

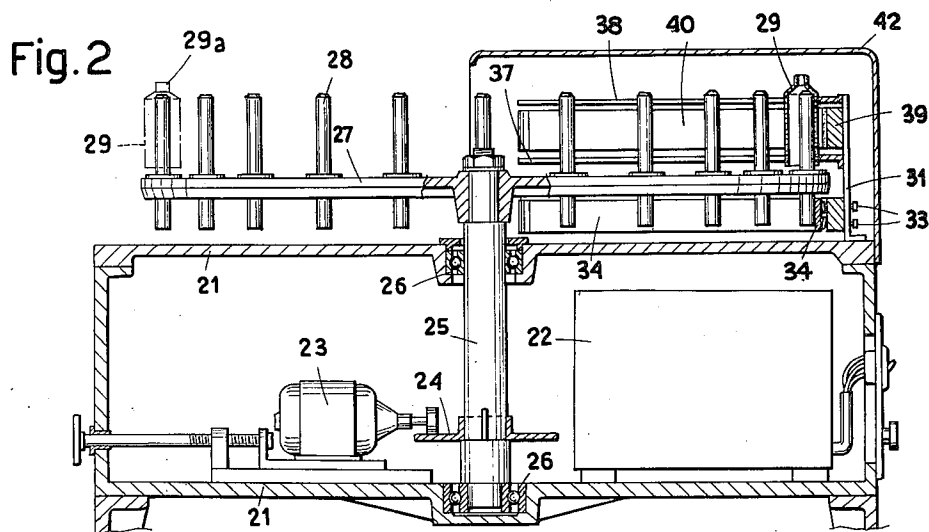
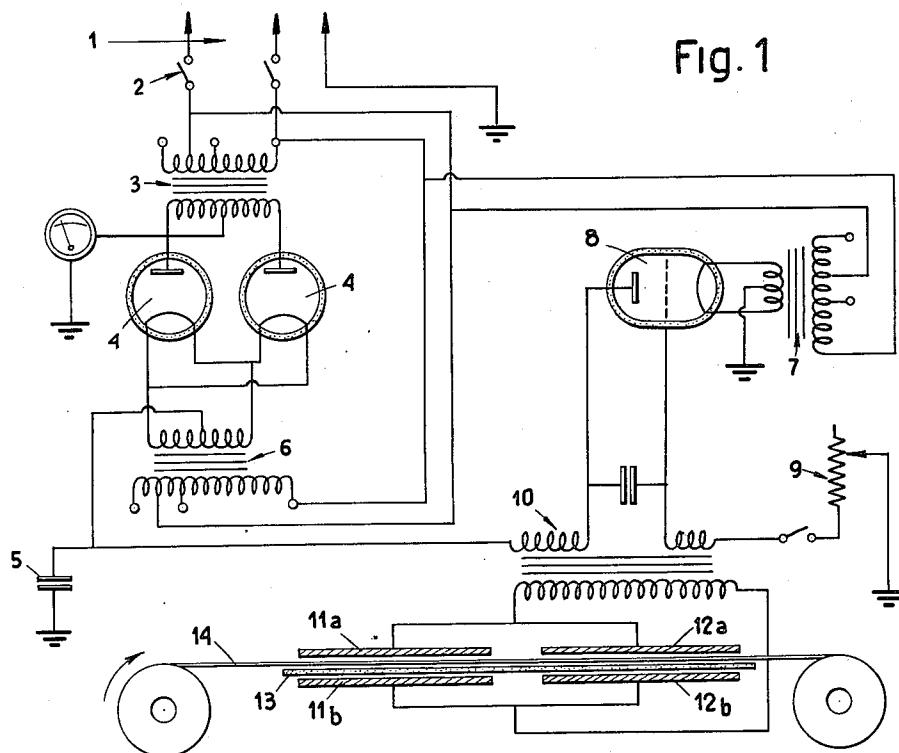
Feb. 13, 1962

A. SESTINI
ELECTRON DISCHARGE APPARATUS FOR TREATMENT
OF PLASTIC MATERIALS

3,021,275

Filed Dec. 20, 1956

2 Sheets-Sheet 1



INVENTOR:
AMERIGO SESTINI
By
Richardson, David and Nordon

ATTY'S.

