

Oct. 3, 1933.

C. H. BISSELL

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RESYNCHRONIZING SYSTEM FOR SERIES OF MOTORS

Filed June 12, 1930

4 Sheets-Sheet 1

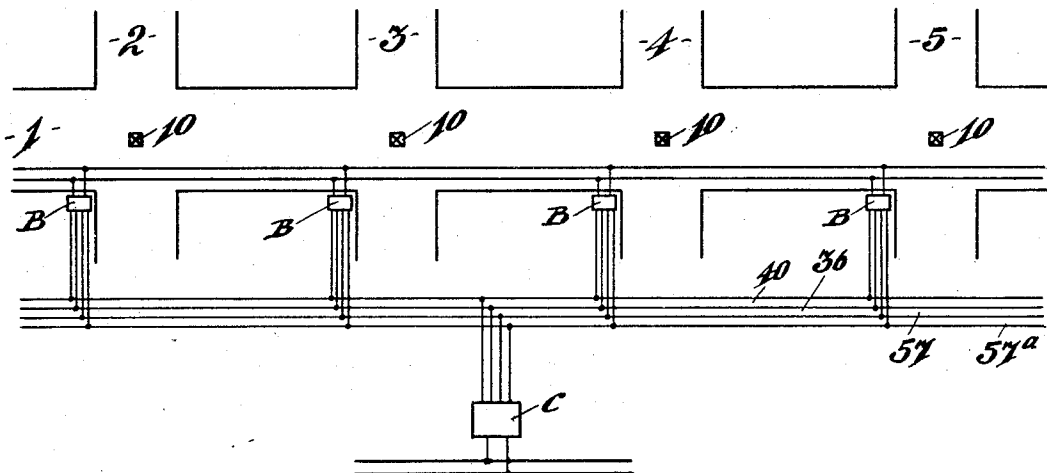


Fig. 1.

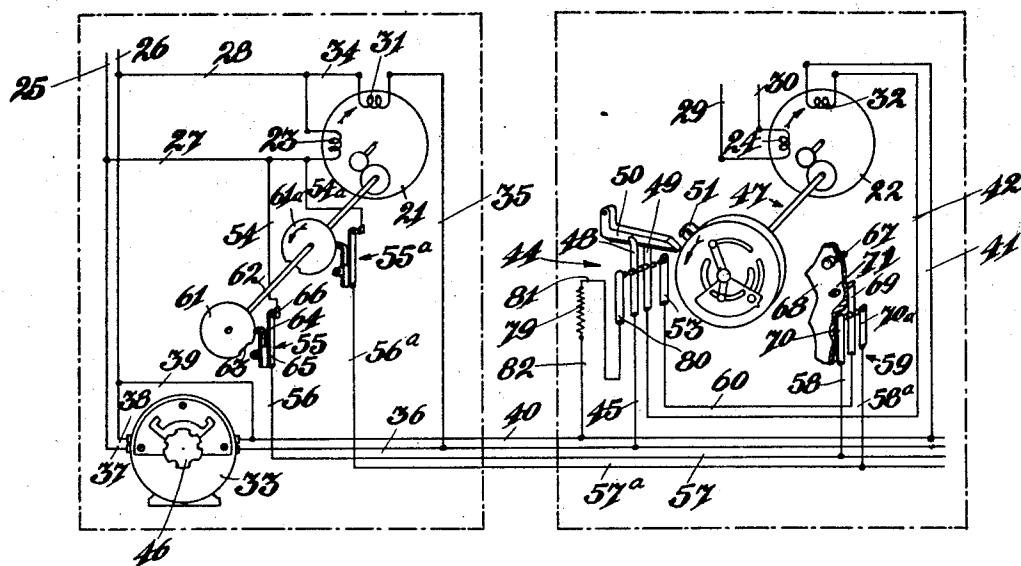


Fig. 2.

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Oct. 3, 1933.

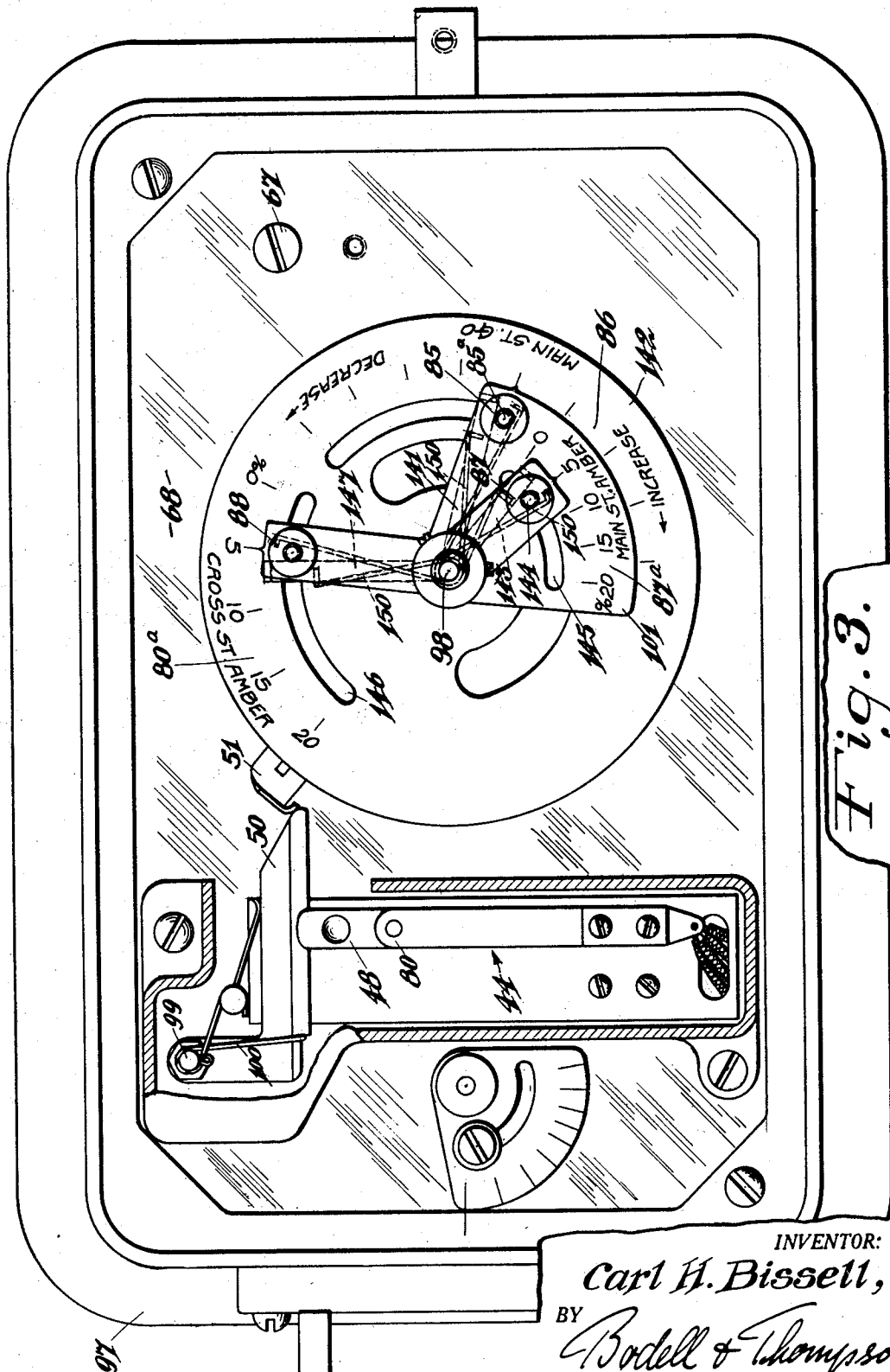
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RESYNCHRONIZING SYSTEM FOR SERIES OF MOTORS

