This invention relates to train dispatching systems of the way-side signal indicating type, and more particularly to a centralized traffic controlling system of the kind where the dispatcher supervises control over the system and wherein OS signals are transmitted through the medium of synchronous selectors and distributors.

In my prior application Ser. No. 321,188 filed November 23, 1928 the synchronous distributors were controlled from a selector in the dispatcher's or central office which selector was constantly operated. All the way station distributors in said system are operated when a control is transmitted from the dispatcher's office and a particular way station distributor only is operated when an OS indication is received from such way station. In accordance with the present invention it is proposed to use a selector and a plurality of distributors, conveniently called a "self-stepping synchronous system" in which the selector at the dispatcher's office and all of the way station distributors are normally at rest and are stepped in synchronism in the event that the selector operates one of his levers or an OS indication is to be transmitted from a way station.

More specifically it is proposed to provide at the dispatcher's office a selector of the stepped rotating type, a master relay and a line relay, so interconnected that movement of the selector operates the master relay, operation of the master relay operates the line relay and operation of the line relay in turn operates the selector. It is thus seen that these devices have a tendency to operate in succession so long as their interconnections are maintained. A further object of the present invention is to permit the closure of the message circuits, many of which are intermittently completed in sequence, only at a time when the selector and the various distributors are at rest, and this is accomplished by carrying each one of these message circuits through contacts of the main relay and the line relay closed only when these two relays are out of step, which occurs only when the selector in the dispatcher's office, and station selectors are at rest. Other features of the present invention reside in the provision of means in the dispatcher's office for allowing the selector and the various distributors to operate through at least two complete revolutions for each initiation thereof, and means at each of the way stations for effecting operation of the selector in the dispatcher's office and all of the way station distributors through at least two revolutions in response to initiation of the synchronous apparatus from the corresponding way station.

Other objects, purposes and characteristic features of the invention are in part obvious from the showing in the accompanying drawings and will in part be pointed out in the specification hereinafter.

In describing the invention in detail reference will be made to the accompanying drawings in which:

Fig. 1A shows conventionally the apparatus located in the dispatcher's office of a simplified system illustrating only the apparatus for controlling the switch machine and signals at one end of the passing siding; and

Fig. 1B illustrates conventionally apparatus embodying the present invention such as found at a single way station controlling a single switch machine and the associated signals, together with additional line relays for controlling apparatus at other way stations.

Apparatus of the system.—Although in practice the dispatcher controls the switch machine and way-side signals of a large portion of a railway system, possibly including many passing-sidings, diverging routes, drawbridges, railway crossing, and the like, the present invention has for convenience been shown applied to the apparatus located at one end of a passing siding PS (see Fig. 1B) connecting a single track section N and a single track section O of a single track railway system signalled with absolute-permissive-block signalling to the single track section O. The east and west end of this passing siding contain the track switches SE and SW, respectively. These switches have associated therewith the usual detector track circuits, in-
sulated from the rest of the track by insulating joints 3 and 4, respectively. The detector track circuit at the east end includes the usual track battery 5 and detector track relay DT. The starting signals of the main track and siding at the east end of the passing siding PS have been designated 2 and 2\textsuperscript{a} respectively, and the corresponding entering signals have been designated 1 and 1\textsuperscript{a}.

In the tower is preferably located a miniature track layout corresponding in every detail to the system of which the dispatcher has control, and in the particular arrangement shown includes only the passing siding PS. This miniature passing siding has an indicating lamp I associated therewith, which if illuminated indicates occupancy of the corresponding detector track circuit, namely the detector track relay DT. The track switch SE at the east end of passing siding PS is preferably controlled by a switch machine SM, which switch machine is preferably controlled by the switch machine relay SMR, which relay is in turn controlled by the lever SML through the medium of synchronous selector system hereinafter described. Similarly, the signals 1, 1\textsuperscript{a}, 2, and 2\textsuperscript{a} are controlled by the signal relay SR and direction relay DR through the medium of the synchronous selector system in accordance with the position of the lever SL located in the dispatcher's office.

The apparatus in the dispatcher's office also includes a synchronous distributor or selector SS. It may be pointed out that each way station includes a similar distributor or selector, and for convenience the dispatcher's device is hereinafter called a selector and is designated SS and the way station device is called a distributor and is designated SD. This selector SS is one of the spring actuating escapement type, in which the main spring 10 through the medium of gear 11 and pinion 12, drives the selector shaft 13, this main spring 10 being wound up intermittently by the winding magnet WM, having an armature 14, acting through pawl 15 to operate ratchet wheel 16 held against return by the pawl 17.