Feb. 13, 1962

A. SESTINI
ELECTRON DISCHARGE APPARATUS FOR TREATMENT
OF PLASTIC MATERIALS

3,021,275

Filed Dec. 20, 1956

2 Sheets-Sheet 2

Fig. 3

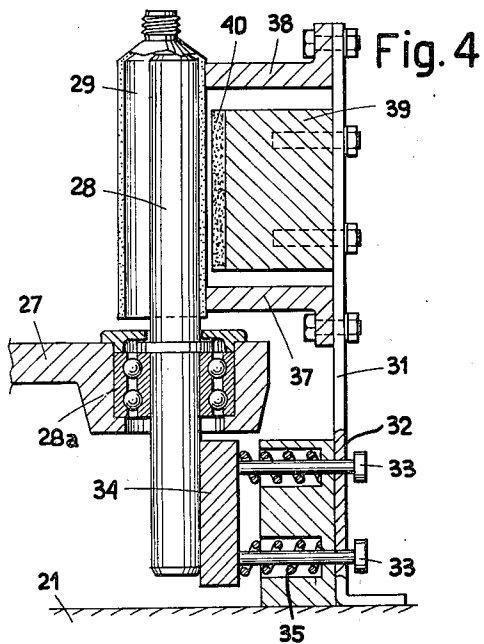
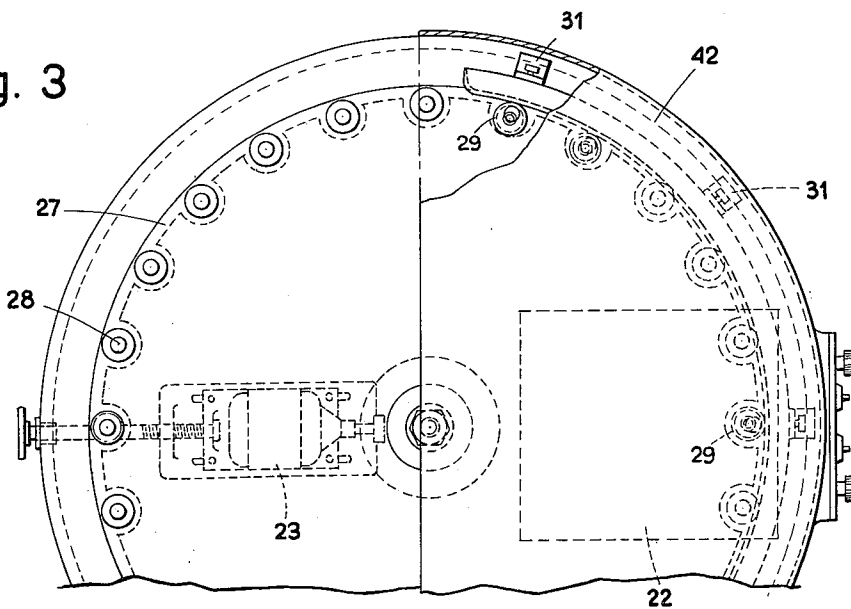
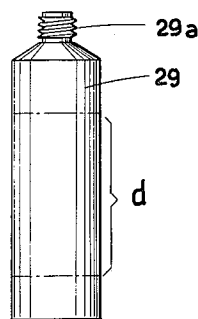


Fig. 5



INVENTOR:
AMERIGO SESTINI
By
Richardson, David and Nordon
ATTY'S.

1

3,021,275

ELECTRON DISCHARGE APPARATUS FOR TREATMENT OF PLASTIC MATERIALS

Amerigo Sestini, Via Pisana 59, Florence, Italy

Filed Dec. 20, 1956, Ser. No. 629,725

Claims priority, application Italy Dec. 29, 1955

1 Claim. (Cl. 204—312)

The invention relates to a method and apparatus for treatment of surfaces of materials to be printed upon, particularly sheets or strips or pre-formed elements of plastic materials, as for example but not exclusively, of polyethylene, in order to assure the stable fixing of inks in the surface portion of such material, thereby making said inks practically indelible.

The procedure consists of providing an electronic bombardment, that is, a passage of electrons through the sheets of the materials to be treated. The method practically consists in passing a high intensity electric field through the material to be treated and is characterized by the fact that the electric field is alternating polarity and of high frequency. It seems that, by means of the treatment of the plastic material in accordance to the invention, the atom of hydrogen is removed from the surface portion of the sheet while its ionization is effected.

The apparatus according to the invention substantially includes two electrodes, between which a high frequency and high voltage electric field is generated and said electrodes being fed or supplied by a corresponding alternate voltage and also includes means for the handling of said material, thereby passing said pre-formed elements to be treated respectively, through said field.

The apparatus, which may include a generator or a current rectifier for the supply of a levelled current, is more particularly provided with a high frequency self-oscillating system and with a step-up transformer, whose secondary is connected to the electrodes generating said electric field. In practice there are arrangements for the use of several pairs of electrodes, for example, two pairs of electrodes through which the thickness of the material to be treated is successively passed. There is also provided a regulator for the adjustment of the intensity of the electrical field, particularly with relation to the thicknesses of the materials to be treated. The regulator is preferably a variable resistor inserted in the grid circuit of an electronic tube, preferably a triode tube forming a part of the self-oscillating system.

