APPARATUS FOR THE CORONA TREATMENT OF PLASTICS

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This invention relates to an apparatus for the corona treatment of plastics, which is more efficient as regards the effective current in the discharge gaps.

The corona treatment of shaped articles of plastics, especially in the form of films, has been known for some years. The main purpose of this treatment is to impart certain surface characteristics to the plastic materials. From German patent specification (DAS) 1,159,159, for example, it is known to expose polyethylene film to the influence of a corona discharge and thus make it capable of being printed in a practical manner, which is particularly important for packaging purposes.

The apparatus used for the corona treatment normally consists, in principle, of a generator for generating a voltage of appropriate frequency, preferably between 1,000 and 500,000 hertz, and a high-voltage transformer which transforms the generated voltage into a suitable operating voltage of about 6,000 to 100,000 volts. Further, the known devices comprise a treating station containing at least one electrode provided with a dielectric, normally in the form of a roll, and one or more counter-electrodes, normally in the form of oblong bars which may be curved on the surface facing the electrode. As regards its electrical arrangement, such an apparatus represents a condenser, so that the current flowing from the generator and the transformer connected thereto over the electrode consists to a large proportion of capacitative displacement current. Only that part of the current which is converted into heat in the dielectric of the insulating layer and in the treated film is effective and thus can be regarded as pure active current.

The known apparatuses have the serious drawback that their performance data must correspond to the full apparent power, in accordance with the following formula

\[ N_{app} = \sqrt{N_{app}^2 + N_{cap}^2} \text{ [va.]} \]

wherein

- \( N_{app} \) is the apparent power [va.]
- \( N_{eff} \) is the effective power [watts]
- \( N_{cap} \) is the capacitative wattless power [VAR]

The apparent power to be calculated for a material surface that is to be treated depends upon the desired intensity of treatment and upon the surface area to be treated per unit of time.

Since the apparent powers acting in the discharge gaps, i.e., the zones of the corona treatment, may be up to 40 kva., the necessary generators must be adapted to this apparent power. Consequently, the generators are of large size and, therefore, expensive. In addition to their uneconomical utilization of power, it is above all their size which very often causes considerable difficulties, when corona discharge stations are to be installed in existing apparatus of other types.

The present invention provides an apparatus which generates the required wattless power without loading the generator therewith. In this manner, the dimensions of the generator and, if desired, also those of the transformer connected therewith, may be limited to those corresponding to the required effective power.

According to the present invention, the problem is solved by an apparatus for the corona treatment of shaped articles of plastics, especially films, comprising a generator for generating a voltage of appropriate frequency, a high-voltage transformer for producing a suitable operating voltage, a grounded electrode provided with a dielectric, at least one counter-electrode and an inductance coil of variable inductivity. In this way, the effective current in the discharge gaps can be varied within wide limits by varying the air gap. The inductivity is adjusted to the maximum apparent power. Several possibilities exist for connecting the inductance coil to the electric circuit. For example, the inductance coil may be connected either in parallel or in series with the discharge gap. In a further embodiment of the apparatus, the inductance coil is connected in parallel or in series with the primary winding of the high-voltage transformer. In the preferred embodiment, however, the inductance coil is connected in parallel with the discharge gap, because in this case the transformer may be of smaller size.

Although electrodes and counter-electrodes of different types may be used in the apparatus according to the invention, it was found to be most advantageous in practice when the grounded electrode provided with the dielectric was a roll.

The invention will be further illustrated by references to the following specific example:

**EXAMPLE**

At a voltage of 10,000 v. and a frequency of 10 kHz, a current of 0.6 amp. flows over the electrodes of a corona discharge station. In this case, the apparent power is 0.6 amp. x 10,000 v. = 6,000 va. Since the discharge station represents a high capacitance, a cos \( \rho \) of about 0.1 kap results. This corresponds to an effective power of \( N_{app} = N_{cap} \cos \rho = 0.1 \times 6,000 = 600 \text{ watts} \). A capacitative wattless power \( N_{cap} = N_{app} \sin \rho = 6,000 \times 0.995 = 5,970 \text{ VAR} \). According to the invention, this capacitative wattless power is generated not by the generator, but by an inductance coil having an apparent power of 6,000 va. In this case, at a capacitative wattless current of 0.597 amp. and an \( L = 10,000 \times 0.597 = 16,700 \), the inductance coil would have to be adjusted to \( L = 16,700 \times 2 = 10,000 \times 0.266 \text{ henry} \). In this manner, the generator may be dimensioned to only 600 va instead of 6 kva.

The accompanying drawing shows a diagrammatic representation of an apparatus according to the invention; the invention is not limited to the embodiment shown.

A generator 1 is fed from the power supply N. The operating voltage is generated by the high-voltage transformer 2 connected to the generator at its outlet end. The inductance coil 4, whose inductivity is variable, is connected in parallel with the discharge gap between the electrode 5 and the counter-electrode 6, which in this case is in the form of a roll. The counter-electrode is provided with a dielectric layer 7. Measuring instruments...
3 are interposed in the circuits between the inductance coil and ground on the one hand and the transformer and ground on the other hand, in order to be able to measure the flows of current, especially when varying the inductivity of the inductance coil 4.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. In an apparatus for the corona treatment of shaped articles of plastic comprising a circuit including a generator for generating a voltage of appropriate frequency, a high-voltage transformer for producing a suitable operating voltage, an electrode and a grounded counter-electrode provided with a dielectric, the improvement which comprises inductance coil means of variable inductivity connected in parallel with the discharge gap between the electrode and counter-electrode for producing capacitive apparent power, for power amplification of the generator.

2. Apparatus according to claim 1 in which the inductance coil is in parallel with the primary winding of the high-voltage transformer.

3. Apparatus according to claim 1 in which the inductance coil is in series with the primary winding of the high-voltage transformer.

4. Apparatus according to claim 1 in which the electrode provided with the dielectric is a roll.

References Cited

UNITED STATES PATENTS
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