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4 Sheets-Sheet 2



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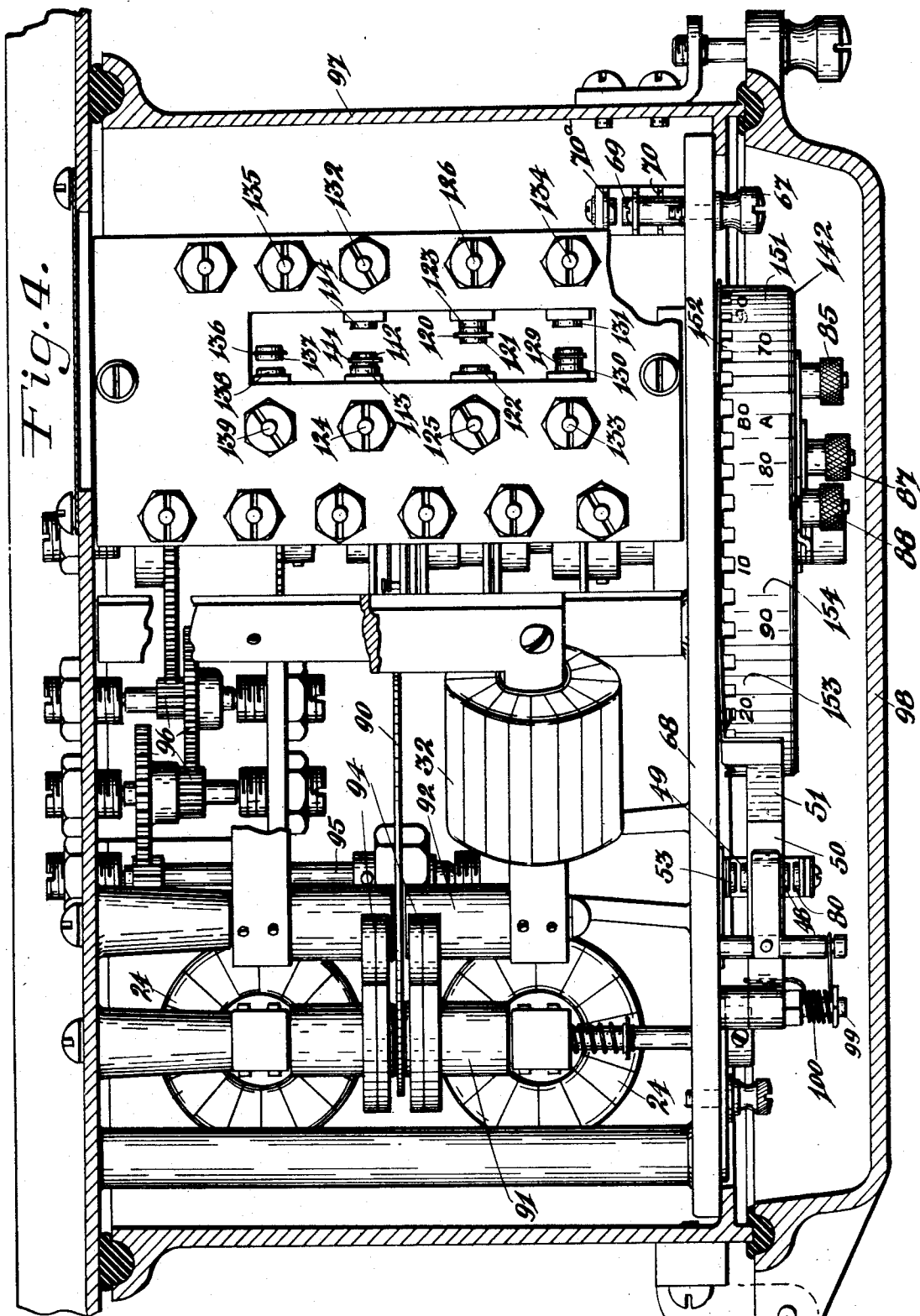
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RESYNCHRONIZING SYSTEM FOR SERIES OF MOTORS

