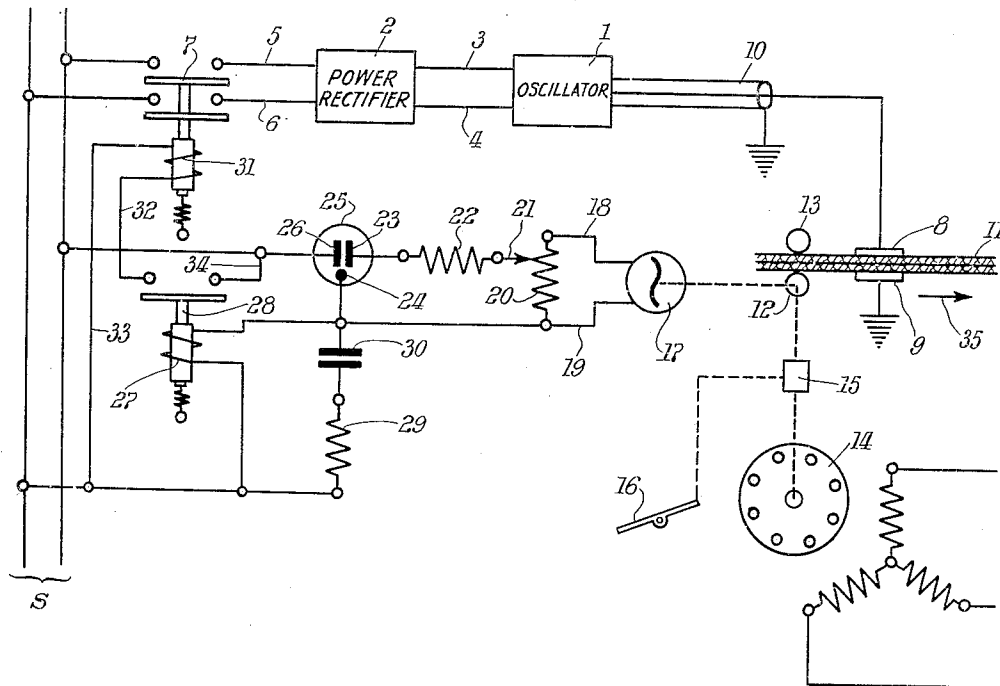


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OSCILLATOR CONTROL SYSTEM FOR
ELECTRIC BONDING MACHINES
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WITNESS:

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OSCILLATOR CONTROL SYSTEM FOR
ELECTRIC BONDING MACHINES

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This invention relates to a control system and particularly to a system for controlling the turning on and off of an electron tube oscillator responsively to the speed of a feed drive for advancing material through a radio-frequency electric field supplied by said oscillator.

It is customary and desirable, with bonding machines in which the material to be bonded is progressively fed through an electric field supplied by an oscillator, to provide means for rendering the oscillator ineffective whenever the feed stops and to render it effective when the feed starts. Formally, this has been accomplished by a switch operated from the foot-treadle which operates to clutch and de-clutch the machine shaft from the machine driving motor. Certain disadvantages are inherent in this treadle switch arrangement, among which the following are the more important:

1. The difficulty of determining a single mechanical setting for the tripping point of the switch relative to the treadle position for minimum feed of unbonded material during both the starting and the stopping periods.

2. The necessity of frequent readjustment of this setting due to compensation for the wear of clutch and brake surfaces.

It is a primary object of this invention, therefore, to provide an on-off control for an oscillator of an electric bonding machine which control shall have an electrical setting for timing with respect to feed which setting remains independent of the ordinarily adverse effects of surface wear of the clutch and brake employed to control the feed drive.

This object is attained, according to the invention, through the use of a control system which responds, with minimum time lag, directly to the speed of the feed.

The invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, the single figure is a diagrammatic illustration of a control system wherein the invention has been embodied.

The figure shows an oscillator 1, preferably of the type employing electron tubes requiring direct-current voltage for the plates thereof. A power rectifier 2 is connected to the oscillator 1 by means of leads 3 and 4 and receives its energy from the single-phase, alternating-current supply S by way of leads 5 and 6 through the contacts of relay 7. The radio-frequency output of the oscillator 1 is connected to electrodes 8 and 9

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by means of coaxial cable 10. Material 11, to be bonded, is fed through the electric field set up between the electrodes 8 and 9. This feed is effected in a direction indicated by the arrow 35 by means of a feed wheel 12 cooperating with a roller presser 13 which may also be a driven feed wheel. The feed wheel 12 is driven from a continuously-running motor 14 through a clutch and brake transmitter 15 rendered selectively effective for starting and stopping the feed upon actuation of a foot treadle 16. This transmitter 15 may be of the type shown and described in the U. S. Patent No. 1,652,319 to which reference may be had for a more complete description thereof.

