

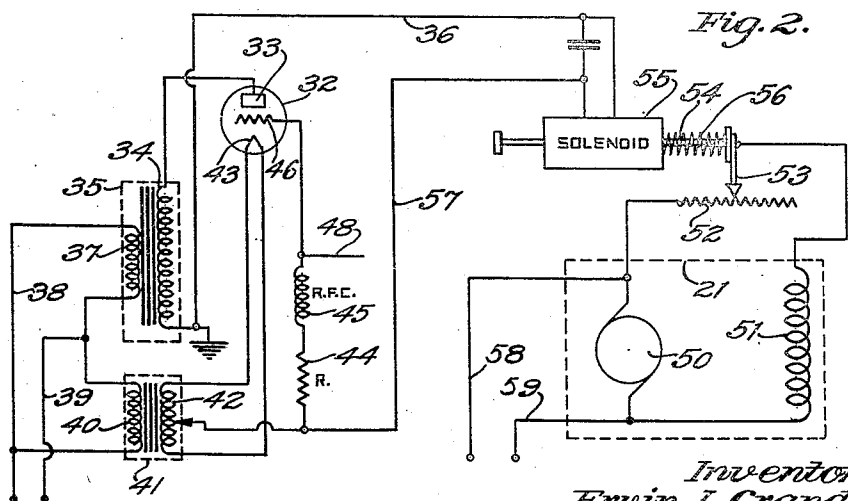
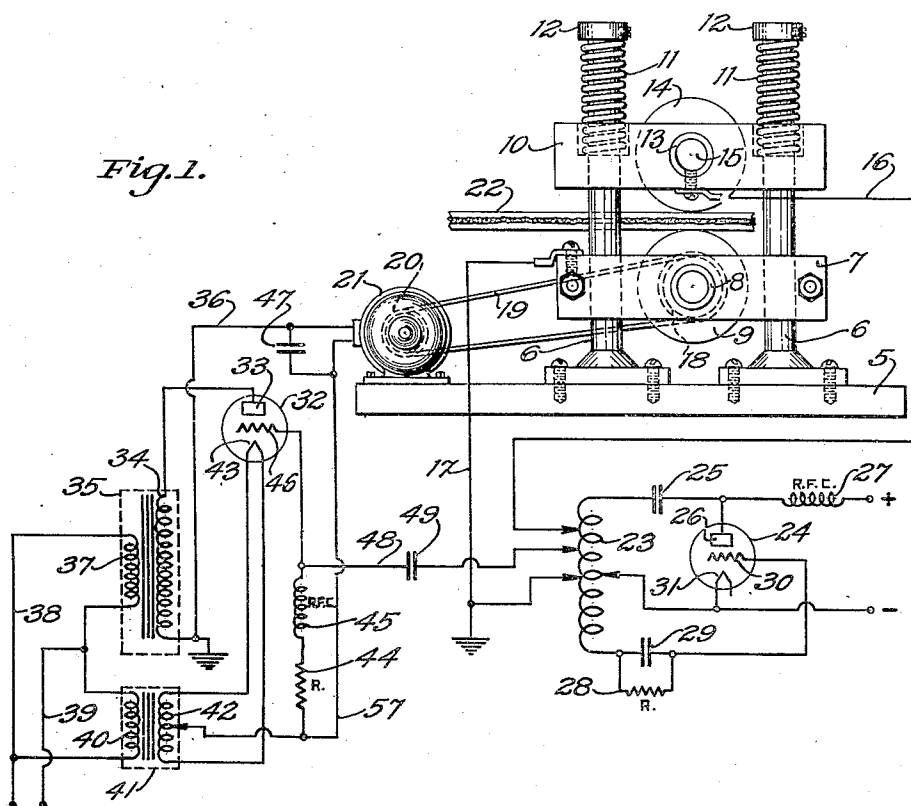
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RADIO FREQUENCY MOTOR CONTROL

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## UNITED STATES PATENT OFFICE

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## RADIO FREQUENCY MOTOR CONTROL

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This invention relates to apparatus utilizing high frequency electrostatic energy for generating heat in materials advanced therethrough and relates more particularly to controls for regulating the speed at which materials are advanced through such apparatus.

