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DISCONTINUING TREATMENT IN ELECTROSTATIC FIELDS

Filed March 3, 1941

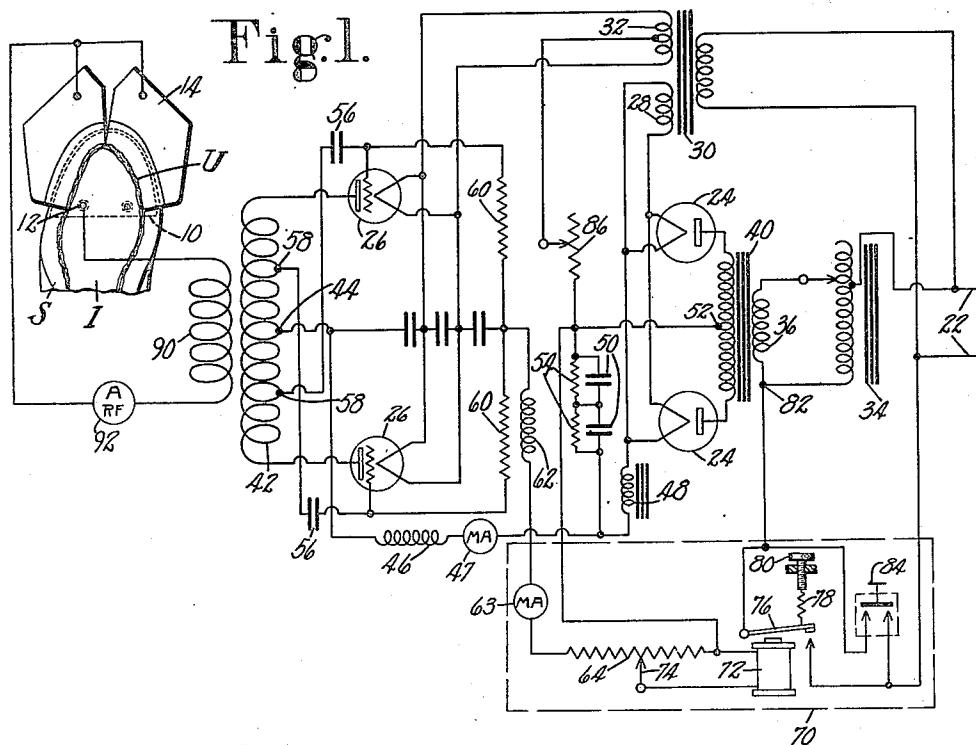
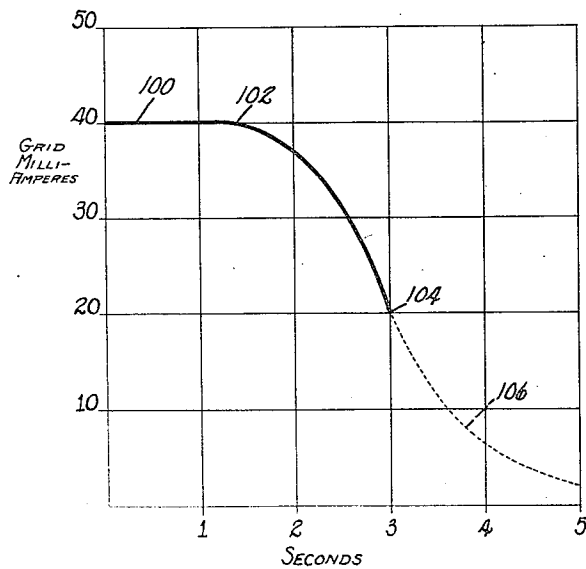


Fig. 2.



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UNITED STATES PATENT OFFICE

2,293,851

DISCONTINUING TREATMENT IN ELECTRO-
STATIC FIELDSWalter S. Rogers, Falmouth, Mass., assignor to
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Application March 3, 1941, Serial No. 381,464

2 Claims. (Cl. 219—47)

This invention relates to the treatment of materials in a high-frequency electrostatic field. It is concerned more particularly with the control of the radio-frequency unit which supplies the field thereby to prevent damage to the materials being treated or to the apparatus and to automatically control the cycle of the operation.

