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J. B. REEVES

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SPEED CONTROL FOR CAPACITOR-RUN MOTORS

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Fig. 1

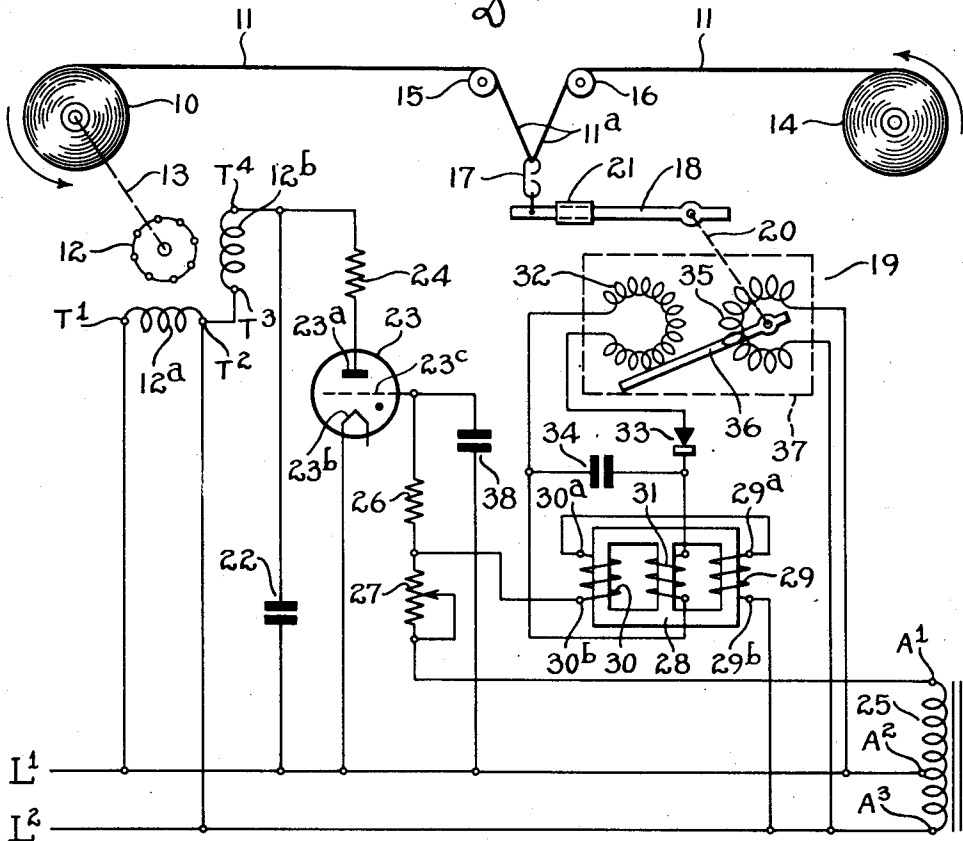
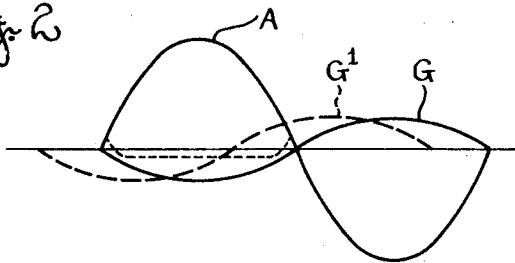


Fig. 2



Inventor
James B. Reeves
By *W. Edgou*
Attorney

UNITED STATES PATENT OFFICE

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SPEED CONTROL FOR CAPACITOR-RUN MOTORS

James B. Reeves, Whitefish Bay, Wis., assignor to
Cutler-Hammer, Inc., Milwaukee, Wis., a cor-
poration of Delaware

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3 Claims (Cl. 318-227)

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This invention relates to speed control for capacitor-run motors.

The speed control herein disclosed is in certain respects similar to that disclosed in the Jones and Reeves application, Serial No. 93,142, filed May 13, 1949, and is an improvement thereon.

While not limited thereto, the present invention is particularly applicable for governing operation of capacitor-run motors when driving winding or reeling devices such as are used in the packaging of textile thread.

A primary object of the invention is to provide control of a simple, sensitive and reliable character for controlling the speed of motors of the aforementioned type so that they will provide for reeling of lengths of material at substantially constant tension.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate a preferred embodiment of the invention which will now be described, it being understood that the embodiment illustrated is susceptible of various modifications without departing from the scope of the appended claims.

