# Electric Oscillations in a High Tension Transformer.

By

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The transformer, having capacity and inductance, may be looked upon as an oscillating system. The oscillations in the transformer have been investigated experimentally and theoretically by Böhme.[1] When the primary circuit is suddenly opened or closed, some electric oscillations in the secondary of the transformer will be excited. By making use of a vacuum tube and rotating film, we have studied the transient state of the current. When the primary is suddenly closed, the electric impulse will give rise to a transient oscillating current in the secondary. But the transient current will be damped soon, and the forced oscillation alone will appear. This is clearly shown in Fig. 2.

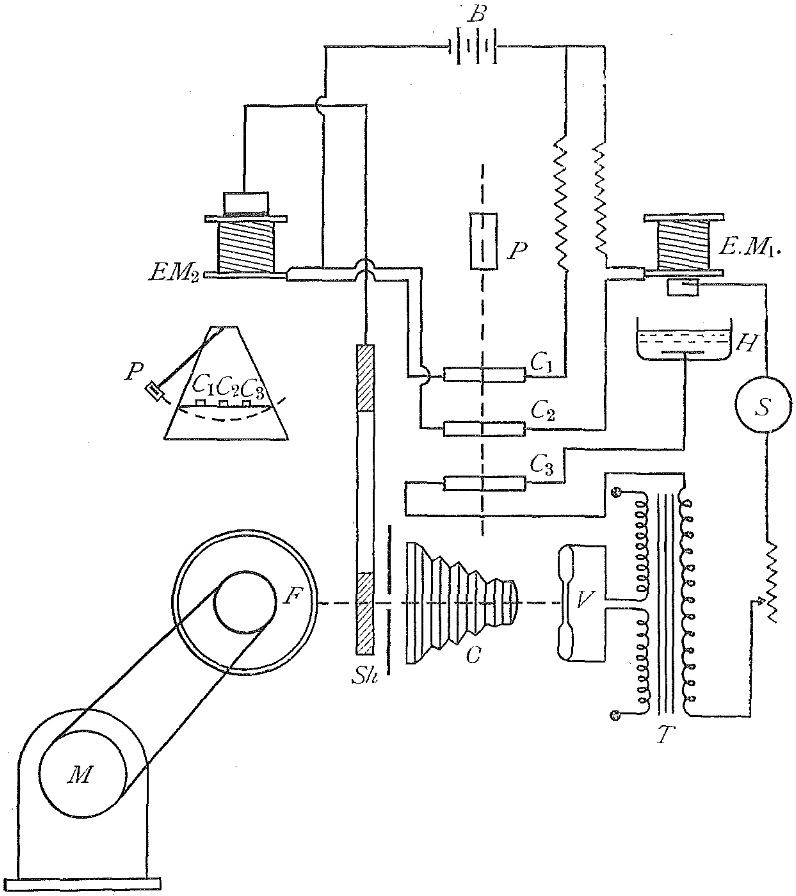
On the contrary, if the primary circuit is suddenly switched out, the forced electric oscillation in the secondary will be stopped suddenly. The stored energy will give rise to the proper oscillation in the secondary. When the terminal of the secondary is open, the oscillating current may be compared to the mechanical vibration of a string with fixed ends. The frequency of the proper oscillation is calculated to be approximately equal to

$$\frac{1}{2\sqrt{cl}}$$

where $c$ is capacity and $l$ the self inductance of the secondary. Of course, this formula is obtained under the assumption that the damping factor is small enough to be neglected. The electric connection is shown in the following diagram;

The secondary is left open, and the vacuum tube is inserted at the middle point of the secondary. Adjusting the positions of the contact pieces $C_1$, $C_2$, and $C_3$, we have photographed the glows of the tube at the moment of the closing or cutting of the primary circuit.

1) O. Böhme: Die stationären Schwingungen der wechselstromgespeisten Spule. Arch. f. EL. 1920, Bd. 9, s. 341.