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4 Sheets-Sheet 3



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RESYNCHRONIZING SYSTEM FOR SERIES OF MOTORS

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4 Sheets-Sheet 4

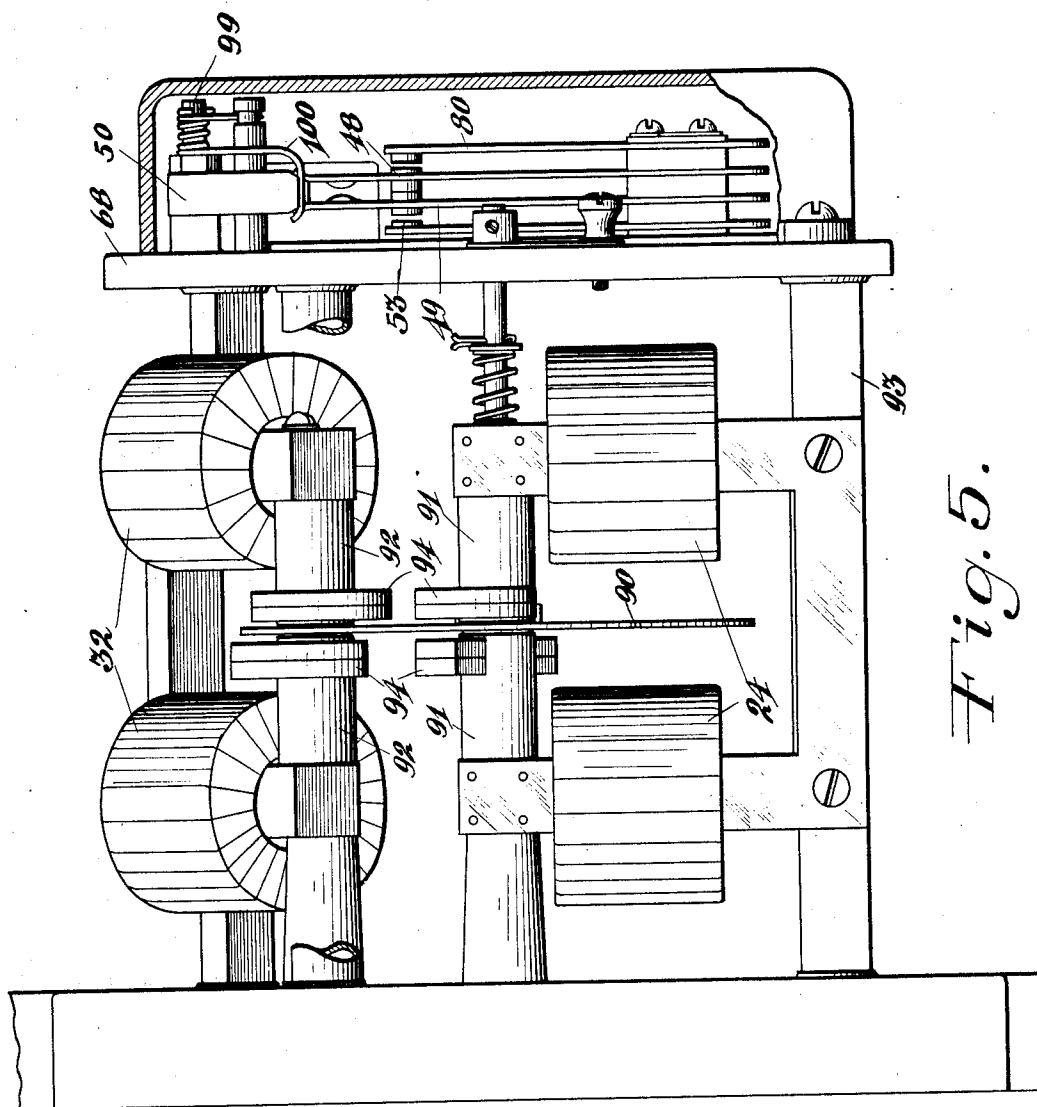


Fig. 5.

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UNITED STATES PATENT OFFICE

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RESYNCHRONIZING SYSTEM FOR SERIES
OF MOTORS

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Application June 12, 1930. Serial No. 460,771

13 Claims. (Cl. 172—293)

This invention relates to resynchronizing systems for a series of actuators or motors and has for its object a particularly simple and efficient timed means for stopping the actuators or motors individually by applying a braking force in opposition to the driving force of the motors sufficient to overcome the driving force, and releasing the opposing forces simultaneously so that all motors start together, the applying and releasing of the braking forces being controlled partly by the timers actuated respectively by the motors and by a timer actuated by a motor which is constantly actuated or unprovided with stopping means. The invention is particularly applicable for controlling work circuits to be timed, as the signal circuits of street traffic signals for intersecting streets.

Other objects appear throughout the specification.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a diagrammatic view illustrating the application of the system to a system of streets.

Figure 2 is a schematic diagram of this traffic system.

Figure 3 is an elevation of one of the cabinets for the controller at each intersection, the door being removed.

Figure 4 is a top view, partly in section, of the controller in Figure 3, the casing being shown in section.

Figure 5 is an end view, partly in section, looking to the right in Figure 3, the casing being removed.

This traffic control system is designed to give a flexible progressive flow of traffic, and comprises the following main features:

I. Control of the total traffic cycle period from one station or headquarters.

II. Control of the offset, that is, the beginning of the green or go interval on the main street at each intersection with respect to signals at adjacent intersections.

III. Automatic resynchronizing, or in other words, maintenance of the offset.

IV. Division of the total traffic cycle period at each intersection between the main and the cross streets, and shifting and varying the intermediate or warning or amber signal.

By traffic cycle period is meant, the total time it takes for the signals to go through a complete change or cycle. This may be for instance 50, 60 or 120 seconds etc.

In a traffic system, the go signals to be displayed on the main street do not, or may not start at the same time, but the signals are so operated that an automobile starting on the main street at one intersection when the go signal is given, and traveling at a certain rate per hour, will reach the next intersection about the time that the signal changes at the second intersection to go on the main street. The difference between the starting of the go or green signal on the main street at one of the intersections, and the starting of the go signal at another intersection, is called the offset of the signals.

In order to maintain this timing, it is necessary that the signals run in such synchronism that the offsets between the signals will be accurately maintained.

At all the intersections, the traffic cycle period will be the same, say for instance, 100 seconds. At some busy intersections, it may be necessary in order to keep the traffic moving smoothly to have the traffic cycle divided evenly, that is, 50 seconds on the main highway and 50 seconds on the cross street, disregarding the interval required by an intermediate or amber light or in fact to favor the cross street by giving it a longer go period than the main street. At other intersections, the traffic cycle may be divided so that the go signal is displayed say for 60, 70 or 75 seconds etc. on the main street, and 40, 30 or 25 seconds etc. on the cross street. The traffic cycle period at other intersections may be divided in other subdivisions to suit conditions, and also the durations of the intermediate warning signal or amber light and the lapping of the amber signal on the preceding green and red signals may be varied from zero to a maximum of say 20 seconds.

In traffic signalling systems, usually the go signals are green lights; the stop signals are red lights; and the intermediate warning signals, yellow or amber, and these signals are displayed through repeated traffic cycles from stop to go on one street; go to stop on the other, back to go on the first street, and stop on the other street.

