen is normally used in machines hydraulic systems and industrial equipments, therefore is a system with high level of reliability and resistance. In our case, can be used one pump built with lower cost materials, because the demand is not so marked.

ELECTRICAL AND ELECTRONIC CONTROL OF SYSTEM

These controls of the system were carefullydesigned and built to guarantee the safety of user. It is impossible to turn on the pump with the ignition system powered. The electrical and electronic control systems work according with the scheme showed on the figure 4. In this scheme the counter shows the mileage traveled by the vehicle, and in case of the prototype this count is made by one little electric engine attached with one pulse counter parallel installed with the speedometer in vehicles equiped with broadside computer. All the set is controlled by one microprocessor PIC16C71/JW. The equipment is powered and protected with "relais" NBAACS24.

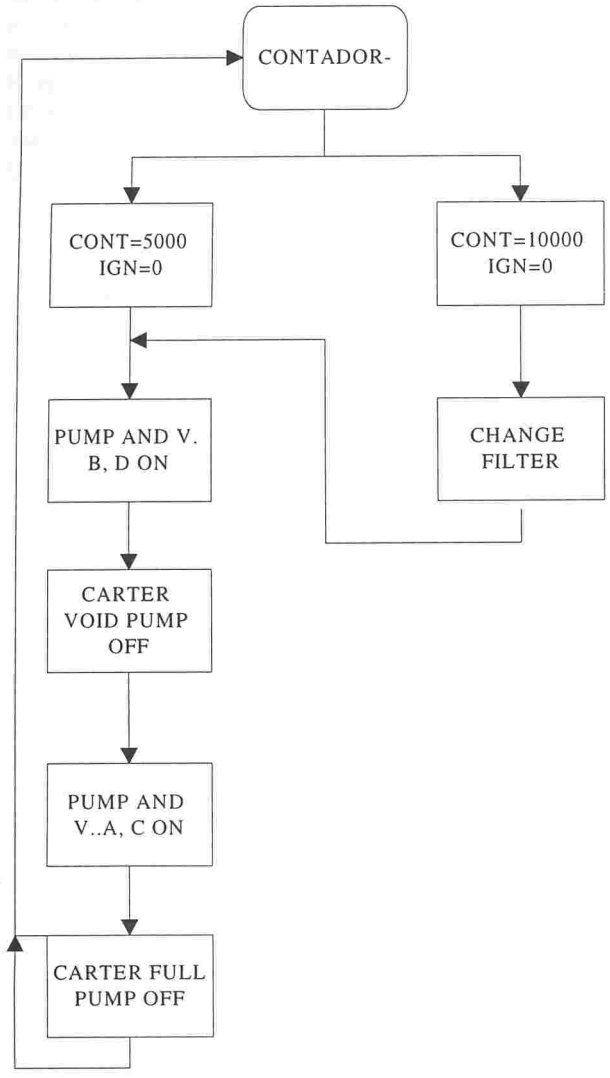

Figure 4 - Flow Chsrt

When 5.000 Km is reached, e.g., the lubricant oil of the engine must be changed, in this case, a light on the vehicle panel, will show this need to the driver. When the key is powered to start the oil exchange, the device will only start the operation if the ignition is turned off, it means IGN=0. Otherwise, IGN=1, means that the ignition is turned on, therefore the system will be automatically blocked. The indication that the oil tank is empty is given by one sensor located on the bottom of it, which is powered by one floating frame which displace through one perforated pipe immersed in the oil tank. As we know, that the crossing oil is made by solenoid valves, two of them will be powered as can be seen on the scheme.

After the oil drainage operation, another level control system similar in the new oil tank, must inform to the microprocessor if it is full. If the new oil tank is empty after the crankshaft's box have been emptied, the ignition is kept blocked until the emptyings of the new oil tank. During the charging operation of the crankshaft's box with the new oil, two another valves are opened showed on the figure scheme. In a similar way with the oil exchange the microprocessor works to replace the oil filter. For example, if the oil filter exchange is necessary when 10.000 Km is reached, a light is turned on on the panel showing to the driver this need. Conventionaly on the scheme figure is assumed IGN=0. In this case the system turn on one of the solenoid valves turning off at the same time another one where before was crossing lubricant oil. The dimensional process of electrical and electronic systems was based in William(1992).

RESULTS ANALYSIS

After the prototype build and instrumentation was made several tests in order to verify the initial conditions of the set to appreciate aspects related to gasket, electrical and electronic results. After that all the solenoids were checked, as well as the microprocessor and the "relais"; and the prototype started to work as a virtual system in a vehicle. Oil flow datas were obtained in function of the temperatures and pressures in the output of the oil tank. The figure 5 shows these dates for 3 pressure values, which are 101 Kpa, 601 Kpa and 801 Kpa with 10 °C temperature gaps. As the figure shows, the varietiun flow for the varous pressure are very slight and can be neglected because the pump used is compound with a pair of gear and its flow cararacteristics remaind relatively constant with the temperature.