The selector shaft 13 is permitted to rotate in step-by-step fashion through the escapement wheel 18, the rotation of which is retarded by the pallet 19 controlled by magnets 20 and 21. The shaft 13 drives a selector arm 25 having an extension 26 insulated therefrom. The arm 25 intermittently connects a series of contacts through the slip ring 27 whereas the extension 26 connects the slip ring 28 successively to one of a plurality of contacts a\textsuperscript{3}, a\textsuperscript{4}, a\textsuperscript{5}, a\textsuperscript{6}, a\textsuperscript{7}...

The apparatus in the station also includes a line relay LR\textsuperscript{a}, a master relay MR, an indicating relay IR and initiating relay IN, a repeater relay RR, a starting relay STR, a starting repeater relay RSR and a cancelling relay CR. It may be pointed out here that the line relay LR\textsuperscript{a} is one of the polar magnetic stick type, which if momentarily energized by current of one polarity assumes a certain position until energized by current of another polarity, which relay is constructed to have its rate of response changed, as conventionally shown by the weight 30 adjustable fastened to the movable contact 31, the position of the adjustable weight being fixed by set screw 32. The master relay MR is a two-element relay adapted to assume any one of three positions this relay being biased to its neutral normal position, and when energized assumes one or the other extreme position depending upon which of its coils is energized. This relay MR also has another operating characteristic of which advantage is taken, namely it will not change its position if the second coil is energized with the first coil still energized, but will move to the other extreme position when the first coil is de-energized.

The indicating relay IR is also a polar stick relay similar to the relay LR. The relays IN, RR, STR, and RSR are all neutral relay, of which the relays STR and RSR are purposely made slow-acting. The cancelling relay CR is a polar relay having two windings, these windings being so arranged that the armature 33 is moved in one direction or the other depending upon which of these windings is energized thereby effecting opening of one or the other of the two circuits completed through the armature 33.

Referring to Fig. 1B of the drawings, the line relays LR\textsuperscript{1}, LR\textsuperscript{2}, and LR\textsuperscript{3} for controlling these different way station distributors have been shown. These three relays are polar relays of the permanent magnet type which have their contacts biased to the neutral position as conventionally shown. The periodicity of these relays is also adjustable, and in each case may be changed by adjusting the weight 30 associated therewith. Attention is directed to the fact that the line relay LR\textsuperscript{2} at the dispatcher's office is a magnetic stick polar relay, whereas the line relay LR\textsuperscript{1}, LR\textsuperscript{3}, and LR\textsuperscript{2} are polar relays having their armatures biased to the neutral position, otherwise the operating characteristics of these relays are the same, that is they are all polar relays and respond in substantially the same period of time. The reason for biasing certain of these relays to neutral is more conveniently explained hereinafter.

The apparatus in the way station location containing the line relay LR\textsuperscript{2} also includes a synchronous distributor SD. This distributor is constructed similar to the synchronous selector heretofore described. The synchronous distributor includes a rotatable distributing arm 35 cooperating with a slip ring 36 and a plurality of contacts a\textsuperscript{3}, a\textsuperscript{4}, a\textsuperscript{5}, a\textsuperscript{6}, a\textsuperscript{7}... a\textsuperscript{31}. The winding apparatus for the distributor SD is identical to
the winding apparatus of the selector SS, and for this reason like parts thereof have been assigned like reference characters. The pallet 37 of the distributor SD is operated alternately in opposite directions by the magnets 38 and 39. On opposite sides of the pallet 37 are located inertia members 40 and 41, which are pivoted, supported at points 42 and 43, and engage stops 68 and 69, respectively, and are adapted through the medium of adjusting screws 44 and 45 to engage and close the contacts 46 and 47, these inertia members being operated through the medium of anvil screws 48 and 49 engageable by the pallet 37. These inertia members 40 and 41 are biased in position to engage stops 68 and 69 as shown and will not be moved in response to engagement by the pallet 37 when this pallet is operated intermittently in response to current flowing alternately in opposite directions if this current is reversed at a predetermined rate; but, one of these members is operated if voltage is applied to the corresponding coil 38 or 39 for a sufficient period of time to allow current to build up to a predetermined value. In other words, if the alternate movement of the line relay LR is very quick the pallet 37 is operated without closing either of the contacts 46 or 47. If, however, the line relay LR is held in one extreme position for an appreciable period of time and the magnet 38 or 39 is energized for an appreciable period of time, the contact 47 or 46 is as the case may be, closed. This functioning of the inertia members 40 and 41 is in part attributed to the inertia of these members, and is in part attributed to the fact that voltages applied to the magnet 38 or 39 for a very short period of time will not allow current to build up in these circuits by reason of the inductive reactance of these magnets 38 or 39 to the necessary voltage to effect operation, so that the current actually flowing in these magnets is not sufficient to overcome the bias of the inertia members 40 or 41, as the case may be.

