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SYNCHRONIZING SYSTEM FOR A SERIES OF MOTORS

Original Filed April 28, 1928

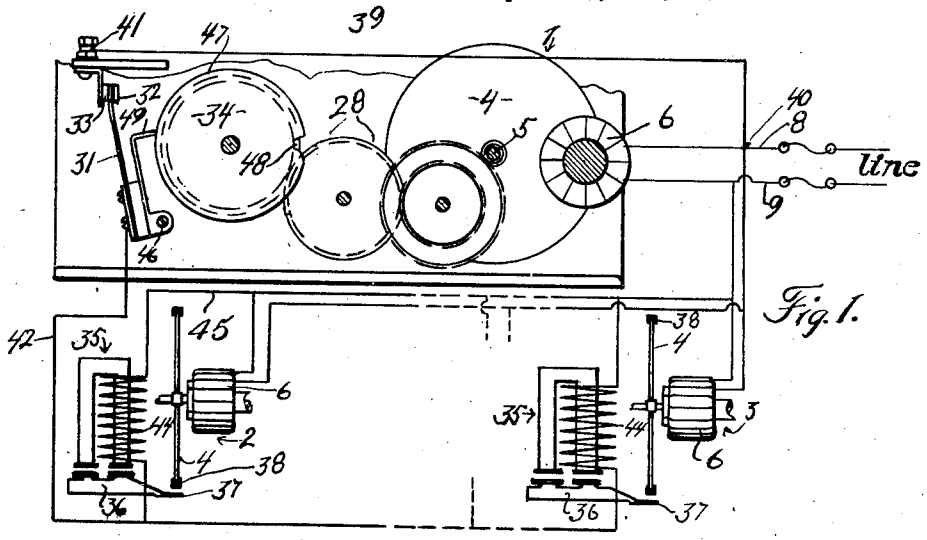


Fig. 1.

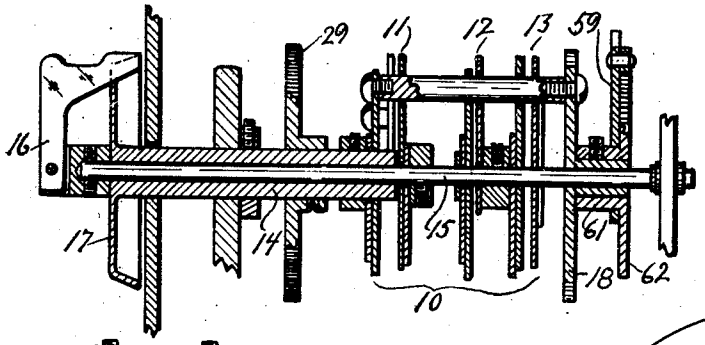


Fig. 3.

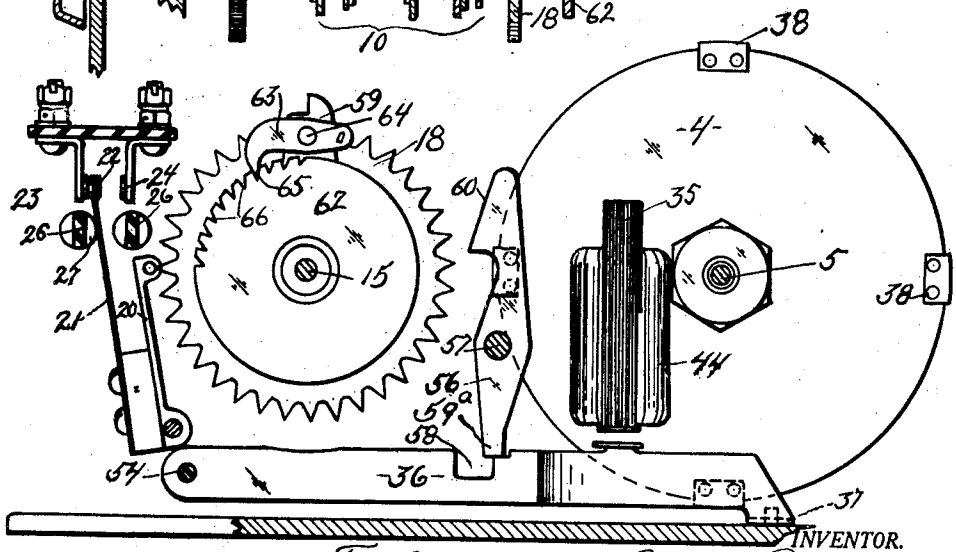


Fig. 2.

