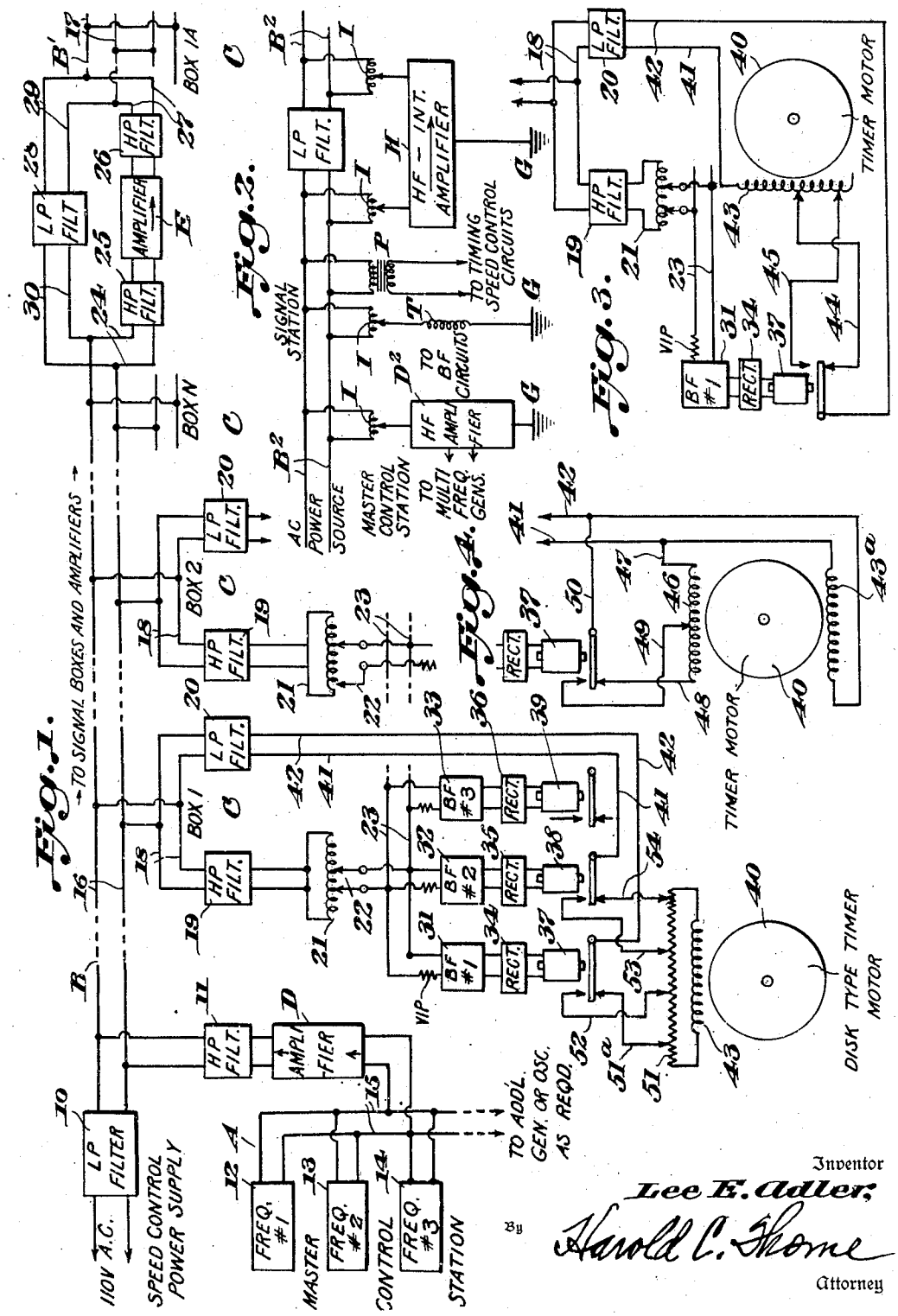
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MULTIFREQUENCY TRAFFIC CONTROL SYSTEM

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MULTIFREQUENCY TRAFFIC CONTROL SYSTEM

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This invention relates to traffic control systems and more particularly to the provision of a multi-frequency system wherein a plurality of control frequencies are employed at a master control station for controlling the traffic system and each traffic box or station is provided with selective operative means responsive to the different control frequencies applied to the system from the master control station.