The distributor shaft 50 in addition to the distributor arm 35 and the escapement wheel 51 contains a worm 52, which is adapted to be engaged by the arm 53, normally resting on a rest 64 and urged against the stop 55 by the spring 56, this arm 53 being pivoted at 57 to an armature 58 which is biased against a stop 59, this armature being attractable by a magnet 60. This apparatus just described is for convenience called a mechanical stick device, which is used for holding the armature 58 closed through a predetermined number of revolutions of distributor contact 36 and as a whole is designated MS. The shaft 50 also contains a stop arm 61 normally engaged by the armature 62 of a release magnet RM. It is believed that the functioning of the various devices, as well as the system as a whole, is most readily described in connection with the operation of the system.

Operation.—For convenience the exact manner of control of the switch machine SM and the signals 1, 115, 2, and 20 by the relays SR, DR and SMR have not been specifically shown but have been illustrated by dotted lines, and for a more detailed description and disclosure of the interconnecting circuits thereof attention is directed to my prior application above identified.

Let us assume that the dispatcher wishes to move his switch machine SM to the reverse position. In order to so move the switch machine he must change the relay SRM from its normal to its dotted position. In order to so operate the relay SM the dispatcher will move his lever SML to the left hand position thereby momentarily completing the following circuit:—beginning at the battery 70, wires 71, 72, 73, 74, 75, and 76, lever contact 77 closed momentarily during movement of the lever SML to the extreme left-hand position, wires 78 and 80, winding of the initiating relay IN, wire 81, upper winding of the repeater relay RR, wires 82, 83 and 84, back to the battery 70. Momentary completion of the circuit just traced completes a stick circuit for the initiating relay IN which may be traced as follows:—beginning at the battery 70, wire 86, armature 33 of the cancelling relay CR, contact 87 of this same relay, wire 88, front stick contact 89 of the relay IN, wires 90 and 80, winding of the initiating relay IN, wire 81, upper winding of the repeater relay RR, wires 82, 83 and 84, back to the battery 70. With the stick circuit just traced completed both of the relays IN and RR are energized to assume their energized position, and remain in such position in spite of the opening of the pick-up circuit of the relay IN.

With the relay RR in its energized position the following stick circuit for this relay is closed and has current flowing therein:—beginning at the battery 70, wire 86, armature 33 of the cancelling relay CR, contact 91 of this relay CR, wire 92, stick contact 93 of the relay RR, wire 94, lower winding of the relay RR, wires 96, 83 and 84, and back to the battery 70. With the contact 96 of the repeater relay RR closed the following circuit for the starting relay STR is completed:—beginning at the negative terminal of the battery 100, wires 101, 102, 103, 104 and 105, winding of the starting relay STR, wire 106 and 107, selector arm 25, selector contact 107, wire 108, contact 96 of the repeater relay RR, wire 109 connected to the common return wire C which in turn through wire 110 is connected to the midpoint of the battery 100. With the starting relay STR in its energized position the following circuit for rewinding the selector mechanism is closed:—beginning at the battery 70, wires 71, 72 and 116, winding of the winding magnet WM, wires 117, and 118, contact 118 of the start-
ing relay STR, wire 114, 115 and 84, back to the battery 70.

With the starting relay STR in its energized position the following energizing circuit for the repeater starting relay RSR is broken:—beginning at the battery 70, wires 71, 72, 73, 74 and 111, winding of the repeater relay RSR, wire 112, back contact 113 of the starting relay STR, wires 114, 115 and 84, back to the battery 70.

With the repeater starting relay RSR de-energized, and with the starting relay STR energized the following circuit for operating the master relay to its left-hand position is completed:—beginning at the battery 70, wires 71, 72, 73, 120 and 121, magnet 122, wires 124 and 125, back contact 126 of the relay RSR, wires 127 and 118, front contact 113 of the relay STR, wires 114, 115 and 84, back to the battery 70.

