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Check Interior Surfaces of the Oil Conservatories of the Power Transformers

Paper presents two experiments designed to verify traversing the inner surfaces of the oil conservatories of the power transformers. Corrosion of internal surfaces of the oil conservatories is a negative aspect, which may affect safe operation of power transformers. Rust particles thus formed, migrate vat transformer insulating oil quality worsening. To prevent such situations should be regular monitoring of the interior surfaces of the oil conservatories.

Keywords: *oil conservatories, rust, insulating oil, the safe operation*

1. Introduction

A common situation in practice transformer repair shops is a discovery rust appearing on the inner surfaces of the expansion tank (oil conservatoires) of the power transformers. Most times, the rubber hammer touch with these exfoliating easily, and their presence is confirmed by specific noise inner containers containing particles. In order to remedy this situation requires cutting oil conservatories in repair of power transformers to create a gateway to the interior surfaces damaged. There are also cases where corrosion has not made their presence felt, but this must be confirmed to avoid unduly cutting the oil conservatories, only a simple verification. Hence the need for verification interior surfaces by nondestructive methods [1].

2. Analysis of related fields

To do some practical tests to check the interior surfaces of metal tanks have chosen imaging methods, like those in medicine. Currently in medicine have made great progress in terms of internal diseases diagnosis by imaging methods. Simple x-rays or newer ultrasound provided little information on some internal problems of the body. Therefore medical technology has evolved to research internal organs

with probes fitted with the acquisition of images and sometimes performing small surgical operations.

Endoscopy is an examination method live a hollow or tubular organ with endoscope, which is a research device cavity internal organs. A lot of areas explored have been shaped following medical specialties: bronchoscopies, colonoscopy, duodenoscopy, gastroscopy, rinolaringoscopy, and sigmoidoscopy. The main components of an endoscope are: eye (ocular) like in Figure 1a,b, videoprocessor, xenon light source and halogen, video printer, other accessories [2].

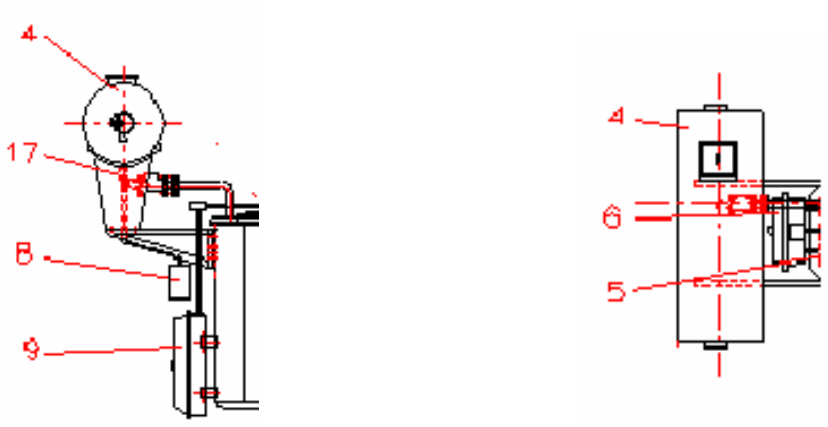
Laparoscopy is a method of investigating the abdominal cavity and abdominal organs with optical instrument called a laparoscope or peritonescop. These devices made: enlarged image by using a large display screen, which enhances the visibility, image stabilization using electromechanical devices for vibration damping due to machine or human hand tremor and function simulator using instruments with virtual reality training to improve skills of doctors in surgery and reduce the number of incisions. Robotic surgery was developed as a solution to underdeveloped nations, where a single central hospital can work remotely served by several machines in different places. The potential of robotic surgery has a strong military interest and intention to provide mobile medical care, while retaining physicians trained in safety, away from the theaters of battle [3]. Method and laparoscopic instruments in Figure 1c was patented by J. D. Altamiano, together with a group of authors: H. J. N. Lazante Maachah, M. Alercia, J. W. Petrone, R. Figuerca Maachah and M. E. Marquez Maachah [4]. We see with red color a multi-device, which introduces camera (eyes), vacuum and instrumentation for operation. Both methods are used in veterinary medicine [5].

a) b) c)

Figure 1 a) ocular for Olympus endoscope **b)** ocular for EYSTRY 06 endoscope, **c)** laparoscopic kit

3. Check Interior Surfaces of the Oil Conservatories of the Power Transformers

As regards developments in service to interior surfaces of oil conservatories of power transformers, from the outset we state that these areas bear a strong corrosion process due to the volume of air contained in used as damper in oil conservatories to allow oscillations at free surface of insulating oil. Condensation occurs inside the oil conservatoires due to temperature variations from day to night and from season to season. Atmospheric moisture penetration is stopped by mounting filter with silica gel, Figure 2a. Silica gel is a hygroscopic substance and therefore is used to stop the penetration of moisture from the atmosphere within the oil conservatoires of the power transformer.