A rotation generator 17 of the inductor alternator type, shown and described in the copending application Serial No. 646,972 of James W. Momberg filed February 12, 1946, now U. S. Patent No. 2,462,761, is mechanically connected to the output shaft of the transmitter 15 so that its speed will be proportional to that of the feed wheel. This generator 17 generates an alternating voltage which is proportional to its speed and therefore to the feed wheel speed and thus to the average linear feeding rate. Connected electrically to the generator 17 by means of leads 18 and 19 is a potentiometer 20 with an adjustable slider 21 for taking off any desired proportion of the total voltage generated. This proportional voltage is applied through a current-limiting resistor 22 to a control or starter electrode 23 and cathode 24 of a cold-cathode gas triode 25 having an anode 26. This tube may be a standard commercial R. C. A. OA4-G tube. The cathode 24 is connected in series with the coil 27 of a relay 28 to one side of the supply S. The other side of the supply S is connected to the anode 26 so that conduction through the tube 25 from cathode to anode will cause current to flow in the coil 27 of relay 28. Due to rectification within the tube, the coil current will be pulsating D.-C. and, in order to filter out the A.-C. component thereof, a series R. C. filter comprising resistor 29 and capacitor 30 is connected across the coil 27.

The relay 28 operates to connect coil 31 of relay 7 across the supply S by way of leads 32, 33 and 34. It will be understood that relays 7 and 28 are shown in their normally-open unexcited condition and, when their respective coils are excited, they pick up to close their contacts.

Tube 25 has special and well-known characteristics so that, for a given voltage impressed across the anode 26 and cathode 24, there is a certain minimum voltage above which, if impressed across the starting electrode 23 and the cathode

24, will cause current conduction through the tube from cathode to anode.

In operation, when the foot-treadle 16 is actuated, the motor 14 is connected to drive the feed wheel 12 through the clutch and brake transmission 15, and material 11 begins to move through the field between electrodes 8 and 9. Simultaneously, generator 17 is being driven up to speed with the feed wheel 12 and is generating a voltage proportional to its speed at any instant. Thus, as the feed accelerates, the voltage increases accordingly and a predetermined proportion of said voltage, controlled by the position of the slider 21, is impressed on the starting electrode 23 and cathode 24 circuit of tube 25. When this voltage has increased to a value determined by the voltage from S impressed on electrodes 24 and 23, the tube 25 will conduct and current will flow from the supply S through coil 27, and relay 28 will pick up and connect relay coil 31 across the supply S. This will cause relay 7 to pick up and connect the power rectifier to the supply S, whereupon the oscillator plates are supplied with D.-C. voltage and radio-frequency energy is liberated in the material 11 between electrodes 8 and 9.

It is clear that there will be a time delay represented by the time taken for the feed to accelerate to a speed productive of sufficient voltage to cause tube 25 to conduct and turn on power to the oscillator. During this delay period, there may be feed without bonding and it should, therefore, ordinarily be kept to a minimum. Due to the very high acceleration with the clutch-type transmitters usually employed, this delay time will be very small and, with the control tied directly to the feeding rate, very little material need be fed before bonding begins.

Similarly, when stopping the machine, the treadle is released to brake the feed drive, the feed rate decreases and the voltage from alternator 17 falls off quickly to a value below that necessary to cause tube 25 to conduct, whereupon relays 28 and 7 drop out and remove direct-current power from the oscillator. Very shortly thereafter, the feed stops and, if material is being fed during this period, it will not be bonded.

Thus, it is perceived that I have provided an oscillator control system which is independent of treadle position and which responds automatically to the feeding rate. Since the response of such a system is independent of how the feeding rate is obtained, it is clear that wear of transmission elements, such as clutch and brake shoes, can have no effect on changing the control setting.

It is evident that, by manual adjustment of the slider 21, the motor speed at which tube 25 conducts and relay 28 picks up may be preset and thereafter said setting does not change, regardless of wear of the clutch and brake elements of the transmitter 15.

Although there is shown herein, as a preferred form, an embodiment in which the electrodes 8 and 9 are elements separate from the feeding elements 12 and 13, the invention is not to be considered as so limited but includes within its scope that form in which the feeding elements 12 and 13 are also the electrodes in which case

the connections from the end of the coaxial cable are made to said feeding elements.

It is to be understood that various changes may be made in the construction, arrangement and interrelation of the parts constituting the invention without departing from the spirit thereof.

Having thus set forth the nature of the invention, what I claim herein is:

1. A control system for an electric bonding machine, comprising a radio-frequency oscillator, electrodes electrically connected to said oscillator to set up an electric field, feeding-means for advancing material through said field, a rotatable shaft for actuating said feeding-means, a pilot generator connected for rotation with said shaft and producing an output voltage of magnitude proportional to the speed of said shaft, electronic means electrically connected to said pilot generator, and relay means connected to said electronic means and operative responsively to said shaft speed to turn on and off the oscillator in step with the respective starting and the stopping of the feed.

2. A control system for an electric bonding machine comprising a radio-frequency oscillator, electrodes connected to said oscillator for establishing an electric field therebetween, feeding-means for advancing material through said field, a generator connected for rotation upon actuation of said feeding means and effective to produce an output voltage of magnitude proportional to its speed, means for selecting a predetermined portion of said voltage, electronic means connected to receive said selected proportional voltage, and relay means connected to said electronic means and operative responsively to the rate of advance of the material by said feeding means whereby to turn on and off the oscillator in step with the respective starting and stopping of said feeding means.

3. In an electric bonding system, a radio-frequency oscillator, electrodes connected to said oscillator for establishing an electric field, a power rectifier connected to supply power to said oscillator, feeding means for advancing material to be bonded through said field, generator means connected for rotation upon actuation of said feeding means and effective to produce an output voltage proportional to its speed, electronic means connected to receive said voltage, and relay means connected electrically to said electronic means and operative responsively to the rate of advance of the material by said feeding means to render said power rectifier ineffective to supply power to said oscillator.

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