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SYNCHRONIZING SYSTEM FOR A SERIES OF MOTORS

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This invention relates to synchronizing means for a plurality of motors or prime movers and particularly to means for synchronizing street traffic signals and the like or the motors or prime movers which actuate or control such signals, which synchronizing means is particularly simple and economical in construction, readily installed and highly efficient and durable in use.

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 drawing, in which like characters designate corresponding parts in all the views.

Figure 1 is a diagrammatic view of a synchronizing system embodying my invention, a master motor and two secondary motors to be synchronized therewith being shown.

Figure 2 is an enlarged view of one of the secondary motors, parts being omitted.

Figure 3 is a longitudinal sectional view of an automatic timing cam mechanism for traffic signals and used in connection with the master motors and each of the secondary motors.

In street traffic signals, there is usually some kind of motor means or prime movers at each intersection for controlling the setting of the signals at that intersection. It is, in most instances, desirable to keep the signals at the different intersections synchronized as the motors which actuate or control the signals at the intersections can not be relied upon to accurately maintain the synchronism of the signals as the motors do not all run at exactly the same speed under the same conditions, and hence, the signals will gradually become more and more out of synchronism.

1 designates generally a master motor which may be located at a street intersection or at a central station or tower.

2 and 3 designates the motors at two additional intersections. The motors here shown are of the induction disk type including a disk or rotor 4 mounted on a shaft 5 and one or more induction coils 6, connected to feed wires 8, 9.

10 designates generally a cam mechanism, associated with each motor for timing the signals. The cam mechanism here shown includes three sets of cams 11, 12 and 13, the cam 11 controlling the go signals as green lights, north and south on one street and the stop signals as red lights, east and west on an intersecting street; also the stop or red signals north and south on one street, and the green lights east and west on an intersecting street; and the cams 12 and 13 control an intermediate amber or warning light. This intermediate light may be displayed at equal intervals on both streets and may overlap either the green or red signals or may follow the green signals indicating that the change is about to be made to the red, and not follow the red signals.

The use or manner of use of the amber signals forms no part of this invention.

The cams 11, 12 and 13 are here shown as made up of different sections for the purpose of adjustment to regulate the extent of time they are displayed. In some instances, the red and green may be displayed say 30 seconds on the main street and 30 seconds each on the cross street making a traffic cycle of 60 seconds. In other instances, the green may be displayed 40 seconds on the main street while the red will be displayed 40 seconds on the cross street and the red displayed but 20 seconds on the main street and the green 20 seconds on the cross street, with a traffic cycle of 60 seconds.

For the purpose of effecting this adjustment, the cams are mounted upon shaft sections 14 and 15, the former being a sleeve and the latter a shaft within the sleeve, and the shaft 15 is adjustable relatively to the sleeve 14 to adjust the cams, by means of a latch 16 mounted on the outer end of the shaft 15 and normally interlocked with the collar 17 on the sleeve 14 so that the sleeve 14 and shaft 15 normally rotate as a unit.

To adjust the cams, this latch 16 may be moved out of engagement with the collar 17 and the shaft 15 rotated by turning the latch 16 relatively to the disk 17. Also on each cam shaft is mounted a cam or star wheel 18 having cam surfaces or teeth which coact with the follower 20, which follower actuates switch 21 having a contact 22 movable between the two contacts 23, 24 connected in the amber light circuit to continually flash the amber lights.

The cams 11, 12 and 13 coact with followers which actuate switches similar to the switch 21 between contacts similar to contacts 23, 24 to control the green, red and amber lights.

In the normal operation of the signals, the flashing amber is used only when the green and red and intermediate amber are locked from movement. They are locked from movement by any suitable mechanism unnecessary to an understanding of this invention. This lock mechanism includes rock shafts 25 and 26 having cut-outs 27 which when brought into alinement permit movement of the red, green and amber

followers and which when brought out of alinement so move that full portions of the shaft are opposite each other and hold the followers from movement.