a) b)

Figure 2. Oil conservatories to 12-63 MVA transformers: **a)** side view **b)** top view

Notations in Figure 2 have the following meanings: 4 – oil conservatories; 5-switch adjustment under load; 6 - mechanism to switch adjustment under load; 8 - air filter with silica gel desiccant; 9 – radiator; 17 - Buchholz relay. Under these conditions, atmospheric oxygen remaining inside the oil conservatories causes, over time, oxidation of insulating oil, but rusting metal surfaces inside the oil conservatories. Over time, rust particles entering from the oil conservatories to vat transformer worsening insulating qualities of power transformer. To prevent such situations should be regular monitoring of the interior surfaces of the oil conservatories. This control is required to be executed and if the reviews by repair shops transformers, to prevent removal of a side wall of the oil conservatories. Because of these phenomena is necessary to use means for verifying nedisruptive periodic internal surfaces of oil conservatories.

The first device to check the inner surface is made on the principle periscope and is an essential element biconcave lens L1, used for image restriction. The lens is mounted in a support S1, which is attached to the bottom of a magnifying glass bulb B1. Medium S1 is fixed to a mirror O1 inclined 45 ° to the direction deviation tracking image by 45 °. Focused image obtained is transmitted through the mirror inside a tube (whose diameter is correlated with diameter access hole inside the oil conservatories) to another mirror O2, which changes direction tracking image with 45 °, and the image is tracked by the center through a biconvex lens L2 mounted S2. On the same support is set and an electric battery is used to power the lamp B1. Order feeding is done through a switch I fixed the access cover to the battery slot, Figure 3.

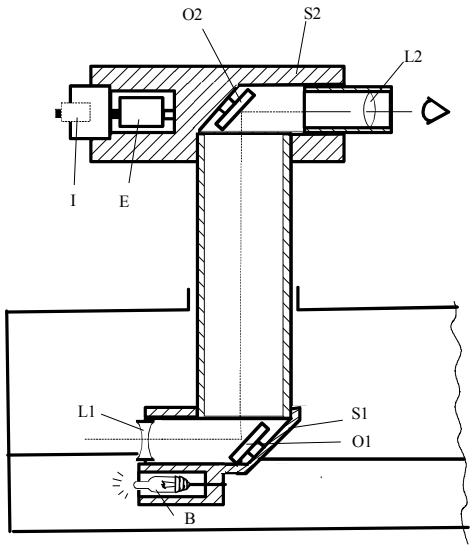


Figure 3. Device for checking the inner surface of the oil conservatories

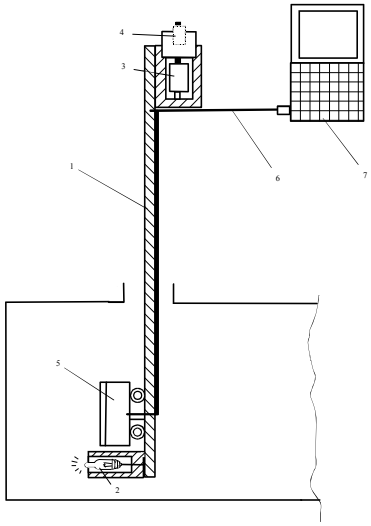
The device has the following advantages: low cost price, high reliability, reduced complexity. It further gives an example for implementing the invention in connection with Figure 4, which is the device for checking the interior surfaces, in the laboratory EMAD [6]. Technical details: - a tube with mirrors is made of PVC outer diameter of 40 mm and has a length of 420 mm; - to capture the image using two mirrors were made on glass silver square with dimensions 60x60 mm; - lamp to illuminate the inner surface is made from hard rubber cylinder with a diameter of 25 mm and 45 mm length, bulb diameter of 5 mm and a length of 10 mm is fed to the voltage of 3 V with serial two R6 batteries placed at the end of an elastic rod length of 720 mm; - lenses 25 mm in diameter. Figure 5 is shown a gallery of images obtained by viewing through the device of internal metal surfaces affected by corrosion.

a) b) c)

Figure 4. Device for checking the interior surfaces: **a)** tube with mirrors **b)** lamp to illuminate the inner surface **c)** inner surface image, reflected in the mirror above the device