As heretofore mentioned, the line relay LR is a polar stick relay and with the selector in the zero position assumes a position to energize the coil 21 of the escapement mechanism of the selector SS, because the master relay was last energized to the right. With the master relay MR in its left-hand position, in response to energization of its coil 129 through the circuit just traced, current flows in the following circuit for energizing all of the line relays LR, LR, LR, LR to the left-hand position:—beginning at the negative terminal of battery 130, wire 131, contact 132 of the master relay MR in its left-hand position, wire 133, winding of the relay LR, stepping or synchronizing wire including the windings of the relays LR, LR, and LR in series, and the common return wire C connected by wire 134 to the midpoint of battery 130. Completion of this circuit operates the contacts 135 and 31 of relay LR to the left-hand position.

With the contact 135 in its left-hand position the following circuit for the magnet 20 of the escapement mechanism of selector SS is completed:—beginning at the battery 70, wires 71 and 136, contact 137 of the relay LR in its left-hand position, wire 137, magnet winding 20, wires 138, 139, 118 and 84, back to the battery 70. With the magnet 20 energized the selector contact 25 and its extension 26 is allowed to take one step corresponding to the position s. With the arm 25 assuming the position one the following circuit for the right-hand coil of the master relay is completed:—beginning at the battery 70, wires 71, 72, 73, 120 and 121, coil 128 of the master relay MR, wire 141 connected through various jumpers to alternate contact 142 at position two on the inner circle of contacts, through the arm 25, the slip ring 27, wire 143, back to the battery 70. With this circuit completed the master relay MR has a tendency to assume the right-hand position, but it is restrained from moving toward the right because the contact 128 of the repeater relay RSR is still down and the contact 113 of the starting relay STR is still energized thus leaving the coil 122 of relay MR still energized. After a short period of delay the circuit for the coil 122 of the master relay MR, and including the contacts 126 and 113 of relays RSR and STR is broken in response to dropping of relay STR, under which condition the energization of coil 128 of the master relay MR is effective to move its contact 122 to the right-hand position, in which case all of the line relays LR, LR, LR, and LR will be operated to the right-hand position, thus allowing the selector SS as well as each of the distributors SD to take the next step. It will be noted that as soon as the arm 25 of the selector SS has moved to the third position current may again flow to the left-hand coil 122 of the master selector, but through a different and the following circuit:—beginning at the battery 70, wire 71, 72 and 73, 120 and 121, magnet 123 of the master relay MR, wires 124 and 144, through various jumpers to the contact 145 at position three on the selector SS, arm 25, slip ring 27, wire 143, back to battery 70.

It is thus noted that if the selector SS has once been initiated, it thereafter repeatedly operates the armature of the master relay MR in opposite directions, which master relay in turn operates the line relays from one position to the other position, and which line relays in turn operate the selector SS and the various distributors SD through successive steps about their circumference. It should be noted that when the selector arm 25 again reaches the zero position the apparatus will be stopped, because the master relay MR is de-energized in this position of the selector SS, because the zero contact on the inner contact ring is not connected to the coil 122 of the master relay MR in the zero position of the arm 25 as is the case in all other even positions about the circumference. This arm 25 applying potential to the coil 123 of the master relay MR in all odd positions of the arm 25 about the circumference. Putting it another way the synchronous selector SS is so connected to the relay MR, the relay MR is so connected to the line relay LR, and the line relay LR is in turn so connected to the selector SS and that when the arm 25 of the selector SS has once been moved off of its zero position, these devices step each other along and effect stepping of the contact arm 25 until it again reaches its zero position the second time. It is understood that the master relay MR is de-energized in the zero position of the selector SS and that if this master relay MR is for any reason energized to its left-hand position the apparatus is again released and operated through at least another revolution.

It is of course possible that a way station...
distributor, such as distributor SD, could lose several steps in one complete cycle of operation, as in case of a lightning stroke occurring at the proper time, and the like. For this reason it is desirable to have all of these way station distributors resynchronized at the end of each cycle. It is noted, and has been pointed out herein before, that the way station line relays LR\textsuperscript{1}, LR\textsuperscript{2} have their contacts biased to the neutral position, whereas the dispatcher's line relay LR\textsuperscript{0} is a magnetic stick relay. It thus appears that if current is cut off of the line circuit for an appreciable time the dispatcher's selector remains at rest whereas all of the way station distributors are permitted to be operated by their driving springs, due to the free movement of their pallets, to the normal position where they are held by the lock arm 62, and this is exactly what occurs when the dispatcher's selector reaches the zero position. It is of course understood that this free stepping along of the way station distributors only occurs when they have lost a step or more.

