4. **On the Motion of the Dielectric Liquid Accompanying the Striated Discharge Figure.**

By Tadasi ITOH.

Physical Institute, Hokkaido Imperial University, Sapporo.


We have reported in the preceding note about the luminous striated figure of electric discharge generated along the surface of a dielectric liquid such as transformer oil. We have observed, besides the luminous striated figure which is observable in darkness, a motion of the dielectric liquid accompanying this peculiar electric discharge.

During the striated discharge, the whole surface of the oil shows such a minute and vivid trembling motion that should occur by a certain mechanical impulse at the surface of a liquid with small viscosity. In Fig. 1 are shown the characteristic forms assumed by the oil surface before, during and after the discharge.

When we place a solid dielectric under the needle point (or filament) and let the level of the oil layer be a little higher than the upper surface of the dielectric solid (as in Fig. 1a), the oil on the whole surface of the solid dielectric is blown out of it by the electric discharge wind emitted from the needle point in the case of the radially striated discharge, while in the case of the parallel striated discharge the oil on the part of the solid dielectric under which the metal plate exists is blown out.

The motion of the oil during the electric discharge can easily be observed by means of small gas bubbles which happen very often to remain or grow in the oil.

The general motion of the oil is such as will be produced by the air current taking place radially from the needle point in the radially striated discharge, and at right angle from the filament in the parallel striated discharge. This fact may suggest us that some material particles are more emitted from than absorbed into the needle point or the filament and flowing just in the directions of the luminous striae, or in other words, the electric current in the circuit is somewhat rectified positively (viz. the current flows from the needle point or the filament to the metal plate).

Besides, in the case shown in Fig. 1a, a mass of oil remains at the needle point (or filament) during the discharge if it takes place under the conditions which are proper to generate the characteristic striated figure on the dielectric, say with a gas pressure of a few cm. and a
proper width of the spark gap. In this case a greater part of the oil on
the dielectric solid is blown off by the first electric impulse as described
already. Under the conditions improper for generating the striated
figure, say with no spark gap or a gas pressure somewhat higher than
the proper value, the oil mass in question cannot remain on the di-
electric solid. The phenomenon is striking especially in the case of
radially striated discharge with a rather thin dielectric. An example
is given in Fig. 1c and Photo. 1. Thus, we see that the present fact is also due to the peculiar striated discharge.

The motion of the air bubbles in the isolated oil mass is somewhat remarkable as shown in Fig. 1c. The direction of the motion is quite contrary to that of the oil around the dielectric solid. The isolated oil keeps its form, as it were, by a certain tightening force during the striated discharge. The isolated oil has, on the other hand, the same order of magnitude with the luminous circular halo\(^1\) which appears around the needle point in the striated electric discharge on the dielectric (the halo is especially conspicuous for a thin dielectric plate).

In short, the motion of the oil above described may gives us many, if not sufficient, clues for studying the distribution of the electric field, the motion of the electrified particles, the mechanical action, etc. in the peculiar striated discharge.\(^2\)

---

1) T. Itoh: Memoirs of the Engineering Faculty, Hokkaido Imperial University, 1, No. 5 (1928), 297.

2) Recently, Prof. Y. Ikeda and Dr. E. Kato in this Institute have published their investigation on "A Vortex-Ring in Transformer oil Produced by Electric Discharge" (these Proceeding, 4, 565-568). There are some similarities between their experiment and the present one regarding the vortex-like motion of oil, but also something quite different especially in the features of the two phenomena. These differences are due perhaps to the difference of gas pressure in the discharge vessel in the two cases, for the electric circuit and the discharging system are nearly common to both cases. We may consider, therefore, that in the present discharge system the causes for producing the vortex-ring and the present discharge figure (radial) are connected with each other in spite of the different features in the resulting phenomena, but the more detailed discussions on this point are left for further researches.

G. L. Addenbrooke's report on dielectric attraction in divergent electric fields, Phil. Mag., [vii], 3 (1927), 1166-1184, may also here be cited as dealing with an allied problem.