My U. S. Patent No. 2,324,068 which issued July 13, 1943, discloses bonding apparatus utilizing electrostatic energy from a vacuum tube oscillator for the generation of heat for bonding piles of material together. In such apparatus, the amount of heat generated in the material being heated is directly proportional to the dielectric loss of the material. Changes in the dielectric loss in the material being heated may be caused by changes in the density, moisture content, thickness or other physical or chemical characteristics of the material and these changes may result in some portions of the material being overheated and other portions being underheated if the material is advanced at a constant rate through the electrostatic field.

This invention compensates for changes in the dielectric loss of material being advanced through an electrostatic field by varying the speed of advance of the material through the field in accordance with changes in the dielectric loss of the material, whereby material having higher dielectric losses is exposed for a smaller time to the electrostatic field and material having lower dielectric losses has longer exposure.

An object of the invention is to improve the quality of the bond of material receiving heat in an electrostatic field by varying the time of exposure of the material to the field in accordance with the dielectric loss of the material.

The invention will now be described with reference to the drawing, of which:

Fig. 1 illustrates diagrammatically the electric circuit connections to the driving motor and electrodes of a roller type bonding press embodying this invention, and

Fig. 2 is a diagrammatic view of another embodiment of a control circuit which may be used with the bonding press of Fig. 1.

With reference first to Fig. 1, the base 5 of the press has mounted thereon the four upright supports 6. The metal bars 7 are attached to the lower ends of the supports 6, and have journaled therein the bearings 8 which support the cylindrical, metal roller 9.

The bars 10 of electric insulating material are slidably positioned along the supports 6. The springs 11 have their upper ends attached by the clamps 12 to the upper ends of the supports 6

and are attached at their lower ends to the insulating bars 10, and serve to support the bars 10 on the supports 6 while at the same time, they bias the bars 10 towards the lower bars 7.

The bearings 13 of the cylindrical, metal roller 14 are journaled in the bar 10. The springs 11 thus act to force the rollers 9 and 14 together for exerting pressure on the work to be bonded as will be described.

The lower roller 9 is rotated through the pulley 15 and belt 16 by the pulley 20 of the electric motor 21 and acts to move the work piece 22 therethrough.

The work piece 22 illustrated comprises two plies of leather with an adhesive therebetween.

The roller 14 is connected through its bearing 13 and shaft 15 to the electric conductor 18 which is connected to the tank coil 23 of the vacuum tube oscillator 24.

The metal bar 7 is connected by the electric conductor 17 to the center of the tank coil 23 and to ground.

The tank coil 23 is connected at one end through the coupling condenser 25 to the anode 26 of the tube 24 and through the radio frequency choke 27 to the positive side of a suitable high voltage direct current supply. The other end of the coil 23 is connected through the grid leak 28 shunted by the condenser 29, to the grid 30 of the tube 24. The midpoint of the coil 23 is connected to the cathode 31 of the tube 24 and to the negative side of the direct current source.

The oscillator circuit described in the foregoing is a conventional one and may be tuned as is well known to those skilled in the art to a high frequency which may, for example, be twenty megacycles, for establishing an electrostatic field between the rollers 9 and 14 which act as electrodes.

The electric motor 21 which advances the work piece 22 through the electrostatic field, is energized by direct current from the vacuum tube rectifier 32.

The anode 33 of the rectifier 32 is connected to one end of the secondary 34 of the transformer 35. The other end of the secondary 34 is connected by the conductor 36 to one supply terminal of the electric motor 21, and to ground.

The primary 37 of the transformer 35 is connected by the conductors 38 and 39 to a suitable source of alternating current which may be 110 volts, 60 cycle.

The primary 40 of the filament transformer 41 is connected in parallel with the primary 37 of the transformer 35. The secondary 42 of the

transformer 41 is connected at its ends to the opposite legs of the filament cathode 43 of the rectifier 32. The center point of the secondary 42 is connected by the conductor 57 through the grid resistor 44 and radio frequency choke 45 to the grid 46 of the rectifier 32, and to the other supply terminal of the motor 21. The condenser 47 bypasses radio frequency currents around the motor 21. The motor thus receives direct current from the rectifier 32.