The cam shaft associated with each motor is connected by a train of gearing 28 to the motor shaft, the gear mounted on the cam shaft being designated 29.

The synchronizing means constituting the subject matter of this invention comprises a synchronizing circuit, a periodically operated switch in said circuit, a controller for opening and closing the switch, the controller being associated with the master motor or prime mover and usually mounted on the cam shaft 15 thereof so that the train of gears 28 constitute connections between the master motor and the controller to actuate the controller, an electric responsive means as an electro-magnet associated with each secondary motor 2, 3 etc. and having its windings connected in the synchronizing circuit so that the magnets are controlled by the switch, each magnet having a movable armature, means operated by each magnet to stop the corresponding secondary motor when the magnet is energized and the controller is in a predetermined position, latch means normally preventing the holding means from movement and a trip device associated with each secondary motor and connected thereto to run in synchronism therewith, and movable thereby to trip the latch means so that if the latch means is tripped while the switch is closed, and hence the magnet energized, the motor will be stopped until the switch is again opened by the controller.

31 is a switch arm having a contact 32 coacting with a terminal 33.

34 is a controller mounted on the cam shaft of the master switch.

35 designates the electro-magnet associated with each secondary motor 2 or 3 and 36 is the movable armature therefor.

The means for stopping the motor is here shown as a detent 37 carried by the armature and movable thereby into the path of shoulders 38 on the rotor or disk of the motor.

The synchronizing circuit includes a wire 39 connected at 40 to the feed wire 8 and to a binding screw 41 connected to the terminal 33. It further includes a wire 42 connecting the switch arm to the windings 44 of the magnets, the windings being connected to a return wire 45 which is connected to the feed wire 9 and constitutes the feed wire for the induction coils 6 of the secondary motors.

The switch 31 is here shown as an arm pivoted at 46.

The controller 34 is a cam shaped to normally hold the switch 31 closed and to momentarily open it at predetermined intervals. It is here shown as having a circular or high surface 47 and a low portion or notch 48. The switch has a follower 49 coacting with the controller 34 and movable at intervals into the notch 48 when the notch comes in alinement therewith. A suitable spring acts upon the follower 49 to hold the follower in contact with the controller 34.

The armature 36 is here shown as pivoted at 54 at one end and as carrying the detent 37 at its free end, the armature extending at its free end along the lower side of the rotor 4 with the detent extending under the lower side of the periphery of the rotor into position to move radially into the path of the shoulders 38 on the disk 4. The magnet 35 is arranged at one side of the disk 4 of each secondary motor.

The detent is moved upwardly by the electromagnet and moves automatically downwardly by gravity into its normal position. The armature 36 with its detent constitutes a retarding member for the secondary motor.

56 is a latch pivoted between its ends at 57 and located above each armature 36 and adjacent the rotor 4 of the associated secondary motor, this latch having its lower end 57^a normally engaging the upper side of the armature 36 and being movable on its pivot when tripped to move its lower end 57^a into alinement with a notch or passage 58 in the armature so that if the magnet is energized, when the latch is tripped, the armature will be actuated to move the detent 37 into the path of the shoulders 38 and hence stop the motor.

The means for tripping each latch is here shown as an arm 59 mounted on the associated cam shaft 15 of each secondary motor, the outer end of the arm 59 being movable into engagement with the upper end 60 of the adjacent latch. This arm is mounted adjacent the star or point wheel 18 and is mounted upon the hub 61 of a disk 62 keyed to the shaft 15 and is adjustable about the hub to regulate the time the latch 59 will engage the trip 56. The hub is held in its adjusted position by a pawl 63 pivoted at 64 to the arm 59 and having a tooth 65 coacting with any one of the series of notches 66 on the periphery of the disk 62. The arm 59 constitutes a timed controlling device for actuating the latch or port 56 out of its normal position.