This traffic signalling system comprises, generally, a controller for the signals at each intersection including an electric motor, and a timer actuated by the motor to control the change of signals at that intersection, means common to all the motors for synchronizing or resynchronizing the motors including means controlled by the

timer of each motor for stalling the motor at predetermined intervals during the operation of the timer, and timed means common to all of the controllers for releasing the stalling means of all the motors simultaneously. The synchronizing or resynchronizing means includes braking elements or means normally applying a predetermined minimum braking force to the motor less than the driving force and operable by and controlled by the timer to at certain times apply full braking force to stall the motor and to be released of full braking force to let the motor start and to again apply the normal minimum braking force.

15 1 designates a main street or boulevard; 2, 3, 4, 5 cross streets intersecting the main street. 10 designates the signal at each intersection. 11 designates the green or go signals on the main street; 12, the red signals on the cross streets. 20 13 designates the amber signals; 14 the stop or red signals on the main street, and 15 the go or green signals on the cross street. These are connected in any suitable manner in a supply circuit controlled by the timer, to be presently described, at each intersection.

Referring to Figure 2, a general description of the system will now be given.

21 is a master motor located at a central station.

22 is a secondary motor forming part of the controller at each intersection, this controller including a timer or timing cams actuated by the motor 22 which controls the display of the signals at the intersection. Each motor 21 and 22 has energizing or driving coils. The motors are usually of the induction disk type.

23 designates the driving coils of the master motor 21, and 24 the driving coils of each secondary motor. The driving coils 23 are connected to the feed wires 25, 26 by conductors 27, 28. Also, the driving coils of the secondary motors are connected in the feed line, or any circuit performing the function of said line, by wires 29, 30. The motors are thus connected in the feed circuit independently of each other.

45 The means common to all the motors for synchronizing or resynchronizing the same are preferably, bucking coils for each motor acting in opposition to the driving coils, and means as a period control regulator normally connected in the feed line and to the bucking coils for regulating the amount of current passing through the bucking coils, the bucking coils being connected in the feed circuit in multiple with each other, and in series with the regulator. The regulator acts to reduce the current from the feed line which say is 110 volts to a lower voltage in the normal bucking coil circuit to say 50 or 60 volts so that the speed of the motors depends on the difference between the driving and bucking coils. The regulator is adjustable for varying the current in order to vary the speed of the motor and hence the traffic cycle.

31 designates the bucking coils of the master motor, and 32 the bucking coils of each secondary motor.

33 is the period control regulator, this being operable to reduce the voltage from the main line to any desired amount. The regulator per se forms no part of this invention and is merely an adjustable voltage reducer. It may be of any suitable construction.

The bucking coils 31 are connected by a wire 34 to the feed wire 26 and by wires 35 and 36 to the regulator 33, the regulator 33 being connected to the service wires 25 and 26 by wires 37 and 38.

The bucking coils 32 of the secondary motors are connected in the feed line through the regulator by wires 39, 40, 41 and 42, and the switch means designated generally 44, to be presently described, wire 45 and wire 36.

Thus, normally the current passes from the feed line through the regulator 33 and is reduced to a predetermined minimum value then to the bucking coils of the motors, and as the driving force of the motors is equal and the retarding effect of the bucking coils equal, all the motors will rotate at substantially the same speed. This speed may be varied by increasing or diminishing the predetermined minimum value of the current by adjusting the regulator by means of its handle 46.

The means controlled by the timer 47 of each secondary motor 22 for stalling that motor at predetermined intervals, comprises switch means 44 controlled by the operation of the timer 47 of each secondary controller.

The switch means 44 includes a pair of normally engaged contacts 48, 49, an arm 50 operable to separate the contacts, and means as a trip arm 51 or offset arm as it is called on the timer for operating the arm 50. The contact 48 is connected by the wire 45 to the wire 36 leading from the regulator 33. The contact 49 is connected to the wire 42 so that normally the current passes to the bucking coils 32 of each secondary motor from the regulator 33, through wire 36, wire 45, contact 48, contact 49, wire 42, through the bucking coils 32, wire 41, wires 40 and 39, back to the feed line. When, however, the timer of any particular controller has moved a sufficient distance to cause the trip or offset arm 51 to engage the arm 50, the contacts 48 and 49 are separated, and hence, the circuit to the bucking coils of the motor of that controller is broken, that is, the circuit controlled by the regulator 33.

This regulator cuts down the voltage to the bucking coils of all the secondary motors 22, so that they are all normally operating under like conditions. The driving coils of the secondary motors are all connected in the main feed circuit and the bucking coils of the secondary motors are all normally connected to the main circuit through the regulator 33 which reduces the voltage of the main line, which say is 110 volts to, for instance, 50 or 60 volts, so that normally the bucking coils are of less strength than the driving coils, and the driving force on all the motors being equal, and the retarding force of the bucking coils being equal, all the motors will rotate at the same speed. Preferably the secondary motors run about ten per cent faster than the master motor. However, the bucking coils 31 of the master motor 21 are always working under the same conditions and the circuit is never broken through the bucking coils 31 of the master motor while the system is in operation.

The switch means 44 is also provided with means for cutting the bucking coils 32 of each secondary motor into a shunt circuit around the regulator, so that when this shunt circuit is closed by the switch means 44, the bucking coils of the second motor 22 are connected directly in the main feed line, say of 110 volts. Hence, the retarding force of the bucking coils is equal to the driving force of the driving coils, and the secondary motor will be stalled. The cutting in of the shunt circuit, and there is a shunt circuit and switch means for each secondary motor, is controlled by the trip or offset arm 51 of each timer. When or shortly after when the offset arm 51

actuates the switch arm 50 to separate the normally engaged contacts 48, 49, it causes the contact 49 to engage a contact 53 of the switch means 44, and the current from the main line, may be said for the purpose of illustration, to take the following path. From feed wire 25, through wire 27, wire 54, through a normally closed switch 55, which performs a function to be presently described, wire 56, wire 57, wire 58, switch 59, to be hereinafter described, wire 60, contact 53 of the switch 44, contact 49, wire 42, through bucking coils 32, wire 41, and wires 40 and 39 to the main feed wire 26. When this shunt circuit is closed through the contacts 53, 49 of the switch 44, the bucking coils 32 of the secondary motor 22 are of sufficient strength to stall the motor so that the timer actuated thereby is stalled, and the signals controlled by the timer are idle.