For the treatment of endless sheets or flattened pipes or tubes, the apparatus includes means for the unwinding of the endless sheet through the high intensity and high frequency alternate field, which is generated by two electrodes between which the material is passed.

In the drawings:

FIG. 1 is a diagrammatic view illustrating an embodiment of the invention.

FIG. 2 is a fragmentary vertical sectional view through a main geometrical axis of a machine for the treatment of small tubes or other equivalent elements in accordance with the invention.

FIG. 3 is a fragmentary view of FIG. 2;

FIG. 4 is an enlarged fragmentary sectional view of the apparatus illustrated in FIG. 2;

FIG. 5 is an elevational view of a small tube illustrating the zone of the tube which may be treated.

In FIG. 1 numeral 1 generically denotes an alternating current power source, designed to supply through the switches 2 the primary circuit of a step-up transformer 3. Two rectifying tubes 4 or selenium rectifiers, for rectifying the current, and a capacitor 5 for levelling the current, are connected to the secondary circuit of the transformer.

A second system of transformers 6, 7 supplies a self-

2

oscillating system including a triode 8, whose grid circuit includes a variable resistor 9. The self-oscillating circuit is completed by a transformer 10 which includes two coupled and calibrated windings to make the system oscillate at the frequency required, and whose high voltage secondary, oscillating at the frequency imposed by the triode system, is connected to two pairs of electrodes 11a, 11b and 12a, 12b respectively; said electrodes being appropriately and mutually close to one another. A dielectric material 13 is inserted between the plate-like electrodes of each pair of electrodes 11a, 11b and 12a, 12b.

The material to be treated, generically indicated in 14 is passed between the electrodes of the two pairs of electrodes and thus is submitted to the aforesaid molecular surface treatment due to the electric field generated as abovementioned. The surface modification of the material, obtained with this procedure, is higher in correspondence of the surface directly facing the electrode and lower in correspondence of the surface facing or in sliding contact with the dielectric material 13. Thus the preliminary treatment prior to the printing is obtained on one surface and thereupon the material 14 is introduced into the apparatus.

The presence of the dielectric material 13, preferably formed of synthetic resin, assures a uniformity of the electrical discharge on the entire surface of the plates, in such manner as to obtain a substantially uniform bombardment thereof.

The adjustable resistor 9 of the grid circuit of the triode 8 is varied in accordance to the thickness of the material to be treated, to the intensity of the treatment required, and also in relation to the passage speed of the material 14.

The apparatus may be combined with an extrusion machine, and to a printing machine for the treatment of the material to be printed. The apparatus may also be alone and include winding and unwinding means.

In accordance to what is shown in FIGS. 2 to 5 numeral 21 denotes a casing forming the main structure of the machine and contains the electric, electronic and electro-mechanical members for the movement of the mechanical members and for the generation of the high frequency and high voltage electric field. 22 generically denotes the generator for the supply of the electrodes generating the electric field, and 23 denotes a motor for the mechanical motion, with an appropriate speed regulator 24. This arrangement allows a relatively slow rotation of a main vertical shaft 25, which is mounted in the casing 21 in bearings 26 and emerges out of said casing at the upper portion to engage a circular table 27. This table thus slowly rotates through the drive of the motor 23 and the rotation is continuous.

The table 27 is provided on its periphery with a plurality of spindles 28 which according to the embodiment are mounted in individual bearings 28a for free rotation about their vertical axes. The spindles are insulated with respect to the casing, the table 27 being made up of a strong insulating material. These spindles 28 extend above the table 27 to a height at least greater than the length of small plastic tubes to be treated; the small tubes being generically denoted at 29. The small tubes 29 are open at the end opposite to the one forming the neck 29a and are treated by the present machine along their outer cylindrical surface upon a surface having the height *d* as shown in FIG. 5, and which is variable in position and in height. The small tubes 29 have a diameter larger than the spindles 28 so that these small tubes may be inserted on the spindles 28. The spindles may be cylindrical or shaped to the openings in the components to be treated.

The spindles 28 are extended under the table 27 for the hereinafter stated purposes.

A plurality of supports 31 is provided adjacent to the trajectory in which the spindles 28 move upon rotation of the table 27 on the casing 21. The supports carry an element 32 in which a plurality of stems 33 is slidably housed. The stems, in turn, hold a slide block 34 at their inner ends and extend for a determined angular portion which may be, for example, in the range of $\frac{1}{4}$ to $\frac{1}{2}$ of a circumference. Springs 35 or other resilient means stress the slide block 34 towards the shaft 25 in such a way that the spindles 28 which pass in frictional contact with the slide block 34 are contacted thereby and thus receive a rotary movement owing to their revoluble mounting on the table 27. In addition, the slide block 34 assures a metallic contact with the spindles, the slide block being electrically connected with a phase of the high frequency generator.