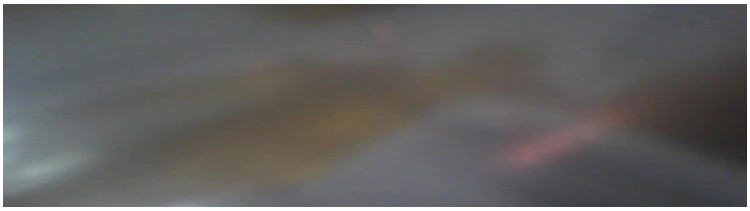
Figure 5. Images obtained with the device for checking the internal surfaces

In order to check the metal tanks are known several methods [7], [8] based on ultrasound, magnetic particle and dye penetrant, with the following disadvantages: high cost price and the need for specialization of the maintenance personnel. Using the model to medical investigation methods outlined above have created a second device for checking the interior surfaces, we present further. The device for checking the internal surfaces as the invention removes the disadvantages mentioned above in that it consists of a video camera mounted on a flexible rod. The advantages of this device are: price low-cost, high reliability, easy to handle.



a)

b)



c)

Figure 6. Device for checking interior surfaces: **a)** the scheme in principle **b)** checking the inner surface of a metal tank **c)** image of a rust spots inside the tank metal

The device for checking the internal surfaces as the invention, Figure 6a is composed of a flexible rod 1 at the end that, in order to illuminate the inner surfaces of the conservative subject to verification, is fitted with a magnifying glass bulb 2, a battery powered 3, commanded by a switch 4. At the same end of the rod 1 is placed a video camera 5, which incorporates the image of the inner surface of the oil conservatoires and forward through a USB cable 6 on a laptop screen 7.

The device for checking the internal surfaces can be used in oil conservatories of the power transformers at the repair revisions as well as mobile field kit. It further gives an example for implementing the invention in connection with Figure 6b, showing the device for checking the interior surfaces in the laboratory EMAD [9] and an image obtained with this device, Figure 6c.

Technical details:

- Video camera type used is the Microsoft LifeCam VX. -700, With geometric dimensions 56x25x25 mm, connected by a USB cable, length of 126 mm at a price of 15.8 € including a microphone to play sounds;
- Type laptop is Acer Extensa 5230 comes with Intel® Celerom® mobile processor, up to 3 MB, L2 cache, 5.4 ″ Visual VXGA hight brightness, having geometric dimensions 360x267x43 mm, weighing 3.02 kilograms and power supply ensured for a period of 2,5-5 hours depending on battery type used;
- Lamp to illuminate the inner surface is made from hard rubber cylinder with a diameter of 25 mm and 45 mm length, bulb diameter of 5 mm and a length of 10 mm is fed to the voltage of 3 V with serial two R6 batteries placed at the end of an elastic rod length of 720 mm.

4. Conclusions and proposals

As a result of experiments conducted to verify the internal surfaces of metal containers with two optical devices can be set off following conclusions:

- it is necessary to check the inner surfaces of oil conservatories, because over time the metal undergoes corrosion and particles results may enter the vat processor power thus jeopardizing its operation;
- the first model (periscope) has the advantage of low cost price and an easy handling, but offers the possibility of using a flexible tube, which would allow a higher close viewed wall;
- the second model developed (LifeCam) is very close to the wall viewed through flexible rod that is made and provide live images from inside the metal tank. The quality of these images can improve performance depends on webcam use;
- for both devices tested angle of illumination is particularly important for image quality obtained;
- can imagine a small kit for intervention within the oil conservatories composed of an abrasive disc driven by an electric MICROMOT and a hose coupled to a vacuum particle.

References

[1] Cernomazu D., *Contract de cercetare ştiinţifică Nr1/20.06.1990,* Beneficiar: URTAE Roman, Universitatea "Ştefan cel Mare" Suceava.
[2] www.advancedendoscopysolution.com
[3] www.womsurgical.com
[4] *** Revista *Argent chirurgia,* Madrid, 2009, 96(3-4), 110-115.
[5] www.clevlanduragyn.com
[6] Cujbă T., *Dispozitiv pentru verificarea suprafeţelor interioare,* Cerere de brevet de invenţie A/00620 din 07.08.2009, OSIM Bucureşti.
[7] Deutsch V. et al *Metode de control nedistructiv* Redactată în limba română de Dipl. Ing. Raimund Aloisiu Zeman, Bucureşti: S.C. Soluţii CND S.R.L., 022944 Aleea Arubium 61- 63, sect.2, 2007.
[8] Ghita E., *Non-Destructive Methods to Appreciate the State of Stress and Cracks in Wheels and Railroads* Analele Universităţii "Eftimie Murgu" Reşiţa, Anul XVI, NR. 1, 2009, 111-118.
[9] Cujbă T., *Dispozitiv pentru verificarea suprafeţelor interioare,* Cerere de brevet de invenţie A/00976 din 25.11.2009, OSIM Bucureşti.

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