These shunt circuits through the bucking coils of the secondary motors are opened by timed means actuated by the master motor 21, and this timed means opens the switch 55 long enough to permit the stalled secondary motors to start quickly while the bucking coils are dead. The timed means is here shown as a cam 61 mounted on a shaft 62 which is connected to the rotor of the master motor 21 through suitable gearing, or other motion transmitting means. This cam has a long, high or dwell portion, and a short, low or recess portion 63, and the cam coacts with a follower 64 suitably connected to a movable contact arm 65 of the switch 55, this contact arm being normally engaged with the contact 66 in the shunt circuit. When the secondary motors are stalled, as just described, the follower 64 is engaged with the high surface of the cam 61, and hence, the contact arm 65 and contact 66 are engaged. However, as the cam is rotated, the recess 63 comes opposite the follower 64 and the follower drops into the recess, thus breaking the circuit at 65, 66 and thus the circuit is broken through the bucking coils so that the bucking coils are entirely de-energized. Hence, the driving coils of the secondary motors are free to act with full force whereupon the secondary motors start instantly without being held back by the retarding effect of the bucking coils.

The starting of each secondary motor actuates the companion timer and causes the trip or offset arm 51 to ratchet by and release the switch arm 50 of the switch 44, and hence, the switch arm 50 returns by a spring to its normal position, permitting the contacts 48, 49 to again engage, and the contact 49 to separate from the contact 53 thus closing the bucking coil circuit through the regulator 33, and opening the shunt circuit which connects the bucking coil in direct connection with the feed wires 25, 26. Hence, the normal conditions are now restored. The contact 49 breaks from contact 53 before contacts 48, 49 re-engage.

In the signalling system in which the display of go signals on the main street progress so that vehicular traffic can travel along the main street at a predetermined rate substantially uninterrupted, it is necessary, or at least highly desirable to stall the motors 22 when the signals at the various intersections are go on the main street, or at least not amber on any street, and means is provided by which with a number of signals, the green will be displayed on the main street when the motor at each intersection is stalled or the offset of the signals maintained. The trip or offset arm 51 of each timer is therefore adjustable into different angular relations

so as to engage the companion arm 50 at a time when the green is displayed on the main street, and hence, stall the corresponding motor at this time.

In large systems, it will usually be found that part of the secondary timers must be stopped and started simultaneously, and another part stopped and started simultaneously, but not at the same time, as the former timers in order to maintain the progressive opening of the main street, that is, the progressive display of the go signals on the main street and not stall any timer when amber is displayed. Therefore the bucking coils of some of the secondary motors are in the shunt circuits controlled by the switch 55, while the bucking coils of other motors are in similar shunt circuits controlled by a switch 55^a, and a cam 61^a on the shaft 62 of the timer actuated by the master motor 21. The cam 61^a is set with its low point behind the low point of the cam 61, usually 90 degrees behind. This additional shunt circuit controlled by the switch 55^a and cam 61^a is connected in the feed lines 25, 26 through the wire 27, wire 54^a, switch 55^a, wire 56^a, wire 58^a, thence through the switch 59 and switch 44 to the bucking coils and the bucking coils are connected in either one of the circuits by a shifting member 67 which is here shown as a plug or screw threading in a support or wall 68 of the frame of each secondary motor and timer. Each secondary motor or timer is provided with such a screw or plug, and when not used, the plug is merely held in an idle hole in the support 68, and the switch 59 connects the bucking coils of the companion motor in the shunt circuit controlled by the switch 55.

The switch 59 includes a contact 69 which coacts with either a contact 70 or 70^a. When the plug is not used, the contact engages the contact 70, and the bucking coils of the companion motor are connected in the shunt circuit controlled by the switch 55. However, when the plug 67 is inserted in a hole 71 in the support 68, it shifts the contact 69 out of engagement with the contact 70 and into engagement with the contact 70^a, and the bucking coils of the companion secondary motor will be connected in the shunt circuit controlled by the switch 55^a and cam 61^a.

As the bucking coils of the several secondary motors will not be cut out of the normal circuit controlled by the regular 33 at the same time, or in other words, as the offset arms 51 of all the secondary timers will not engage their companion switch arms 50 at exactly the same time, means is provided for balancing the bucking coils when they are cut out in order to maintain the conditions in the bucking coil circuits controlled by the regulator 33, uniform. This means is here shown as a resistance 79, one for each secondary motor and timer, this resistance being cut into circuit with the bucking coils by the operation of the offset arm 51 engaging the companion switch arm 50 when it separates the contacts 48, 49.

The operation of the switch arm 50 in separating the contacts 48, 49 in addition to engaging the contacts 49, 53 also engages the contact 48 with the contact 80. This contact 80 is connected by a wire 81 to the resistance and the resistance is connected by a wire 82 in the bucking coil circuit controlled by the regulator 33. Thus, when the bucking coils of any one secondary motor 22 are cut out by the offset arm 51 actuating the switch arm 50 to separate the contacts 48, 49, the contacts 48 and 80 are engaged so that the resistance 79 is cut in the circuit controlled by the regulator, 150

and the current for that particular motor and timer passes from the wire 25, through the regulator, which reduces the voltage, through the wire 36, wire 45, contact 48, contact 80, wire 81, resistance 79, wire 82, wires 40 and 39 to the feed line 26, instead of passing over the same course just traced to the contact 48, to the contact 49, wire 42, bucking coils 32, wire 41 to the wires 40 and 39, to the feed line 26. Thus, the resistance 79 balances the impedance of the bucking coils 32 that have been cut out by the switch arm 50, and the conditions in the bucking coil circuits of the other secondary motors controlled by the regulator 33 are maintained. The timer actuated by each secondary motor is provided with means for splitting up the traffic cycle period into different divisions, that is, assuming that this period is 100 seconds, each timer is provided with means for splitting up the period into equal divisions of 50 seconds go and stop on the main street, and 50 seconds go and stop on the cross street, and for adjusting it into any other proportions, as 60 seconds go on the main street, and 60 seconds stop on the cross street, and 40 seconds go on the cross street, and 40 seconds stop on the main street. This adjustment is effected by shifting the cams of the timer by means of a handle 85 movable over a dial 86, the handle and dial being located on the outside of the panel for each secondary motor and timer where it is readily accessible. Also, handles 87 and 88 are provided for effecting the adjustment of the intermediate or warning or amber signals on the main and the cross streets respectively, these handles being mounted on the face of the dial 86, all being concentric with the timer shaft on which the timer cams are mounted. There are other control features embodied in the system such as means for effecting a steady amber or a flashing amber, and means operable to set all signals red or stop and means for cutting out the entire system and means for operating the signals at any one intersection independently of the rest of the system, but these features form no part of my present invention.