$V$: Vacuum tube.
$T$: Transformer (200,000 volts, 60 cycles).
$S$: Source (100 volts, 60 cycles).
$Sh$: Shutter of the camera.
$P$: Pendulum.
$C_1$, $C_2$, $C_3$: Metal pieces for contacting the terminals.
$E.M_1$: Electromagnet used for closing primary circuit of the high tension transformer.
$E.M_2$: Electromagnet used for controlling the time when the shutter falls down.
$H$: Vessel containing mercury.
$F$: Film wound on the drum.
$M$: Motor.
$C$: Camera.
$B$: Battery (6 volts).

Fig. 1.

For the transformer we used

$$l=94{,}000 \text{ henry}$$

$$c=0.004\ \mu\text{F}$$

$$\frac{1}{2}\frac{1}{\sqrt{cl}}=26 \text{ cycles}$$

But in reality, the magnitude of the damping factor is not so small as to be neglected and the oscillation is damped before it can reach the ultimate state, to which the proper oscillation corresponds. From Fig. 3, a and b, we see that the period of the oscillation becomes gradually larger.

As the frequency of the proper oscillation is rather low,[1] the state of the current can be photographed by the ordinary oscillograph. But in the high tension transformer, the high tension current is liable to be accompanied by small oscillations through the electric impulse. For this reason, it is preferable to make use of a vacuum tube and rotating film in order to illustrate the fluctuation of the secondary current of the high tension transformer. The small oscillation of a high frequency current is clearly shown in Fig. 3, a and b.

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2) R. Rüdenberg: Elektrische Schaltvorgänge. s. 464.

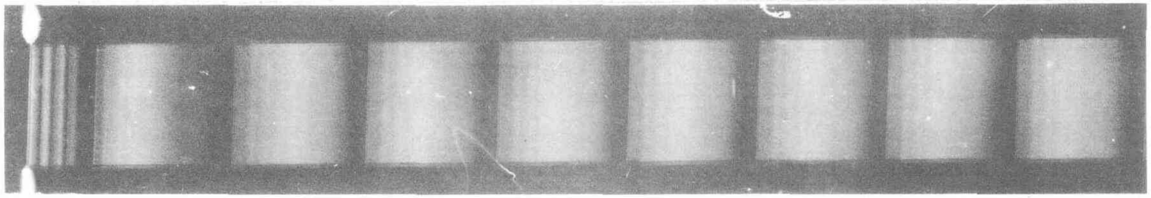

Fig. 2.

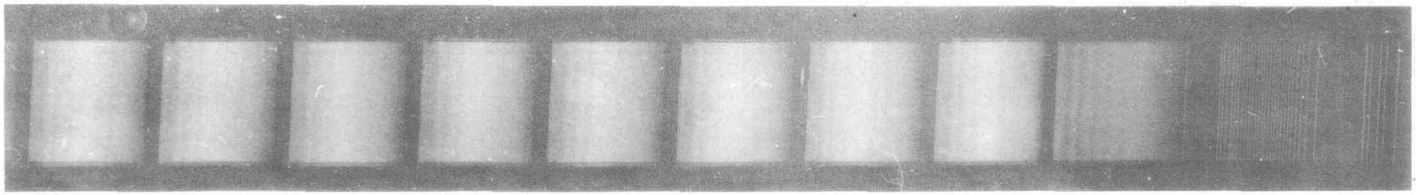

Fig. 3, a.

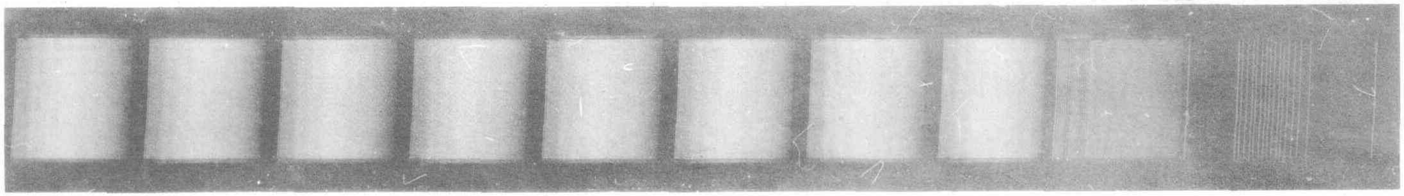

Fig. 3, b.