Let us now consider the apparatus associated with the line relay LR\textsuperscript{0}. As heretofore explained the synchronous distributor SD is held in its normal position by the release arm 62 engaging the stop arm 61. Also as heretofore mentioned, the first impulse transmitted to the line, namely the synchronous impulse operates the various line relays to the left-hand position, and which impulse is of a long duration, because of the slow acting characteristics of the starting relay STR and a repeater starting relay RSR, causes release of these distributors as will presently be explained. This first and long impulse operates the line relay LR\textsuperscript{0} to its left-hand position, thereby closing the following circuit for a rather long period of time:—beginning at the battery 150, wires 151, contacts 152 of the line relay LR\textsuperscript{0}, wire 155, magnet winding 39, wires 154, 155, 156 and 157, back to the battery 150.

The circuit just completed operates the pallet 37 to the left-hand position, and by reason of the long duration of current application to the coil 39 the contact 46 is closed, thereby completing the following circuit for the release magnet RM:—beginning at the battery 150, wires 158 and 159, winding of the release magnet RM, wire 160, slow-closing contacts 46, wires 161, 158 and 157, back to the battery 150.

Energization of the release magnet RM causes the stop arm 61 to be released thereby permitting the escapement wheel 51 to operate one-half tooth, that is until the right hand anvil of the pallet 37 engages the next tooth of this escapement wheel, thus allowing the distributor SD to assume the position \( a' \) as distinguished from its normal \( a \) position. 

Operation of the release magnet RM also closes the contacts 163, thereby re-winding the distributor by energization of the winding magnet WM through the following circuit:—beginning at the battery 150, wires 158, and 162, contact 163 of the release magnet RM, wire 164, winding magnet WM, wires 163 and 157, back to the battery 150. Completion of this circuit winds the distributor SD to an extent to operate it through at least one complete revolution.

If the distributor SD has once been released by energization of the release magnet RM it is permitted to rotate in step-by-step fashion and in synchronism with the selector SS in the dispatcher's office through alternate energization of the coils 48 and 50 in response to alternate polarity of energization of the line relay LR\textsuperscript{0}. It is understood that the slow-closing contact 40 is only closed in response to the first impulse of the series of impulses transmitted from the master relay MR, this first impulse being much longer than the rest of the impulses, this by reason of the slow-acting characteristic of the starting relays STR and RSR which causes the master relay MR to be held in its left-hand position for an appreciable period of time at the beginning of each cycle of rotation of the selector arm 25 of the selector SS.

It is noted that during the last two steps of each rotation of the selector SS in the dispatcher's office the upper winding and the lower winding of the cancelling relay CR are momentarily energized in succession, the upper winding being energized on the 30th position of the selector arm whereas the lower winding is energized on the 31st position of, this arm 25. The turns of these windings are arranged oppositely so that energization of the upper winding causes the armature 33 to be moved to the left whereas energization of the lower winding causes the armature 33 to be moved to the right. These circuits need not be traced, it is believed. Movement of the armature 33 to its left-hand position in response to engagement of the extension 26 with the contact 30 breaks the stick circuit for the repeater relay RR including the stick contact 33, but this relay RR will not be de-energized because its upper winding is still energized. Upon movement of the extension 26 in engagement with contact 30, which effects energization of lower winding of the relay CR and effects movement of armature 33 to its right-hand position, causes opening the stick circuit for the initiating relay IN.

This effects dropping of its stick contact 89, thus leaving this relay IN de-energized but leaving the repeater relay RR still energized. With the contact 96 of the repeater relay RR still closed the starting relay STR is again energized when the arm 25 reaches the zero position, because the circuit heretofore traced for this relay STR is again closed.

Energization of this starting relay STR effects de-energization of the repeater relay 130.
RSR and again initiates the apparatus and causes it to be operated through an entire cycle of operation comprising 32 steps of which the first step is of long duration for reasons heretofore explained. When the selector arm 25 reaches the position where the extension 26 engages the contact s\textsuperscript{th} the canceling relay CR is again energized to its left-hand position, thereby opening its contact 91 and breaking the stick circuit for the repeater relay RR. Since this relay RR at this time relies on its stick circuit for its energization this relay RR is caused to assume its de-energized position, so that the apparatus is again brought to stop after having made two complete revolutions in response to the movement of the lever SML to its left-hand extreme position.