The spindles passing in the arc defined by and in contact with the slide block 34 have mounted thereon small tubes 29 to be treated. These small tubes 29 lie on two stationary slide blocks 37—38 carried by the supports 31. These slide blocks 37—38 cause the tubes 29 to roll on the surface of contact and also to impose a rotation of the spindles 28 on the same axis. The rotation of the spindles 28 and of the tubes 29 is assured by this arrangement even if the slide block 34 only solves the work of assuring an electrical contact.

An arcuate block 39 of metal is arranged between the two slide blocks 37—38 on the supports 31. The block 39 is electrically connected to the other phase of the high frequency generator and thus said block 39 forms an electrode designed to cooperate with the multiple electrodes formed by the spindles 28 which pass in front of it. The block 39 carries a spacer 40 of the dielectric material which grazes the walls of the tubes 29, remaining appropriately distant therefrom.

The spindles' zone of travel, which, at least corresponds to the extension of the electrode 39 is closed by a shielding hood 42.

As the two phases of the high frequency generator 22 are brought one to the electrode 39 and the other to the resiliently movable slide block 34, when a spindle with its relative small tube or the like located thereon contacts the slide block 34 and is located in front of the electrode 39, an electric field is developed between the electrode 39 and the spindle through the dielectric spacer 40 and the thickness of the tubular wall of the small tube 29. By contacting the slide blocks 37—38, the rotary unit of the small tube 29 and of spindle 28 rolls on said slide blocks and thus the entire surface of the tubular portion of the tube is successively located and then repeated several times in the abovementioned electric field. The rolling is extended for all the portion of the trajectory of each spindle in front and along the slide blocks 37—38 and for the entire extension of the slide block 34 and of the electrode 39. The treated zone (having the height d of FIG. 5) depends upon the height of the electrode 39, measured parallel to the axis of shaft 25. The electrode 39 is replaceable as are also the spindles.

The small tubes are removed and replaced along a portion of the circular path of movement of the spindles and at points from the area where the electrical treat-

ment is being effected. A hand control or a totally or partially automatic control may be provided for this purpose. For instance, the expulsion of the tubes may be effected by a jet of compressed air.

The machine may also be used for the treatment of plastic material elements different with respect to the tubes but having such a shape to be adapted to the above described treatment. The spindles may be, for instance, formed in such a way as to suit them each time to the shape of the elements to be treated, as also the eventual modification of the cross-section profile of the electrode 39 may be provided. This electrode may also be mounted in an adjustable manner in order to vary its distance from the spindles. The spindles may be insulated with respect to the table 27. Instead of providing a rotary table, there may be provided an endless conveyor, as for example, a chain conveyor or the like.

The drawing only shows certain embodiments of the invention, which may be varied in form and arrangement of parts.

What I claim is:

A device for the treatment of sheets and plates of synthetic material, particularly of polyethylene, for the preparation of their surfaces for the reception of inks and colors so that with the subsequent printing on said surfaces an adherence of the ink and color will occur, comprising: a voltage change device; a voltage rectifying device; a high frequency auto-oscillating electronic circuit including at least a triode; a step-up transformer wherein one winding is fed by said auto-oscillating circuit; a second primary winding on said step-up transformer connected on one side of the grid of said triode and on the other side to an adjustable dissipation resistor; a secondary for said step-up transformer energized with a high frequency and high voltage; at least a pair of electrode means, relatively approached and extended, for the generation of a high frequency and voltage electric field; a dielectric material layer separating said electrodes means; means for the conveying of the sheet material between said electrode means whereby the surface of said sheet material, which is opposite to that facing said dielectric material layer, is treated.

References Cited in the file of this patent

UNITED STATES PATENTS

1,927,381	Allen et al. -----	Sept. 19, 1933
2,226,871	Nicholas -----	Dec. 31, 1940
2,459,225	Hickok -----	Jan. 18, 1949
2,526,724	Bradley -----	Oct. 24, 1950
2,528,428	Drugmand -----	Oct. 31, 1950
2,666,129	Ellsworth -----	Jan. 12, 1954
2,679,573	Newhouse -----	May 25, 1954
2,691,613	Baer -----	Oct. 12, 1954
2,779,848	Bosomworth et al. -----	Jan. 29, 1957
2,802,085	Rothacker -----	Aug. 6, 1957
2,810,933	Pierce et al. -----	Oct. 29, 1957
2,859,480	Berthold et al. -----	Nov. 11, 1958
2,864,756	Rothacker -----	Dec. 16, 1958
2,910,723	Traver -----	Nov. 3, 1959

FOREIGN PATENTS

159,822	Australia -----	Nov. 16, 1954
---------	-----------------	---------------