One of the primary objects and advantages of the invention in the provision of a multi-frequency traffic control system is the reduction of the number of cable conductors or line wires for the operation of the traffic lights to one pair of conductors or a maximum of two pairs, whereby the system may be installed to operate over any existing line facilities such as fire alarm circuits, telegraph or telephone lines, underground power lines, etc.

Another object and advantage is that where existing underground traffic control lines are "blocked" and more master-controlled functions are needed, the multi-frequency control system can be applied to such lines at much less expense than the cost of replacing the under-ground system.

Another object and advantage in the provision of a multi-frequency control system in accordance with my invention is that smaller gauge conductors can be used than now required.

Another object of my invention is to provide a multi-frequency control system which may be superposed on power lines supplying power for operation of the traffic signal appliances and/or other devices.

Another object of the invention is to extend the distance over which the signals may be transmitted whereby centralized control of long highway systems may be obtained.

Another object of the invention is the provision of one way amplifiers at any desired points along the control lines whereby the multi-frequency control may be extended any required distance for the operation of signal appliances at various stations or boxes along the system in synchronism with each other throughout the system.

Another object of the invention is the provision of means whereby the multi-frequency control system may be superimposed on power lines either directly or in simplexed relation thereto without interfering therewith and the amplifiers may be introduced at the required points so as to amplify the control frequencies independently of the power current in the lines.

Another object of the invention is to provide a multi-frequency traffic control system wherein each traffic control station or box is connected with the control lines through an impedance matching or potential equalizing means such as an impedance matching transformer whereby a uniform operation of the successive traffic control boxes is maintained.

Another object of the invention is to provide for individual control frequency potential regulation in each of the traffic control station boxes whereby each of the frequency control circuits in each signal control station may be independently adjusted.

Another object of the invention is to provide a multi-frequency traffic control system wherein the control frequencies and the power supply frequency are supplied independently to each traffic control station or box or when the control frequencies are superimposed on the power supply frequency, for separating them from each other for the control and operation of traffic signal appliances.

Further objects, details and advantages of the invention will be more fully set forth in the following specification in conjunction with the accompanying drawing and claimed hereinafter.

In the drawing,

Fig. 1 is a diagrammatic illustration of a multi-frequency control system in accordance with my invention.

Fig. 2 is a fragmentary diagram of a modified arrangement of the system.

Figs. 3 and 4 are fragmentary diagrams of modified arrangements of timer controllers at traffic signal control boxes.

In general the control system in accordance with this invention includes a master signal control station with a control panel for applying a multiplicity of frequencies either singly, successively or simultaneously from frequency generators or oscillators, A as shown in the drawing, on existing line facilities illustrated as power lines B for conducting the usual power current frequency and potential, —30, 50 or 60 cycles and 40, 50, 80–110 volts or more, as may be employed in the traffic system to traffic signal control station boxes C along the power transmission lines or the like B of the traffic control system. The system is such that the control frequencies which preferably are in the audio range, say 500, 1000, 2000 cycles per second, etc., may be superimposed on said power transmission lines. Both the power current frequency and signal control frequencies are introduced from lines B into each

signal control station box C where they are separated from each other to control the timer speed and perform the signal control functions respectively and the signal control frequencies are amplified at D at the master signal control station and at E along lines B at such intervals as amplification may be required so that there is no limit as to the distance which the system will operate.

In the embodiment of the invention illustrated in Fig. 1 the transmission lines B are shown as being supplied with 110 volt AC power at the master signal control station through a low pass filter 10 and the various control frequencies are fed into lines B through a high pass filter 11. These filters 10 and 11 prevent interference of the low (power) and high (signal) frequencies with each other at their sources back of the filters.

The signal or multi-frequency controls at A in the master signal control station, comprises a plurality of frequency generators or oscillators 12, 13, 14, etc. each capable of generating a different and distinct control frequency above the power current frequency and separated from each other by a megacycle or even half a magacycle is found sufficient for the purpose, and their functioning may be controlled by means of switching mechanism on a master control panel (not shown).