When a radio-frequency supply unit is used to set up an electrostatic field between electrodes which are associated with a piece of work to be treated, it is desirable to limit the effective treatment of the materials to get the desired operation cycle and to eliminate the danger of damage to the work. A frequent use of such apparatus relates to the activation of thermoplastic adhesives employed for attaching one piece of work to another. If, for example, it is desired to attach two shoe parts by means of a thermoplastic adhesive which has been applied to one or both of the parts and then allowed to dry before these parts are put together, it is important that the action of the field, in activating the adhesive or cement, shall be strictly limited so that enough heat, but not more than enough, may be applied to the cement. It is important, of course, that enough heat shall be applied so that the cement will be well activated. If, on the other hand, too much heat is applied, the adhesive itself may be spoiled and the parts to be attached may be burned. Desirably, the action of the field is terminated just as soon as the adhesive has been thoroughly activated.

In the use of radio-frequency supply units, including oscillators, amplifiers and the like, for such purposes, it has been observed that there is a sharp change in the electrical characteristics of the circuit currents when, for example, the activation of the cement takes place and in consequence there are changes in the physical characteristics of the cement. My observations indicate that there is always a sharp change, usually a drop, in the grid current and a sharp change, usually a rise, in the plate current at this time as well as a change in the radio-frequency power drawn from said supply as noted by observing the radio-frequency current in the supply leads to the electrodes.

Viewed in its broad aspects, the invention provides an improved method of timing the treatment of material being acted upon in an electrostatic field by interrupting the effectiveness of the radio-frequency supply unit upon noting a marked change in the current flow in a circuit of the supply unit, as in the circuit of an element such as the grid or plate of a tube therein.

Conveniently, the radio-frequency supply unit may be disconnected from its source of power whenever the grid current is changed to a certain value or when the plate current is changed to a predetermined value, or where the radio-frequency current in the leads to the work assumes a certain level.

From another aspect and considered with respect to one particular apparatus such as an oscillator of the push-pull, Hartley type, the invention consists in the provision of apparatus responsive to a change in current as in the grid or the plate circuit of the oscillator tube thereby to render the action of the oscillator ineffective. The illustrated arrangement provides a relay which is responsive to changes of grid current and which is adjusted to become effective, when that current has dropped below a predetermined value, to disconnect the oscillator from its supply circuit. As illustrated also, a manually-operated switch is provided for momentarily bridging the relay contacts when it is desired to set the apparatus in action and cause the oscillator to produce a high-frequency electrostatic field.

The invention will best be understood from consideration of the following description taken in connection with the accompanying drawing, in which

Fig. 1 is a wiring diagram of an oscillator connected to the electrodes of a toe-lasting machine; and

Fig. 2 is a graph indicating a typical change in the grid current of the oscillator tube as the time during the application of the field to the work increases.

For the sake of making the description definite, the invention will be herein described in its application to the one particular operation of activating cement and, by way of example, the cement which has been applied to the margin of the toe end of an insole I of a shoe S and to the overlapped margin of the upper U. One way in which a high-frequency electrostatic field may be applied to the activation of the cement for this particular work has been described in U. S. Letters Patent No. 2,249,224, granted January 21, 1941, upon my application. As therein indicated, it is convenient to utilize the metal toe plate 10 upon the bottom of a last as one of the electrodes and to electrically connect one side of an oscillator to that plate by way of a positioning pin 12 which passes through an aperture in the insole. The other side of the oscillator may be connected to wiper plates 14 by means of which the overlapped margin is carried into

position above the margin of the insole and is pressed into engagement therewith during the toe-lasting operation to the end that cement used for holding the margin in lasted position may be activated.

In the diagram of Fig. 1, one particular typical oscillator is indicated to which power is supplied from a source (not shown) of low-voltage current at a commercial frequency (in this case, 110 volts A. C., 60 cycles) by way of leads 22. The illustrated oscillator is of the push-pull type Hartley oscillator, having two-element rectifier tubes 24 giving full wave rectification, and three-element oscillator tubes or triodes 26. The filaments of the rectifier tubes are supplied from a secondary winding 28 of a transformer 30 while the filaments of the oscillator tubes are supplied from another secondary winding 32 of this same transformer. At the same time, power is also supplied through an auto-transformer 34 to the primary 36 of a step-up transformer 40, to the secondary of which the plates of the rectifier tubes 24 are connected. This auto-transformer 34 controls the maximum power input.