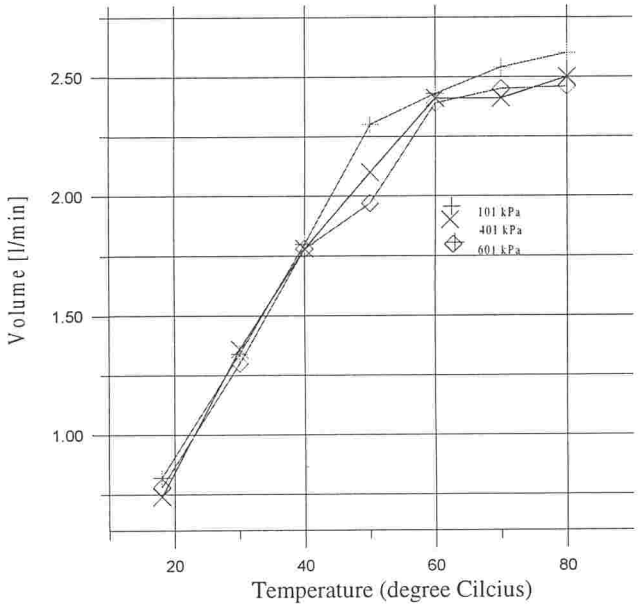

Figure 5 - Flow measurements

In the other hand the gear pump can work with very high pressures. This fact is important for the oil pumping control system, because with the finish of the oil pumping (emptyings of the crankshaft's box) we have the increase of electrical current value of the pump engine. This diference can be use as a control sign for the microprocessor.

For a convencional vehicle, where the oil capacity is around 4 liters, this dimension order is enough, because would be necessary only tfew minutes for the oil change of the crankshafts's box and two more for the complete replacement with new oil.

For heavy vehicles, the oil volume is superior and the replacement time is bigger as well, around 10 minutes. In this case we could think in another type of pump, centrifugal for example instead of gears pump.

The figure 6 shows the viscosity curve of the lubricant oil used in the oil exchange system. This curve was obtained in Engines Laboratory (DEMÊC) Universidade Federal do Rio Grande do Sul with one viscosimeter SSU.

William, B. R., *Understanding Automotive Electronis*, 4a. Edition, SAE, 1992

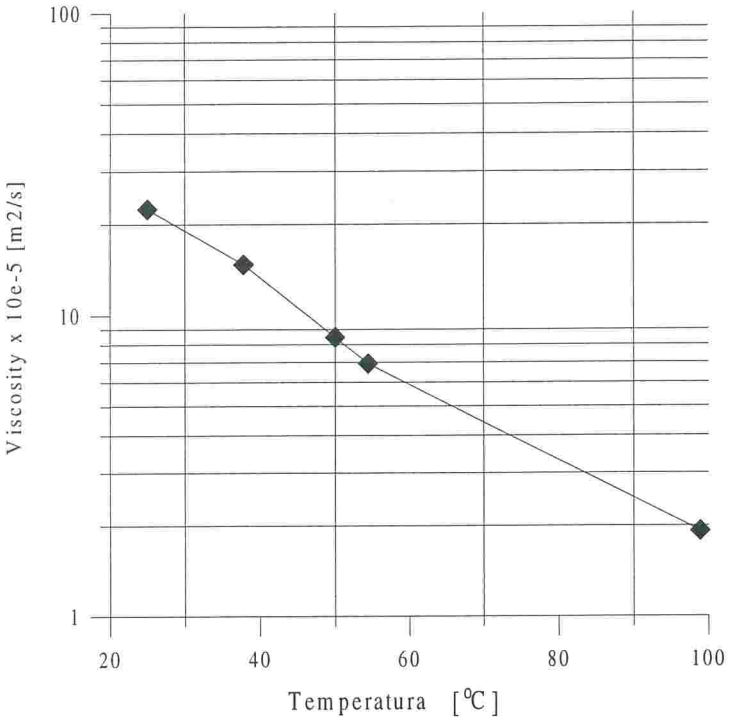

Figure 6 - Viscosity measurements

CONCLUSION

In this work was designed and built a lubricant oil changer system prototype for internal combustion engines. The results achieved are very meaningly because there are several datas for the projector to install in whatever kind of vehicle. The electrical and electronic systems were carefully developed in order to guarantee the well operation and safety.

About to the temperature conditions especial attention had been taken in order to bring the situation as real as possible, we had care also to find out the oil flow datas for temperatures similar like a normal conditions. As mentioned in the introduction this type of equipment has a very wide appliancation and is very useful as well, in heavy vehicles, which need to exchange the oil during the travels countryside and many times so far from the companies.

The final conclusion is that, although the equipment construction is relatively simple from the mechanical point of view, it can become more sophisticated in according with the control demand of the driver. It can obviously, in the other hand, represente for sure one cost condition higher.

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