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ELECTROMECHANICS SEPARATION OF THE IMPURITIES AND WATER DROPLET FROM OILS FOR ENGINES AND TRANSFORMERS

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Abstract: *This paper is referring to the field of dielectric liquid purification of mechanical impurities and water droplet by the method of electrical separation. It presents and examines modern method of purification of these liquids and argue using the method of electromechanics separation.*
Is presented a new technology of electromechanics separation, advantage which is increasing the degree of retention of disperse phase and increasing the purification velocity a dielectric liquid processed.

Keywords: *transformer oil, engine oil, electric filter, electromechanic separation, mechanical impurities*

1. Introduction

Because the alert rhythm of industrialization known by human society, lubrificants have emerged as a natural necessity, their necessity being required for the proper function of technical systems, now being used in most industries.

The European Community consumes about 4 million tons of annual oil industry. [1].

In conditions in which they are subjected, they lose their physical, mechanical and chemical properties in time, such as those related to lubrification itself, electrical insulation, cooling, etc., being contaminated with various polydisperse compounds typical to the plant were are used.

Economic aspects of oil production and aspects of environmental protection requires proper maintenance. Currently are used several methods of filtering the oil, methods being different for motor oils as from the transformer.

Power transformer is an important component of energy systems, the implications for disruption of having a strong impact on the distribution process of electricity to consumers.

In general transformer oils are regenerated from time to time, the most important characteristic sought in this process being dielectric rigidity.

Various technologies are known for regeneration of waste oils, some of which are large generators of acid tars, lye and bleaching land, products that raise issues related to environmental protection.

Next is given a brief characteristic of modern technology know for filtering oils for transformers and motors, following a presentation of the proposed cleaning technology.

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2. Modern Technologies of Filtering for Transformers Oils

The filtration of transformer oil, it is generally consist in: heating of oil, removing solid particles larger than 3 μm from oil, degasification in vacuum and drying in oil (Figure. 1). In the field of engine oil filtration most popular filters are mechanical filters, magnetic, centrifugal, sedimentation, etc.

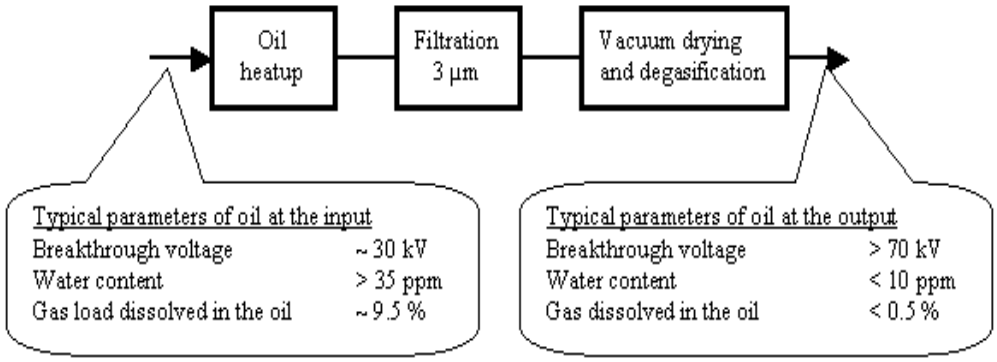

Fig 1. *The oil filtering process and the parameters of entry and exit of the oil* [2].

The role of oil filters for engine is to retain the unwanted impurities, increasing lenght of life of engine. First modern filter is considered to have ocurred in 1923, was invented by Ernest Sweetland, by then technology progressing incessantly. [3]

Have been studied and constructed such separators for separation of mechanical impurities and water drops in residual liquid fuels and from transformer oil by companies such as: Alfa Laval, Sweden, Westfalia, Germany, Titan, Denmark; Mitsubishi, Japan; Penvolt Charples, USA and England etc. These separators have a reduced productivity in the case of filters or are effective only on retaining large particles in the case of mechanical separators and settling filter.

Not incidentally in existing publication there is a tendency to conception new methods of cleaning liquid fuels and oils. Currently the most prospective method of cleaning such fluid is filtering in electric field, taking advantage of being economic power consumer, compact and certify a short cleaning time, so have high productivity.

Internationally are known more companies that sold equipament for electromechanics filtering of dielectric fluids such as: ASL Technologies, USA; Kleentek Industrial Co Ltd, Japan; Oilkleen International Inc. and Oilkleen LLC, USA etc.

Filtering method of dielectrics liquid used in these electrical filters is a combination of the classical mechanical method of filtration with filtration in electric fields. Electric filter have the advantage of removing particles of varying sizes in very large limits, can be separated particle by microns in size.

Electric filter operation is based on the Coulomb forces that occur between particles of different size or between particles and electrodes. In a scratchy electric field particles like dipole are attracted to the area of separation.

To be retained, the particles too small in size are attracted one other by the force of

electric field until is achieve the size for filtration or sedimentation.