Bridged across the plates of the oscillator tubes 26, is a tank coil 42 and through the mid point 44 of this coil, power is supplied to these plates from the rectifier by way of a radio-frequency choke 46 and through a milliammeter 47 indicating plate current. In its passage from the rectifier, this current is smoothed out by an iron core inductance 48 and by filter condensers 50. Grid biasing is accomplished by means of resistances 54, and the grids of the oscillator tubes are connected through suitable condensers 56 to taps 58 upon the tank coil 42 and by way of the grid leaks 60, a high-frequency choke 62, a milliammeter 63 indicating rectified grid current, and a resistance 64 to the mid point 52 of the step-up transformer 40.

It will be noted that the resistance 64 is a part of a control apparatus contained within the dash lines 70 and that it serves as a convenient way of connecting a relay 72 so that it shall be responsive to the combined grid currents of the oscillator tubes. An adjustable tap 74 makes it possible to adjust that portion of the grid current which is to be diverted through the coil of the relay 72. This relay has a circuit-closing armature 76 normally held in open position by a spring 78 capable of adjustment by means of a screw 80. The contacts of the relay 72 are interposed between one side of the supply lines 22 and one side 82 of the step-up transformer 36. A manually-operated bridging switch 84 is connected across the contacts of the relay to enable these to be momentarily short-circuited in starting the apparatus.

The purpose of the grid leaks 60, the high-frequency choke 62, an adjustable resistance 86, and various blocking, by-passing and filter condensers will be well understood by one skilled in the art. Power derived from the tank coil 42 may be transferred to the work by means of an inductively related output coil 90 herein shown as connected respectively to the plate 10 and the wipers 14 which have been employed as electrodes to set up an electrostatic field for activating the toe-lasting cement. The output current is led through a radio-frequency ammeter 92.

In order more readily to describe the action

which takes place, there has been shown in Fig. 2 a graph of a typical relation existing between grid milliamperes as ordinates, and time in seconds as abscissae. The values indicated in the graph 100 correspond to the changes of the grid current of the oscillator tubes during the activation of the toe-lasting cement. It will be noted that the changes incurred are nil or are regular and in the same direction for a substantial time until, as at the point 102 on the graph, there occurs a sharp drop in the grid current which at the point 104 falls to a value low enough in accordance with the adjustment of the relay 72 so that the oscillator is disconnected from its source of current. The sharp drop in grid current takes place at a time when the activation of the cement is substantially completed. If the circuit were maintained and no means of disconnection provided, then the changes in the grid current would be indicated by the dotted line 106 and might readily be continued to a point where the work itself would be overheated and possibly the cement over-activated so that it would lose a portion of its adhesive power.

Similarly, it will be noted that the plate current of the oscillator tubes rises sharply at the time when the cement is activated and, if no automatic control apparatus 70 were provided, it will be possible for an operator watching the indications of meters 63 and 47, which are commonly provided indicating the grid current and the plate current, respectively, or meter 92 indicating load current, to disconnect or render ineffective the oscillator as the sharp deviation in such an indicating device occurs.

With the automatic control device 70, however, the apparatus may be set in operation by closing the bridging switch 84 whereupon the armature 76 of the relay 72 will be attracted and the grid circuit closed. Thereupon, the power of the electrostatic field will be applied to the work until the oscillator is automatically disconnected by the sharp decrease in grid current, for example, flowing through the resistance 64. By properly adjusting the adjustable tap 74 and the screw 80 controlling the tension of the spring 78, the discontinuance of the operation will be brought about at exactly the desired time without the need of careful attention upon the part of the operator.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A device for the activation of cement in a high-frequency electrostatic field produced between electrodes, said device comprising an oscillator adapted to be connected between a source of supply and said electrodes, and means responsive to a grid current in the oscillator for controlling the continued operation thereof.

2. That method of activating a thermoplastic adhesive between two articles to be joined thereby which consists in subjecting the adhesive to the action of a high-frequency electrostatic field produced by a supply unit containing an electronic tube having a grid circuit, observing the magnitude of the current flowing in said grid circuit, and reducing said field to an ineffective value when there is a sharp drop in the grid current.

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