In operation during the actuating of the master motor, the switch 31 is normally closed and each of the magnets 35 connected to the wire 42 are energized, and their armatures 36 held from movement by the latches 56. As the notch 48 comes into alinement with the follower 49 the switch 31 will open the circuit and all of the magnets 35 will be de-energized. If the secondary controls are all in step with the master controller the trip 59 will be in engagement with the upper end of the latches 60 and upon operating the latches the armatures 36 are thus free to rise, but, as the coils 35 have been de-energized the armatures do not rise and the motors are therefore not stopped. Should any of the secondary controllers be ahead of the master controller the arms 59 will operate the latches 56 and as the coils 35 are now in energized condition, the armatures 36 will rise, stop the motors, hold them stopped until the synchronizing circuit is broken by the switch 31 of the master controller.

It will, therefore, be seen that any secondary controllers which are ahead of the master will be held until the master catches up with them. Any secondary controls which are slower than the master will be stopped in a similar manner and held until released by the master controller.

In the illustrated embodiment of my invention, this notch comes into alinement with the follower during each revolution of the cam shaft or during each traffic cycle.

If any one or more of the secondary motors run in advance of the master motor, the trip 59 of the secondary motor so running in advance will trip the latch 56 and the magnets being energized because the switch 31 is closed, will attract the armature 36 causing it to move the detent 37 into the path of a shoulder 37 and hence stop the secondary motor or motors running in advance and hold the same stopped until the notch

48 of the controller comes into alinement with the follower 49, whereupon the magnets will be de-energized and the motor or motors start again in synchronism with the master motor.

If any one or more of the secondary motors lag behind the master motor so that the trip 59 does not engage the latch 56 of the motor lagging behind, when the notch 48 comes into alinement with the follower 49 then the secondary motor so lagging behind will not be stopped momentarily but will continue to run while the others are stopped and then, after the other motors have started, the trip 59 will trip the latch 56 of the motor lagging behind and as the electro-magnet of the lagging motor is then energized the motor lagging behind will be held stopped for the remainder of the traffic cycle or until the notch 48 comes again into alinement with the follower 49.

What I claim is:

1. A system for synchronizing a series of motors comprising a master motor and a plurality of secondary motors, a circuit between the secondary motors and the master motor, a switch connected in said circuit and operated by the master motor for periodically energizing and de-energizing the circuit, electro-responsive means associated with each secondary motor and connected in the circuit, a member operated by the electro-responsive means and movable into and out of position to retard the secondary motor, a second member for retarding the operation of the first member by the electro-responsive means and means operated by the secondary motor for periodically releasing the second member so that the said first member may be operated by the electro-responsive means to stop the secondary motor, said last mentioned means being adjustable relatively to the secondary motor whereby each secondary motor may be stopped in any one of a plurality of positions relative to the other secondary motors in the circuit.

2. In a system for synchronizing a series of motors including a master motor and a plurality of secondary motors, a normally energized circuit between the master motor and the secondary motors, said circuit being periodically de-energized by the master motor, a member associated with each secondary motor and movable into and out of position to stop said motor, a movable detent associated with said member and normally positioned to retard said member from movement, a trip mechanism associated with each secondary motor and operated thereby for periodically tripping said detent, an electro-responsive device associated with each secondary motor and connected in said circuit for moving the retarding member into position to stop the motor, the trip mechanism being adjustable relatively to the secondary motor, whereby the detent member may be tripped when one secondary motor is in any relative position to the other secondary motors, and means for moving said retarding member away from the motor to permit the same to start when the circuit is de-energized.

3. The combination of a master motor and a secondary motor, a controller connected to and actuated by each of said motors, means for periodically synchronizing the secondary controller with the master controller including a member operable to retard the secondary motor and means operated partly by the master controller and partly by the secondary controller for shifting said retarding means into operated position to periodically stop said secondary controller in any one of a plurality of positions relative to the master controller.

4. The combination of a master motor and a secondary motor, controllers connected to and actuated by said motors respectively, and means for resynchronizing the secondary controller with the master controller including a member operable to retard the secondary motor at intervals, a second member coacting with the first member to partly control the operation thereof, a third member operable by the secondary controller in synchronism therewith and coacting with the second member to operate the same, means for actuating the retarding member, and timer means operated by the master controller for operating the actuating means for the retarding member, the third member being adjustable into different positions relatively to the second controller, all whereby the retarding member is controlled by the timer means of the first controller and the second controller through the third member, and said third member is adjustable to vary the synchronizing period of the secondary controller relatively to the master controller.

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