The outputs of these frequency generators are connected in parallel by means of conductors 15 as shown and to the input of a one way amplifier D which is a standard audio amplifier capable of transmitting all frequencies from 200 to at least 10,000 cycles with little or no discrimination. The output of amplifier D, as shown feeds through the high pass filter 11 into transmission lines B.

Traffic control transmission lines B as illustrated in Fig. 1 comprise a cable with one pair of conductors 16 which may extend in any desired manner along the traffic system to be controlled through preferably underground conduits, and an advantage of the present system is that it may be applied to an existing cable having a single pair of conductors without having to replace the cables with a greater number of conductors or larger conductors. At various traffic control points along the system are traffic control stations C designated as boxes. As many station boxes C as may be required are connected to transmission lines B, three, box 1, intermediate box 2 and box N being shown and then along extension transmission lines B^1, comprising a pair of conductors 17, more stations are connected, box 1A being indicated.

The signal control stations are identical in construction and arrangement, the arrangement being shown diagrammatically in box 1 is not repeated in full in the succeeding boxes along the system.

As shown at box 1 and box 2 connected with the transmission lines B by means of a pair of conductors 18 are a high pass filter 19 and a low pass filter 20 which separate the low frequency speed control power supply from the higher control frequencies. The high pass filter 19 at each station is connected with an impedance matching or potential equalization transformer shown as an auto transformer 21 having variable taps 22 feeding into multi-frequency circuit conductors 23. It will be seen that by means of these variable tapped transformers the potentials supplied to the multi-frequency circuits at the different station boxes may be adjusted and equalized, box 2 being at a greater distance along the system has taps 22 of its transformer 21 set to include a larger number of transformer turns than the number of transformer turns included by taps 22 at box 1.

A still greater number of transformer turns are included at succeeding traffic control station boxes along transmission lines B to a distance where the control high frequencies are amplified by a one way amplifier E which is similar to amplifier D at the master control station. The input of amplifier E is connected with conductors 16 of the power transmission lines B by conductors 24 through a high pass filter 25 and its output is connected through another high pass filter 26 by conductors 27 with conductors 17 of an extension power transmission line B^1 where the potentials of the control high frequencies are amplified sufficiently so as to operate the control equipment for the signals to be controlled along lines B^1 for an extended distance where another amplifier may be installed.

Speed control AC power is supplied into extension transmission lines B^1 through a low pass filter 28 by conductors 29 to conductors 17 of lines B^1. While this may be an increased potential speed control power supply but as shown the input of filter 28 receives the power supply through conductors 30 from conductors 16 of the power transmission lines B without amplification.

In this manner the control, high frequencies may be amplified and the speed control power supply maintained on the transmission lines of the traffic control system for any desired distance and the potentials of the high control frequencies may be boosted without interference. Low pass filters 28 prevent feeding of the control frequencies backward into the power supply or backwards into transmission lines B.

It will be seen that the arrangement of high pass and low pass filters at the master signal control station, the station boxes and at amplifiers connecting extension control lines prevent interference between the power supply and control frequencies whereby both power and a multiplicity of control frequencies may be transmitted and operate traffic control equipment at various station boxes along the system without interference. Obviously by employing two separate pairs of conductors, one for the power supply and the other for control multi-frequencies the high and low pass filters will not be required, but in such an arrangement two pairs of conductors instead of one pair will be required which is not always practicable and increases the expense if such extra facilities have to be provided.

While in the arrangement shown in Fig. 1 multi control frequencies are impressed directly on the transmission lines, of course one of the high frequency conductors may be the ground and the other one of the line conductors as suggested by Fig. 2. In Fig. 2, however, is disclosed an arrangement whereby the control frequencies are in simplexed relation with respect to a two conductor power transmission line B^2. In this arrangement one side of the high frequency one way amplifier D^2 at the master signal control station is connected to a center tap of an inductance I connected across the line conductors B^2 and the other side of the amplifier is grounded at G. At each traffic control station box a similar center tapped inductance I feeds into one side of a transformer T and therethrough to a ground G. The control station is similar to the

signal control boxes as shown in Fig. 1, transformer T being similar to transformers 21 and feeds into a multi-frequency control circuits as shown therein and described hereinafter. Power current is derived from lines B^2 through a transformer P if one is required for supplying a different potential from that of the transmission lines for operating the timing speed control.