In the general operation, after the offset arms 51 for the several secondary timers are set, and also the timing cams set by means of the handles 85, 87 and 88, the system is ready for operation and a suitable switch operated to cut the system in the feed circuit, so that the current flows to the driving coils 23 of the main motor, and the driving coils 24 of the secondary motors, and also the current flows through the bucking coils of the motors 21, 22 through the regulator 33.

The time extent of the traffic cycle is set by adjusting the handle 46 of the regulator so that a predetermined retarding current flows to all the bucking coils and hence all the secondary motors, other things being equal, are actuated at the same rate. The plug or screw 67 is used in some of the secondary motors to connect them in the shunt bucking coil circuit controlled by the switch 55^a, others being connected in the circuit controlled by the switch 55.

During the rotation of the secondary motors, the timers actuated thereby, cause the signals at the various intersections to go through a regular traffic cycle. During the rotation of the timers, the trip or offset arms 51 engage the switch arms 50 respectively once during each revolution of the timers, or once during each traffic cycle, thus cutting in the bucking coils or the companion secondary motor in the shunt circuit controlled by the switch 55 or 55^a, as the

case may be, so that the full voltage of the feed circuit flows through the bucking coils and stalls the companion motors and hence stops the companion timers. This operation takes place approximately but not exactly simultaneously in all the secondary motors, although the arms 51 may be adjusted differently in the timers. The master motor 21 continues to rotate and the cam 61 first opens the switch 55 which controls the shunt circuits to some of the bucking coils, so that the motors, the bucking coils of which are connected in the shunt circuits controlled by switches 55, start under full voltage, and are not retarded during the starting by the bucking coils. Thereafter, the other circuits controlled by the switch 55^a and cam 61^a are likewise opened so that the other secondary motors start. The cam 61^a is set about 90° behind the cam 61. As the secondary motors start, their companion timers also start, and the offset arms 51 ratchet past the switch arms 50, thus again cutting in the bucking coil circuits controlled by the regulator 33 and original conditions are restored. Thus, during each traffic cycle, the secondary motors are resynchronized and the offset of the signals necessary for a progressive system is maintained. The bucking coils are generally variable braking means normally applying a predetermined minimum braking force and operable by timed means to apply full braking force and then to release all braking force and finally reapply the minimum force.

The specific construction of the motors, timers, and other mechanism will now be described.

The motors are of the induction disk type, and both the master motor and secondary motors are of the same general construction. The master motor drives the cam shaft 62 in any suitable manner, and the master motor and the cam shaft or timer actuated thereby is mounted in a suitable housing or casing C located at any central station, as for instance, a police station. The period control regulator 33, which is adjustable to vary the time extent of the traffic cycle is also located in the casing C which encloses the master motor and timer actuated thereby, so that the traffic cycle at all intersections can be operated from the central station. This regulator may be of any suitable form, size and construction, and is a standard article of manufacture. It functions merely to reduce the voltage of the feed line, which assume is 110 volts to any lower voltage, the regulator having means for adjusting the amount of reduction so that the retarding current supplied to the bucking coils can be varied to suit conditions and hence, the speed of the various motors varied.

In Figures 4 and 5, 90 designates the disk of the motor; 24 the driving coils and 32 the bucking coils, these acting on suitable cores 91 and 92 having terminals on opposite sides of the disk 90. The parts of the motor are mounted on a suitable frame 93. The cores 91, 92 are provided with shading coils 94, the positions of which are initially adjusted. These shading coils form no part of this invention. The frame is mounted in a suitable housing or casing 97 having a door 98 and the casing or housing is located in a casing or box B. There is one casing or box B at each intersection.

The disk 90 is mounted upon a suitable supporting shaft 95 and the motion thereof is transmitted through suitable reduction gearing 96 to the shaft 98 of the timer. This timer may be of any suitable construction, and is here shown

as of the rotary cam type in which the cams control the opening and closing of the contact points.

Each motor 22 and its companion timer and mechanism is mounted in the frame 93 as a unit, and this frame has a face plate 68 on which the dial 86 and the various handles 85, 87 and 88 are exposed. The switch 44 is mounted on the outer side of the face plate 68 and as seen in Figure 4, is enclosed in the detachable housing 97. The switch arm 50 is pivoted at 99 to the plate 68 and is acted upon by a returning spring 100. Contact 80 which controls the flow of current to the resistance 79 is spaced apart from the contact 48 a slightly less distance than the contact 53 from the contact 49 which controls the flow of current of full voltage to the bucking coils so that when the contacts 48, 49 are separated by the arm 50 and immediately thereafter or at about the same time, the resistance is cut in by reason of contact 48 engaging the contact 80 and thereafter, after the contacts 48, 49 are completely separated, the bucking coils are cut into the shunt circuit controlled by the cam 61 or 61^a which supplies full voltage to the bucking coils by the engagement of the contacts 49 and 53. Thus, the condition in the bucking coils of other secondary motors is not affected and the liability of full voltage being inadvertently supplied to the bucking coils of other motors by reason of the contact 49 engaging the contact 53 or not being entirely separated from the contact 48 when contact 48 engages contact 53, is avoided, and the following operation is effected without the use of complicated mechanism.

The bucking coils are first cut out by the separation of the contacts 48, 49 and at practically the same instant, the resistance 79 cut in the circuit to keep the conditions in the other bucking coil circuits the same, or to not unbalance the load on the regulator 33, and all the current in the bucking coil circuit of the companion motor cut out so that momentarily the bucking coils are dead, then immediately thereafter, the full current is supplied to the bucking coils of the companion motor by reason of the engagement of the contacts 49 and 53. When the switch arm 50 is released by reason of the offset arm 51 ratcheting past the same, and hence the circuit through the shunt controlled by the master timer cam 61 or 61^a opened, the bucking coils are immediately rendered entirely dead, and the corresponding motor 22 released of all retarding effect so that the driving coils are free to act unretardingly and start the companion motor 22 instantly. Thereafter, the contacts 48, 49 again re-engage and apply the minimum or normal retarding effect through the bucking coils, and hence, the motor is free to start without any retarding and thereafter, the minimum retarding force is applied. Also, the balancing effect of the resistance continues practically until the contacts 48, 49 again re-engage, due to the spacing of the contact 80 from the contact 48 a less distance than the spacing between the contacts 49 and 53. This spacing between the contacts 48 and 80 is such that when contact 48 lets go from contact 80, it immediately takes hold of contact 49.