In known electric filters, area for the retention of impurities made consists of a mechanical filtering placed between electrodes (Figure 2). [4]

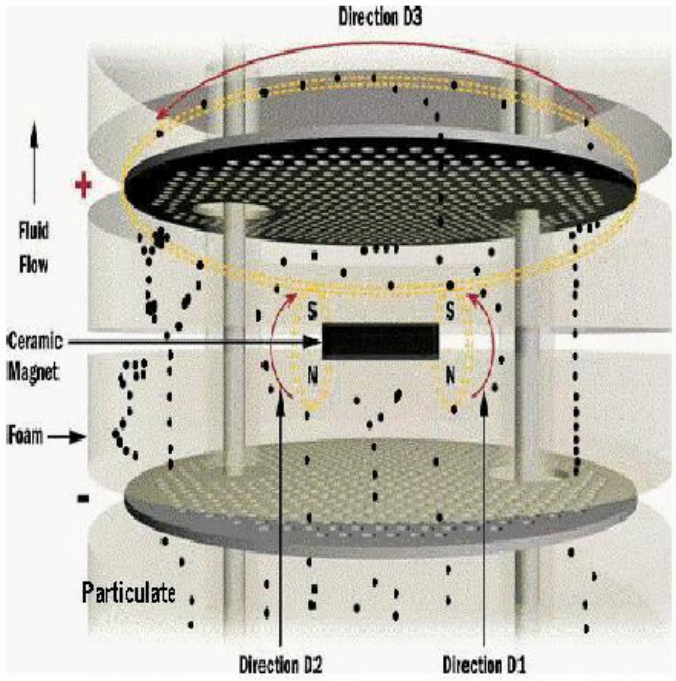

Fig. 2. *Electric filter for dielectric liquid [4]*

Besides the known advantages these present disadvantages of a restricted retention by mechanical filter between the electrodes. These filters do not retain water drops of filtered liquid.

3. Electric Filter for Dielectric Liquids

The proposed installation [5] is an electric filter for dielectric liquids with optimal configuration for the electrical separation process of the electrodes and high efficiency of retention of impurities.

In Figure 3 is given the longitudinal section of the electric filter; in Figure 4 - section A-A of Figure 3; in Figure 5 - high potential electrode loop from Figure 3.

The electric filter consists of a body (1) in the form of a vertical cylinder with dielectric caps (2) and (3) and the inlet fittings (4) of impure dielectric liquid (a) and evacuation (5) of the filtered dielectric liquid (b). Cylindrical wall of the body (1) is made of metal and is used as an electrode (7) connected to the ground. The electrode (8) with high potential (φ), executed in the form of cylindrical rods (9), with the dielectric coating (10) perforated with transversal slit (11) is positioned in the body (1) concentric with the electrode (7) connected to the ground and fixed to the lids (2) and (3). Connecting electrode (8) to the source of high tension is made with terminals (12).

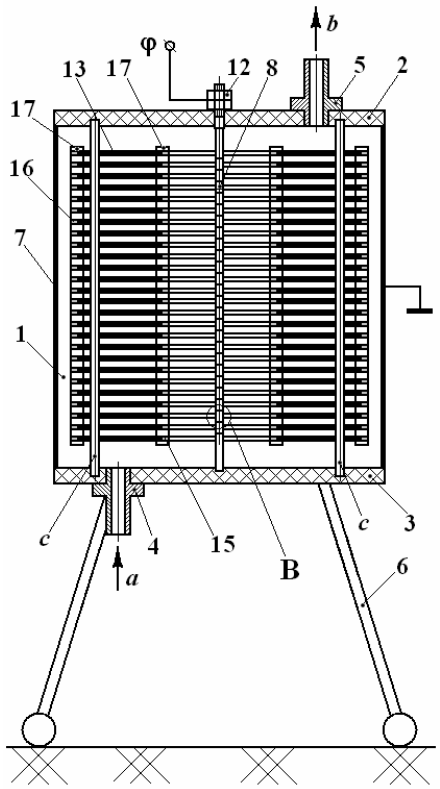

Fig. 3. *Electric filter for dielectric liquid*

Between electrodes (7) and (8), concentric with them, is positioned the intermediate group of electrode (13) with floating potential, in the form of discs with central circular windows (14).

Cylindrical inner surface and peripheral of intermediates electrodes (13) are insulated with cylindrical layers of dielectric (15) and (16), attached on the disks of the intermediate electrodes (13) with elements of spacers (17) thereof, which are used as insulators for isolation between them of intermediate electrode (13) . To not overlap the spacers on a disc with the spacers on the adjacent disc, when mounting them on, electrodes (13) neighbors are angular move with an angle of 45^0. Centering and fixing on the lids (2) and (3) of the intermediate electrodes (13) is make with the dielectric bars (c) which penetrate the group with electrodes (13).