In the drawings:

Figure 1, which is in part diagrammatic and in part schematic, illustrates a control system for motor-driven thread winding apparatus embodying my invention, and

Fig. 2 graphically illustrates the time phase relationship of voltages existing in an element of the control system of Fig. 1.

Referring to Fig. 1, it shows a motor-driven thread winder comprising a reel or bobbin 10 on which a length of thread 11 is to be wound by means of a capacitor-run, alternating current motor 12 which drives bobbin 10 through a shaft 13. The thread 11 is shown as being supplied from a spool 14 which may here be assumed to be driven by known means in a manner to insure a constant let-off speed of the thread with respect thereto.

Idler rollers 15 and 16 are suitably placed in the path of thread 11 between spool 14 and bobbin 10 to facilitate the formation of a loop or festoon 14' in thread 11 which passes through a thread guide or eyelet 17 secured to a tension arm 18 of a control device 19. Tension arm 18 is non-rotatably secured to a shaft 20 of control device 19 and is provided with a weight 21 which may be variously positioned thereon to adjust the force exerted through the eyelet 17 on thread 11.

Motor 12 is provided with two primary windings 12^a and 12^b. Winding 12^a is connected through end terminals T¹ and T² to supply lines L¹ and L², said supply lines providing a source of single phase alternating current. Winding 12^b is connected to supply line L² through its end terminal T³ and is connected to one terminal of a

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capacitor 22 through its end terminal T⁴. Capacitor 22 has connection through its other terminal to supply line L¹. Winding 12^b also has connection through its end terminal T⁴, in series with a current limiting resistor 24, with the anode 23^a of a gas triode tube 23. Tube 23 is provided with a cathode 23^b which has connection with supply line L¹ and a control electrode 23^c through the medium of which its conductor is controlled.

Control electrode 23^c of tube 23 is connected, in series with a resistor 26 and an adjustable resistance 27, to a high potential terminal A¹ of an autotransformer 25. Autotransformer 25 is also provided with terminals A² and A³ which have connection with supply lines L¹ and L², respectively.

A saturable reactor 28 is provided with differentially connected alternating current windings 29 and 30 which are interconnected through their respective end terminals 29^a and 30^a. Winding 29 has connection through its end terminal 29^b with supply line L² and winding 30 has connection through its end terminal 30^b with a point common between resistor 26 and adjustable resistance 27. Reactor 28 also has, for controlling its degree of saturation, a winding 31 which is supplied with energizing current derived from the output coil 32 of control device 19.

One end of coil 32 of control device 19 is connected, in series with a half wave rectifier 33, to one end of saturating winding 31, and the other end of coil 32 is connected to the other end of said winding 31. A filter capacitor 34 is connected in shunt across saturating winding 31 to maintain saturating current in winding 31 during the half cycles when rectifier 33 is non-conducting.

Control device 19 is provided with an input coil 35 which is connected at one end to supply line L¹ and at its other end to supply line L². Control device 19 is further provided with an arm 36 which is non-rotatably secured to shaft 20 and is adapted to assume various angular positions in response to rotational movement of shaft 20 to vary the magnetic flux linking coils 32 and 35. A frame 37 (shown in broken lines) is provided to support the aforescribed components of control device 19. The arm 36 and frame 37 are preferably formed of a magnetic material such as soft steel to provide a low reluctance path for the magnetic flux induced by energization of coil 35. A preferred form of control device 19 is shown and described in detail in the Jones and Reeves patent application, Serial No. 36,718, filed July 2, 1948, which application also describes the characteristics and behavior of the device.

A capacitor 38 is preferably connected between control electrode 23^c of tube 23 and line L¹ to provide for suppression of transient currents in a well known manner.

As will be apparent to those skilled in the art, adjustable resistance 27 inclusive of its connections with autotransformer 25, constitutes one side of a phase-shift network for the control electrode 23^c of tube 23 while the saturable reactor 28 and the control device 19 inclusive of their interconnections aforescribed, constitutes the other side of the same phase-shift network. Through the medium of this phase-shift network, control electrode 23^c of tube 23 is subjected to an alternating current potential of substantially constant amplitude which is varied in time-phase relation with respect to the potential of anode 23^a of tube 23 in accordance with the degree of magnetic coupling afforded between coils 32 and 35 of control device 19 by the arm 36 as will now be more fully described.