The switch 59 is mounted on the inner side of the plate 68 where the insertion of the screw 67 in the proper hole will cause the contact 69 to break from the contact 70 and engage the contact 70^a.

The construction of the timer per se and the means for splitting up the traffic cycle into sub-

divisions of different lengths and for shifting the time that the amber lights will occur in accordance with the adjustment of the cams of the timer, and to vary the extent of time of the amber signals or to cut out the amber signals, forms no part of this invention, and further description is thought to be unnecessary. These adjustments of the timer are in a general way, as follows:

The traffic cycle splitting adjustment (a) is effected by shifting the handle 85 over the dial 86 and the adjusting (b) of the amber light by the handle 87. The handle 87 is normally clamped to a segment 101 to which the handle 85 is attached, so that when the handle 85 is operated to split the traffic cycle, the handle 87 moves therewith and thus shifts the amber cam so that the amber light will occur with proper relation to the red and green signals.

To effect adjustment (c) that is vary the extent of time of the amber light on the main street from zero to maximum, as from zero to 20 seconds, is effected by shifting the handle 87 relatively to the segment 101 over the scale 87^a on the segment 101. The corresponding change of time on the cross street, that is, changing the time the amber is displayed from zero to maximum, say to 20 seconds, is effected by the handle 88 which is movable over a scale 80^a.

In the operation of the entire system, the extent of the traffic cycle period is determined by adjusting the handle 46 of the regulator 33 and thus determining the amount of current flowing to the primary and secondary motors and the bucking coils 31 and 32 normally place a predetermined retarding effect on each motor. The offset of the signals at the various intersections is determined by shifting the offset arm 51 along the scale 153 or 154.

The split up of the traffic cycle at any one intersection is determined by shifting the handle 85 which actuates the hollow shaft 115 and as this handle normally carries with it the handle 87 which actuates the hollow shaft 119 the amber signals are adjusted to occur at the proper intervals when the signals change from green to red and the time extent of the amber signals on the main and cross streets is determined by adjusting the handle 87 relative to the segment 101 and the handle 88 relative to the disk 86.

During the rotation of each timer shaft 98, the offset arm 51 cuts out the bucking coils of the companion motor, and then cuts the bucking coils in the main circuit so that the motor is stalled, and all the motors are stalled during some period of their operation at the same time and remains stalled until the cam 61 or 61^a opens the shunt circuit controlled thereby, thus momentarily relieving all the motors of all retarding effect of the bucking coils so that the motors can start instantly, and thereafter cutting in the bucking coils simultaneously in the circuit controlled by the regulator 33 so that the normal conditions are restored.

The bucking coils of all motors connected in the shunt circuit controlled by the cam 61 start at the same time while those controlled by the cam 61^a all start at the same time, but a little later than the motors in which the bucking coils are controlled by the cam 61 and the bucking coils of the motors are connected in either one of the other of the shunt circuits controlled by the cams 61, 61^a.

The offset arms 51 of the various motors are set to maintain a predetermined offset of the

signals and if the arm 51 of any one timer would operate its companion switch arm 50 and hence, stall the companion motor at a time that the amber light was displayed, then in order to avoid an extension of the amber light period, the bucking coils of that motor are connected in the other shunt circuit by shifting the plug 67 as before described.

Thus, by this signalling system, the traffic cycle period can be readily adjusted by merely turning the handle of the regulator 33; the split up of the traffic cycle into subdivisions at any one intersection can be determined by manipulating the handle 85 and the extent of the amber period at any intersection fixed by shifting the handles 87 and 88. Hence, by this system, adjustments can be readily made by means of handles to suit the traffic conditions at any one intersection of the system, and the system can be adjusted so that the traffic will flow on the main street substantially uninterruptedly at a given rate per hour.

What I claim is:

1. In a controlling system of the class described, the combination of a plurality of controllers, each comprising an electric motor and a timer actuated by the motor, a feed circuit, each motor having energizing coils connected in the feed circuit independently of the other motors, means for synchronizing the operation of the motors comprising bucking coils for each motor, means common to the bucking coils of all the motors for controlling the flow of a current of predetermined value from the feed line to the bucking coils, means individual to each controller and operated by the timer thereof at predetermined intervals to effect a greater flow of current to the bucking coils of the companion motor sufficient to stall the same, and means common to the bucking coils of all the motors for simultaneously reducing the flow of current to the bucking coils from the maximum sufficient to stall the motors, to the predetermined minimum.

2. In a controlling system of the class described, a plurality of controllers, each comprising an electric motor, and a timer actuated by the motor, a feed circuit, the motors having energizing coils connected in the feed circuit independently of each other, and bucking coils acting in opposition to the energizing coils, a regulator for normally controlling the flow to the bucking coils of a current of predetermined minimum value, the bucking coils being connected in the feed circuit in multiple with each other and in series with the regulator, a normally open shunt circuit connecting the feed line and each bucking coil, switch means for each controller operable by the companion timer to close the companion shunt circuit and connect the bucking coils in the feed circuit independently of the regulator, whereby the bucking coils act with full strength in opposition to the energizing coils to stall the motor, a normally closed second switch means common to all the shunt circuits, a timer for controlling the second switch means to open the same at predetermined intervals and thus break the shunt circuit, and a constantly running master motor connected in the feed circuit and connected to the last mentioned timer.

3. In a controlling system of the class described, a feed circuit, a master motor having energizing coils connected in the feed circuit, a plurality of controllers, each comprising a secondary electric motor, and a timer actuated by that motor, each of the secondary motors having

energizing coils connected independently of each other in the feed circuit, a period control regulator connected in the feed circuit, the master motor and the secondary motors also having bucking coils acting in opposition to their energizing coils, conductors connecting the bucking coils in the feed circuit in multiple with each other and in series with the regulator, normally open shunt circuits around the regulator and connecting the feed circuit and the bucking coils of the secondary motor, there being a shunt circuit individual to each secondary bucking coil, switch means operated by the timer of each secondary controller operable to close the companion shunt circuit, normally closed switch means common to the shunt circuits, and means operated by the master motor for opening the last switch means at predetermined intervals.