In amplifying the control frequencies at distant points along the system an amplifier of the type heretofore described is illustrated as a high frequency intermediate amplifier H providing an interconnection between the transmission lines B^2 and transmission lines B^3. Center tapped inductances I are provided in the interconnection with the two conductors of each of the two transmission lines and a ground G provides the connection for the ground conductor for the high frequency currents. Transmission lines B^3 are energized with low frequency power potential in any suitable manner, as shown by a low pass filter F, an interconnecting transformer between the transmission lines B^2 and B^3 which provides a block to the passage of the higher control frequency currents between them.

In the arrangement of the frequency control system in the signal control stations C as shown in detail at box 1 in Fig. 1 the multi-frequency circuit conductors supply the regulated potentials from transformer 21 to each of a plurality of band filters 31, 32, 33 which are individually responsive to potentials generated by the frequency generators 12, 13 and 14 respectively at the master signal control station. In circuit with each of these band filters is an additional potential adjuster such as a rheostat, variable impedance transformer or variable impedance pad VIP whereby in addition to the station potential equalizing by means of the adjustable transformer 21 each separate control frequency potential may be individually adjusted in its control circuit.

While a somewhat similar embodiment of frequency control system wherein elements are disclosed more or less in detail in my Patent No. 2,099,250 of Nov. 16, 1937, for a Telephone signal system, now pending reissue, in accordance with the present invention an improved arrangement for multi-frequency control operation at each of a multiplicity of control stations of a traffic control system is provided as just referred to above and hereinafter further described.

For purposes of disclosure and a highly satisfactory arrangement the band filters 31, 32 and 33, each feed their corresponding frequency potential #1, #2 and #3, as they are applied to the transmission lines B from the oscillators 12, 13 and 14 at the master signal control station, directly into corresponding rectifiers 34, 35 and 36 and the rectified currents therefrom are employed to energize DC relays 37, 38 and 39 respectively.

At each of the signal control stations C signal control timing mechanism, as shown a disk type timer motor 40, is connected with the power supply, that is with conductors 41 and 42 which are connected with the low pass filter 20 through which the power current is supplied. The speed of operation of motors 40 is controlled by means of a number of the control frequencies which are superimposed upon the control transmission line conductors 16, 17. These motors operate the signal circuits in the usual manner and in turn, as just set forth, their operation in effecting the signal operations is controlled over the control transmission lines from the master signal control station.

Simplified control arrangements for effecting the operation of motors 40 are shown in Figs. 3 and 4. For simplicity these arrangements are disclosed for two speed operation employing but one control frequency, frequency #1, however obviously additional speeds can be obtained by additional relays and taps. Resistors, as will also be referred to, may likewise be used in place of motor winding taps, or separate winding sections may be employed in assisting or opposing connections.

As shown in Fig. 3 power is applied by way of conductors 41 and 42 to the driving winding 43 of disk type motor 40, relay 37 controlling the application of power through conductors 41 and 42 through a portion only of winding 43 when the relay is deenergized and through the entire winding when relay 37 is energized by the application of frequency #1 to the control transmission lines at the master signal control station. The circuits for accomplishing this comprises the connection of conductor 41 with one end of driving winding 43, conductor 42 connected with the armature of relay 37, the back contact of said relay connected by conductor 44 with a mid portion or tap of winding 43, and the front contact of relay 37 connected by conductor 45 with additional turns or the other end of driving winding 43.