When control device 19 is in the condition depicted in Fig. 1, minimum coupling exists between coils 32 and 35 and the voltage induced in coil 32 is at minimum value. Consequently, saturating winding 31 of reactor 28 is afforded minimum energization with the result that the alternating potential of control electrode 23^c is essentially 180° out of phase with respect to the potential of anode 23^a of tube 23. Fig. 2 depicts the relation of the potential of anode 23^a (curve A) with respect to the potential of control electrode 23 (full line curve G) when the latter is displaced essentially 180° in time-phase therefrom. Consequently, tube 23 is thereby rendered non-conducting throughout its conducting half cycles.

Under the condition depicted in Fig. 1, motor 12 will run at maximum or top speed. With tube 23 rendered non-conducting throughout its conducting half cycles, motor winding 12^b is supplied with current which is displaced substantially ninety degrees out of phase with respect to the current supplied to winding 12^a and at the same potential.

In the control system herein disclosed, the relationship of tension arm 18 and coupling arm 35 is such that as the length of the loop 11^a in thread 11 decreases, due to an increase in the diameter of bobbin 10, arm 36 will be moved toward the position where it affords maximum magnetic coupling between coils 32 and 35.

As the coupling between coils 32 and 35 is increased, the alternating potential to which control electrode 23^c is subjected is progressively shifted more into an in-phase relation with respect to the potential of anode 23^a, as depicted by broken line curve G' in Fig. 2. Consequently, the conductivity of tube 23 is progressively increased. Thus the current in the motor winding 12^b is thereby altered in potential and changed in phase relationship with respect to the current in motor winding 12^a and motor 12 is caused to decrease in speed. When the condition of maximum coupling obtains in control device 19, motor 12 will run at minimum speed.

The speed range of motor 12 may be varied between a top speed, which remains essentially fixed, and a minimum speed which may be varied by adjustment of the adjustable resistance 27. Adjusting resistance 27 to include more resistance in circuit causes motor 12 to operate at a lower minimum speed.

The use of the current limiting resistor 24 in the anode circuit of tube 23 is preferred in order to limit the peak current which may pass through tube 23. This is desirable because it is possible to start tube 23 conducting when capacitor 22 is charged to peak voltage.

I claim:

1. In combination, an induction motor having a primary winding for substantially constant excitation and a second primary winding for variable excitation, means to subject said second primary winding to potentials differing in phase and amplitude with respect to the potential impressed upon said first primary winding, said means comprising in series with said second winding and in parallel relation with one another a capacitor and a gaseous electron tube having a control grid, a transformer comprising an input coil to be subjected to constant alternating current excitation, an output coil, and means for varying the magnetic coupling between said coils of said transformer, and a phase-shift network in circuit with said control grid for subjecting the same to an alternating control potential varying in phase relation with respect to the anode potential of said tube in accordance with the degree of magnetic coupling between said coils of said transformer.

2. In combination, an induction motor having a primary winding for substantially constant excitation and a second primary winding for variable excitation, means to subject said second primary winding to potentials differing in phase and amplitude with respect to the potential impressed upon said first primary winding, said means comprising in series with said second winding and in parallel relation with one another a capacitor and a gaseous electron tube having a control grid, a transformer comprising an input coil to be subjected to constant alternating current excitation, an output coil, and means for varying the magnetic coupling between said coils of said transformer, and a phase shift network in circuit with said control grid for subjecting the same to an alternating control potential, said network including a saturable reactor having its saturating winding supplied with rectified current derived from said output winding of said transformer for affording variation in the phase relation of said control grid potential with respect to the anode potential of said tube in accordance with the magnetic coupling between said coils of said transformer.

3. In combination, an induction motor having a primary winding for substantially constant excitation, and a second primary winding for variable excitation, means to subject said second primary winding to potentials differing in phase and amplitude with respect to the potential impressed upon said first primary winding, said means comprising in series with said second winding and in parallel relation with one another a capacitor and a gaseous electron tube having a control grid, and a phase shift network for subjecting said control grid to an alternating control potential comprising a transformer having an input coil subjected to constant alternating current excitation, an output coil, and means for varying the magnetic coupling between said coils of said transformer, a saturable reactor, means in circuit with said output winding and the saturating winding of said reactor for supplying the latter with rectified current varying in value in accordance with the magnetic coupling between said coils of said transformer, said reactor by consequent variation of its saturating current serving to vary the phase of the control potential with respect to the anode potential of said tube.

JAMES B. REEVES.

No references cited.