4. In a controlling system of the class described, a feed circuit, a master motor, a plurality of controllers, each comprising a secondary motor, and a timer actuated thereby, the master motor and the secondary motors having energizing coils connected in the feed circuit and also having bucking coils acting in opposition to their energizing coils, and an adjustable period control regulator connected in the feed circuit, the bucking coils of the secondary motors being connected in the circuit in multiple with each other and in series with the regulator, means for synchronizing the operation of the secondary motors at predetermined intervals comprising shunt circuits around the regulator to connect the feed circuit and the bucking coils of the secondary motors, there being one shunt circuit for each secondary motor, switch means for each shunt circuit and normally opening that circuit and operable by the companion timer to close each shunt circuit at predetermined intervals, a normally closed switch common to all the shunt circuits and timer means actuated by the master motor for opening the last switch at predetermined intervals.

5. In a controlling system of the class described, a feed circuit, a plurality of controllers, each comprising an electric motor and a timer actuated by the motor, each motor having energizing coils connected independently of the other motors in the feed circuit, a period control regulator connected in the feed circuit, each motor having bucking coils acting in opposition to its energizing coils, conductors connecting the bucking coils of the motors in the feed circuit in multiple with each other and in series with the regulator, normally open shunt circuits around the regulator and connecting the feed circuit and the bucking coils, there being a shunt circuit individual to the bucking coils of each motor, said conductors having normally open shunt circuits connected therein, resistances in the latter shunt circuits to balance the bucking coil of the companion motor, switch means operated by the timer of each motor operable to open the bucking coil circuits and close the companion resistance shunt circuit, normally closed switch means common to the first mentioned shunt circuits, and timed means for opening and closing the last switch means at predetermined intervals.

6. In a controlling system of the class described, a feed circuit, a master motor having energizing coils connected in the feed circuit, a plurality of controllers, each comprising a secondary motor and a timer actuated by the motor, each of the secondary motors having energizing coils connected independently of the coils of the other

motors in the feed circuit, a period control regulator connected in the feed circuit, the secondary motors having bucking coils acting in opposition to their energizing coils, conductors connecting the bucking coils of the secondary motors in the feed circuit in multiple with each other and in series with the regulator, normally open shunt circuits around the regulator and connecting the feed circuit and the bucking coil circuits of the secondary motors, there being a shunt circuit individual to each secondary motor, said conductors also having normally open shunt circuits having resistances therein to balance the bucking coil of the secondary motors, switch means operated by the timer of each secondary motor and operable to open the bucking coil circuits and close the companion resistance circuit and open the circuit through the bucking coils of the companion motor, normally closed switch means common to the first shunt circuits, and timing means operated by the master motor for opening the last mentioned normally closed switch means.

7. In a controlling system of the class described, a plurality of controllers, each comprising an electric motor, and a timer actuated by the motor, and brake means normally applying a predetermined minimum braking force to the companion motor less than the driving force, means controlled by the timer of each motor for causing the brake means to apply full braking force to the motor to stall the same at predetermined intervals, and means common to all of the controllers for operating the brake means to release the full braking effect and restore the minimum braking effect.

8. In a controlling system of the class described, a plurality of controllers, each comprising an electric motor, and a timer actuated by the motor, brake means normally applying a predetermined braking force less than the driving force to each motor and operable to apply full braking force to the motor to stall the same, means controlled by each timer for operating the brake means to apply full braking force at predetermined intervals, and means for operating all the brake means simultaneously to first release all braking force and then reapply the minimum braking force.

9. In a controlling system of the class described, a plurality of controllers, each comprising an electric motor having energizing coils, and a timer actuated by the motor, an electric circuit common to the coils of all the motors, and brake means controlled by the timer of each motor for stopping that motor at predetermined intervals, means common to all the controllers for releasing the braking means, and means for equalizing the load in the circuit of the energizing coils of all the motors when full braking force is applied to stall any one or more of the motors.

10. In a controlling system of the class described, a plurality of controllers, each comprising an electric motor, and a timer actuated by the motor, an electric circuit common to the coils of all the motors, brake means normally applying a predetermined minimum braking force to each motor and operable to apply full braking force to the motor to stall the same, means controlled by each timer for causing the brake means to apply full braking force at predetermined intervals, means for operating the brake means to first re-

lease full braking force and apply the minimum braking force, and means for equalizing the load in the circuit of the energizing coils when full braking force is applied to stall any one or more of the motors.

11. The combination of master and secondary controllers, the secondary controller including an electric motor having driving coils and also bucking coils, a bucking coil circuit in which the bucking coils are connected, a normally open switch and a normally closed switch in the bucking circuit, timed means operated by the master controller for normally holding the normally closed switch closed and opening it at predetermined regular timed intervals and timed means operated by the secondary controller for closing the normally open switch at regular predetermined timed intervals just prior to the opening of the normally closed switch.

12. In a system for resynchronizing a plurality of electric cycle controllers, each controller comprising an electric motor and a timer actuated by the motor, a feed circuit, each motor having energizing coils connected in the feed circuit independently of the other motors, brake means for each motor, a brake controller individual to each cycle controller and operable by the timer thereof at predetermined intervals to effect the application of the brake means with sufficient force to stop the motor at predetermined times in the cycle of the timer, timed means common to all the brake means of all the motors operable to release the brake means, and means for adjusting the brake controller of each timer relatively to the brake controller means of the other timers, whereby the stopping braking force for each of the timers can be applied at any time in the cycle of that timer irrespective of the time the stopping force is applied to the other timers, and the stopping force of all timers is released simultaneously.

13. In a controlling system of the class described, the combination of a plurality of controllers, each comprising an electric motor and a timer actuated by the motor, a feed circuit, each motor having energizing coils connected in the feed circuit independently of the other motors, a first means for synchronizing the operation of the motors comprising bucking coils for each motor, means common to the bucking coils of all the motors for controlling the flow of a current of predetermined value from the feed line to the bucking coils, a second means individual to each controller and operated by the timer thereof at predetermined intervals to effect a greater flow of current to the bucking coils of the companion motor sufficient to stall the same, and means common to the bucking coils of all the motors for simultaneously reducing the flow of current to the bucking coils from the maximum sufficient to stall the motors to the predetermined minimum, the second means of each controller being adjustable relatively to the second means of the other controllers, whereby the controllers can be set to effect the energizing of the bucking coils to stop the corresponding motors at different periods relatively to the stopping of the other motors, and the bucking coils of all the motors are released simultaneously.

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