The simplified arrangement in Fig. 4 is similar in many respects to that shown in Fig. 3, the variations being that the disk type motor 40 has its driving winding 43a connected directly with the power through conductors 41 and 42 and I have provided a tapped bucking winding 46 for varying the speed of the timing mechanism. In this instance the bucking winding 46 or a portion thereof is energized also with power from conductors 41 and 42, the amount of this winding which is energized being controlled by relay 37 in a manner similar to that shown in Fig. 3 wherein different amounts of the driving winding are energized by the control of the relay. Here bucking winding 46 has one end connected by conductor 47 to power conductor 41 and its other end by conductor 48 to the back contact of relay 37; a tapped portion of this winding is connected by conductor 49 with the front contact of said relay and the armature of this relay is connected by conductor 50 with the other power conductor 42. While this arrangement is operable from the master signal control station by a single frequency, frequency #1 for two control speeds of the signal control timing mechanism, by means of additional taps of the bucking winding and additional control frequencies and relays responding thereto additional speeds may be obtained.

Such additional control speeds are disclosed in the arrangement of the signal control timing mechanism shown connected with box 1, Fig. 1, wherein the disk type timer motor 40 has its driving winding connected with the power, and by means of only two frequencies, frequency #1 and frequency #2, a four speed control of the timing mechanism is obtained leaving frequency #3 and other additional control frequencies which may be available for other purposes. Such additional control frequencies may be employed in the operation of another differently timed signal control system, or in the signal control stations or boxes performing other operations such as starting, stopping, resetting the timing mech-

anism, all of which is not specifically claimed in this particular application.

In this arrangement, while the speed control of the timing mechanism could be had by varying the current effect in a bucking winding, as shown the control is obtained by varying the current strength in the driving winding 43. A tapped resistance or potentiometer 51 is connected across the ends of winding 43. Tap conductors 51 and 52 of this potentiometer are connected to back and front contacts of relay 37 respectively and the other two tap conductors 53 and 54 extending from the potentiometer are connected with the front and back contacts respectively of relay 38. Power conductors 41 and 42 are connected to the respective armatures of relays 37 and 38 and the current strength in driving winding 43 is variably controlled at the master signal control station by the variable application of frequencies #1 and #2 on the signal control line conductors for such variable operation of these two relays 37 and 38. The four speeds are obtained by the relay operation as follows:

1st speed (HI) neither relay operated.
2d speed (INT) relay 37 operated.
3d speed (INT) relay 38 operated.
4th speed (LOW) relays 37 and 38 operated.

For first speed it will be seen that the greater portion of the resistance of potentiometer 51 is between the power connections whereby driving winding 43 receives its heaviest current, (the adjustment of the taps in each instance of course determines the speed), whereby the motor timing mechanism is driven for high (HI) speed operation. As relays 37 and 38 are energized and operated the amount of resistance between the power connections is decreased and the resistance in series with the driving winding is increased thereby reducing the speed of operation for second and third speeds, the two intermediate (INT) speeds. When both relays are operated the series resistance of the potentiometer with respect to the driving winding is a maximum and the resistance between the power taps in a minimum (in accordance with the adjustment of the taps) and the timing mechanism will be driven at fourth (LOW) speed.

In view of the foregoing description the operation of the signal control system is clearly set forth and numerous other advantages and embodiments within the scope of my invention will appear to those skilled in the art.

I do not wish to limit myself to any of the specific embodiments or modes of operation described above in this specification for purpose of giving examples or illustrations of employment of the invention, for it will be obvious that wide departure from the above may be made without departing from the spirit and scope of my invention which is as set forth in the following claims.

I claim:

1. A control system operable in cooperation with a power transmission line comprising, a master transmitting control station and a plurality of receiving control stations distributed at points along the power transmission line, means at the transmitting control station for generating a plurality of control frequencies and transmitting them as desired over the power transmission lines, control circuits individually responding to the control frequencies transmitted at each receiving control station, a variable speed motor at each receiving control station receiving its operating power current from the power transmission line, and means for controlling the power delivered to each of said variable speed motors and thereby the speed of the motors simultaneously by simultaneous operation of one or more of the control circuits at each receiving control station in response to control frequencies transmitted.