The grid 46 of the rectifier is connected by the conductor 48 and the coupling condenser 49 to the tank coil 23 and receives high frequency alternating current therefrom.

In operation, as the motor 21 advances the work piece 22 through the electrostatic field between the roller electrodes 9 and 14, changes in the dielectric loss in the work piece cause changes in the high frequency voltage at the tank coil 23. Increases in the dielectric loss in the work piece will cause reduced high frequency voltages and decreases in the dielectric loss will cause increases in the high frequency voltages.

The high frequency alternating currents applied through the conductor 48 and coupling condenser 49 to the grid 46 of the rectifier 32 are rectified and provide voltage drops in the radio frequency choke 45 and the resistor 44 which vary with changes in the voltage of the high frequency current. These voltage drops bias the grid 46 of the rectifier 32 negative. Increases in the grid bias of the rectifier 32 cause corresponding decreases in the direct current voltage delivered by it to the motor 21 and decreases in the grid bias cause corresponding increases in the direct current voltage delivered to the motor 21.

The speed of the motor 21 varies in accordance with the voltage of the current delivered to it by the rectifier 32 so that when the dielectric loss in the work piece 22 increases, the motor 21 automatically speeds up so that the work piece has a shorter exposure to the electrostatic field, and when the dielectric loss decreases, the motor 21 automatically slows down so that the work piece is exposed a longer time to the electrostatic field. Thus regardless of changes in the dielectric loss of the material being bonded, the heat produced therein is that which is desired.

With reference to Fig. 2, the rectifier 32 instead of supplying the energizing current to the motor 21, acts instead to vary the strength of the magnetic field of the motor for varying its speed as will be described.

The motor 21 receives its energizing current from a suitable source through the conductors 58 and 59. Its armature 50 is connected directly to these conductors and its field winding 51 is connected in series with the resistor 52, the contact arm 53 and the armature 50.

The contact arm 53 is attached to one end of the plunger 54 of the solenoid 55. The plunger 54 has mounted thereon the bias spring 56 which tends to restore the armature 54, when retracted, to unretracted position.

The energizing winding of the solenoid 55 receives through the conductors 36 and 57, energizing current from the rectifier 32, which is connected and operated as described in the foregoing except that its output current is supplied to the solenoid 55 instead of the motor 21.

An increase in the voltage of the current supplied by the rectifier 32 to the solenoid 55 and caused as described, by a decrease in the dielectric loss in the work being bonded, causes the solenoid 55 to retract further its plunger 54. This causes the contact arm 53 to move along the resistor 52 and to decrease the resistance in series with the motor field winding 51 and causes the motor 21 to slow down. A decrease in the voltage of the current supplied by the rectifier to the solenoid, caused by an increase in the dielectric loss in the work being bonded, causes the field strength of the solenoid to be less so that the spring 56 moves the plunger 54 towards unretracted position, which in turn moves the contact arm 53 to place more resistance in series with the motor field winding 51 causing the motor to speed up.

While the work piece being bonded has been illustrated as a continuous ply of leather with adhesive therebetween, the material being bonded may be plastics not requiring adhesives and may be advanced as separate items as on a conveyor.

While embodiments of the invention have been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangements of apparatus illustrated as modifications thereof may be suggested by those skilled in the art without departure from the essence of the invention.

What is claimed is:

1. Heating apparatus comprising means including a vacuum tube oscillator for generating alternating current, means including said oscillator for establishing an electrostatic field, means for advancing material to be heated through said field, a rectifier, means for supplying alternating current from said oscillator to said rectifier for rectification, and means including means utilizing rectified current from said rectifier for adjusting the rate of advance of said advancing means.

2. Heating apparatus comprising means including a vacuum tube oscillator for generating alternating currents, means including said oscillator for establishing an electrostatic field, means including an electric motor for advancing material to be heated through said field, a vacuum tube rectifier, means including said rectifier for supplying rectified alternating current to said motor for energizing same, and means responsive to variations in the alternating current voltage from said oscillator for varying the impedance of said rectifier for varying the voltage of the current delivered thereby to said motor.

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