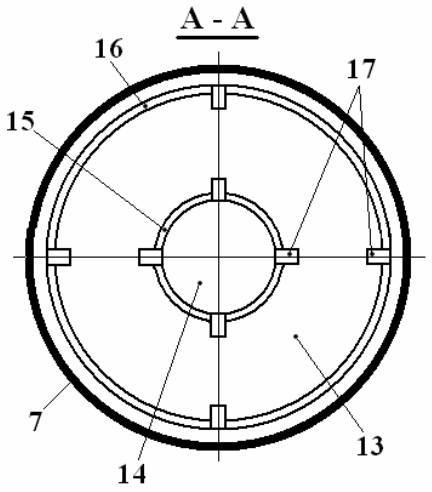

Fig.4. *Electric filter for dielectric liquid, section A-A from figure 3*

Transversal slit (11) of the dielectric coating (10) of the elctrode (8) with high potential are symmetrically positioned between the intermediate electrodes (13).

The electric filter presented above works as follows: on the inlet (4) impure dielectric fluid (a) is placed inside the body (1) of electric filter.

After the body (1) is filled with impure dielectric liquid on electrode (8) through the terminal (12) is applied a high potential **(φ)** with the value that ensure effective electrification of dielectric liquid and to the particle and impurities in the vicinity of electrode (8).

Under the Coulomb force of the electric field between electrodes (7) and (8) in the liquid occur electroconective crowns flow radial and circular (Benard cells), in the direction from transversal split (11) of the electrode (8) to electrode (7) connected to the ground between intermediates electrodes (13) and back. In this field each of the intermediate electrodes (13) obtained a floating potential due to their isolation from the electrodes (7) and (8).

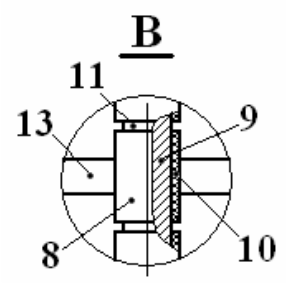

Fig. 5 .*The electrode with hight potential, magnifier B from Figure 3*

On motion of electrified liquid to the electrode (7) the particle of electrified impurities are atracted to electrodes (13) and deposit on them. Due floating potential the swirl of liquid to the intermediates electrodes (13) is high, which favors sedimentation on the electrodes of impurities particles. In the opposite way will be returned to the central chanel formed by the windows (14) dielectric liquid filtered, which is discharged from the body of electric filter through the inlet (5).

The system of electric electrodes of proposed filter creates optimal conditions for electric filtration of liquid, increasing the efficiency of retention of the impurities to values over 95%. By isolating the sharp edges of intermediate electrodes (13) with layers of dielectric (15) and (16) is excluded the formation of ionized jets with opposite polarity, wich would return a part of captured impurities and reduce the efficiency of retention.

The construction of electric filter allows simple dismantling and assembling of elements for the procedure of electrodes washing.

The electric filter for dielectric liquid, according proposed technology, presents advantages of increase with 50-60% efficiency of retention of mechanical impurities and water drops in comparison with other known electric filter.

This technical result was achieved because :

- execution of the electric filter body in the form of a vertical cylinder with the cylindrical wall made of metal, wich is used as an electrode connected to the ground, positioning of electrode with hight potential in the body concentric with the electrode connected to the earth, execution of the intermediate electrode with floating potential in the form of discs with central circular windows and positioning of them concentric with electrode connected to the ground and high potential electrode, are constructive improvements, wich facilite sedimentation of impurities on short trajectory, cleaning action being uniform divided on all layer of fluid in the body, improvments that transform the electrodes system from electric filter known in a system of electrodes adapted optimally to the process of cleaning, contributing essential to increasing the efficiency of retention;
- isolation of cylindrical surfaces internal and peripheral of intermediate electrodes with cylindrical layer of dielectric, fixed on the disk of intermediates electrodes with elements for spacers of this which are used as insulators for isolation between its of intermediaries electrodes, excludes formation of electrohydronynamic jets from sharp edges of the intermediate electrodes oriented opposite to the trajectories of sedimentary of particles and thus improves the efficiency of retention of the impurities;
- symmetrical positioning of transversal slit of dielectric coating of the electrode with high potential between the intermediate electrodes ensures ionization of particles on direct entry into each space between the intermediate electrodes and increase efficiency of their capture.

4. Conclusion

The methods for the electromechanics separation of impurities and drops of water from oils for motors and transformers are presented, these taking advantage of separation of particle with submicronics size.

Working of known electric filter is conditional by the presence of mechanical filtering elements which retain unwanted dispersed phase under the influence of the electric field.

It is proposed an electric filter for dielectric liquid with optimal configuration of electrodes for the electro-separation process. The electric filter for dielectric liquid under proposed technology, presents advantages of increase with 50-60% efficiency of retention of mechanical impurities and water drops in comparison with other known electric filter. The electric filter proposed presents the advantages of simple construction, reliable operation, rapid and economic recoditioning.

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