2. A control system operable in cooperation with a power transmission line comprising, a master transmitting control station and a plurality of receiving control stations distributed at points along the power transmission line, means at the transmitting control station for generating a plurality of control frequencies and transmitting them as desired over the power transmission lines, control circuits individually responding to the control frequencies transmitted at each receiving control station, a variable speed motor at each receiving control station receiving its operating power current from the power transmission line, means for controlling the power delivered to each of said variable speed motors and thereby the speed of the motors simultaneously by the simultaneous operation of one or more of the control circuits at each receiving control station in response to control frequencies transmitted, means to prevent interference between the power and control currents as they are introduced and received from the power line, means for equalizing the potentials of the control frequency currents at each receiving control station, and means for adjusting each control frequency potential with respect to the others at each receiving control station.

3. A control system operable in cooperation with a power transmission line comprising, a master transmitting control station and a plurality of receiving control stations distributed at points along the power transmission line, means at the transmitting control station for generating a plurality of control frequencies and transmitting them as desired over the power transmission lines, control circuits individually responding to the control frequencies transmitted at each receiving control station, a variable speed motor at each receiving control station receiving its operating power current from the power transmission line, means for controlling the power delivered to each of said variable speed motors and thereby the speed of the motors simultaneously by the simultaneous operation of one or more of the control circuits at each receiving control station in response to control frequencies transmitted, means to prevent interference between the power and control currents as they are introduced and received from the power line, means for equalizing the potentials of the control frequency currents at each receiving control station, means for adjusting each control frequency potential with respect to the others at each receiving control station, and means in the transmission lines at a distance from the master transmitting control station for amplifying the control frequency potentials for extension of the control system to a greater distance along a power transmission line.

4. A control system operable in conjunction with a power transmission and distribution system including transmission lines over which power potential and frequency currents are transmitted and on which control currents of different frequencies are superimposed, said sys-

tem including a central master control transmitting station and receiving control stations disposed at plurality of points along said transmission lines, means for generating a plurality of control frequencies at the central master control transmitting station and imposing them on the transmission lines intermittently either independently or simultaneously, a filter connecting said control frequency generators with the transmission lines through which the control frequencies are superimposed on the lines and which prevents the power frequency currents from passing to the control frequency generators, a power frequency pass filter in the lines ahead of said central master control station to prevent the control frequency currents from passing backwards to the power supply, control means individually and separately responding to the various control frequency currents imposed on the transmission lines at each of the receiving control stations, a variable speed motor at each of the control receiving stations variably controlled by the several receiving control means, means for introducing operating power current from the transmission lines to each of the variable speed motors including a power frequency pass filter in the connection, and connections between the transmission lines and the control means at each of the receiving control stations each including a control frequency pass filter for passing the control frequencies to the control means and preventing power frequency currents from passing thereto.

5. A signal control station in accordance with claim 1, wherein the control timer motor comprising a variable speed disk type signal control driving rotor having a driving winding, said winding continuously connected to receive operating power current from the power transmission lines, said motor also having a bucking winding cofunctioning therewith for controlling the speed of the rotor, and means controlled by energization of the control circuits for varying currents from the power lines applied to the bucking winding to vary the speed of the signal control timer motor.

6. A signal control station in accordance with claim 1, wherein the control timer motor comprising a variable speed disk type signal control driving rotor having a driving winding, said winding continuously connected to receive operating power current from the power transmission lines, said motor also having a bucking winding cofunctioning therewith for controlling the speed of the rotor, and means controlled by energization of the control circuits for varying currents from the power lines applied to the bucking winding to vary the speed of the signal control timer motor including a potentiometer connected across the bucking winding having tap connections variably connected with the power current supply as controlled by the energization of the control circuits.

7. A signal control station in accordance with claim 1, wherein the control timer motor comprising a variable speed disk type signal control driving rotor having a driving winding, said winding continuously connected to receive operating power current from the power transmission lines, said motor also having a tapped bucking winding cofunctioning therewith for controlling the speed of the rotor, and means controlled by energization of the control circuits for varying the current effects from the power lines applied to the bucking winding to vary the speed of the signal control timer motor by changing the connections with the tapped bucking winding.

8. A signal control station in accordance with claim 1, wherein the control timer motor comprising a variable speed disk type signal control driving rotor having a tapped driving winding, said winding connected to receive operating power current from the power transmission lines, and means controlled by energization of a control circuit for varying the connection of the power supply with the driving winding for varying the speed of the signal control timer motor.

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