During these two revolutions of the selector SS and each of the various distributors SD the following circuit for the switch machine relay SMR is momentarily completed during each revolution of the selector arm 25 and distributor arm 35:—beginning at the battery 100, wires 101 and 170, selector contact SML in its left-hand position, wire 171, selector contact s, extension 26 of the selector arm 25, slip ring 28, wire 172, contact 173 of the master relay MR assuming its left-hand position, wire 174, contact 91 of the line relay LR\textsuperscript{th} assuming its right-hand position, selecting or message wire 175, wire 176, slip ring 36 of the distributor SD associated with the east end of passing siding PS, distributor arm 35, contact d\textsuperscript{th}, wire 177, winding of the switch machine relay SMR, wire 178, common return wire C connected to the midpoint of battery 100 by wire 110. It will be noted that the circuit just traced applies negative potential momentarily to the switch machine relay SMR thereby causing it to be operated to its left-hand dotted position, in which position it will remain until it is again de-energized by current of a positive polarity. It is deemed unnecessary to trace the momentary circuit completed for the relays SR and DR, since they can be readily traced in the drawings and are completed momentarily when the rotating contact arms assume the positions 6 and 7 respectively, while the relays MR and LR\textsuperscript{th} assume certain positions. In this connection it should be noted that in completing the message circuits through contacts s\textsuperscript{th} and d\textsuperscript{th} the relays MR and LR\textsuperscript{th} must assume respectively the left-hand and right-hand position, as was the case when the message circuit included contacts s\textsuperscript{th} and d\textsuperscript{th}. If, on the other hand, the message circuit is completed through contacts s\textsuperscript{th} and d\textsuperscript{th} such message circuit is only complete when the relays MR and LR\textsuperscript{th} assume respectively the right-hand and left-hand position. In this connection it should be noted that the message circuit is only completed when the selector SS as well as all of the distributors are at rest. Further it should be noted that this occurs at the time when the various line relays are energized for operation to the next extreme position but have not yet started to move to such position. For this reason the rapidity of operation of the line relays is reduced below that of the operation of the control relays such as relays SR, DR and SMR. The retarding of operation of the line relays, such as LR\textsuperscript{th}, LR\textsuperscript{th} and LR\textsuperscript{th}, may be accomplished in any suitable way and is preferably accomplished by adjustable means, and such adjustable means has been conventionally shown by the adjustable weights 80. In order to transmit as many distinctive control impulses as practicable the master relay is made very quick acting as is also true of the various distributors, but in order to permit message current to flow for a sufficient period of time to obtain the desired result the line relays are made somewhat slow acting. In this connection it should be understood that all line relays should respond in substantially the same period of time, and likewise all of the distributors and the selector SS should have substantially the same operating characteristics as far as rapidity of response is concerned. In this connection the rate of operation of the selector and distributors may be increased by strengthening the main spring thereof. Also, if desired, the master relay MR may be constructed to have its rapidity of operation adjustable in the same manner as have the line relays.

Let us now assume that there is a west bound train moving in the single track section O, and that the switch machine has been operated to a take-sided position in response to movement of the relay SMR to its left-hand dotted position, and that the signal 1\textsuperscript{st} has been cleared in response to proper positioning of the signal relay SR and the signal relay DR. Let us further assume that the train in question has accepted the signal 1\textsuperscript{st} and is moving into the side track, thereby effecting de-energization of the detector track relay DT. If this track relay DT moves from its energized to its de-energized position the following circuit for the magnet 60 of the mechanical stick device MS is momentarily closed:—beginning at the terminal B of a suitable battery, contacts 180 and 181 connected in series, wire 182, winding of the magnet 60 to common return wire C connected to the other side of said battery. With the magnet 60 momentarily energized its armature 58 is moved to its dotted position, thereby causing the arm 53 to be pulled off of the rest 54 and causing it to drop to a position to engage the worm 52. With the arm 53 in this engaged position the armature 58 is held closed through several revolutions of the distributor contact 35. When the arm 53 has been moved beyond the rest 54, it is engaged by a pin 188 which will raise the arm 53 back on top of
the rest 54, thereby again effecting release of the armature 58 and opening of its contact. It is thus seen that the armature 58 remains in its attracted position through a predetermined number of revolutions of the arm 56 in response to momentary energization of the magnet 60.

With the armature 58 in its attracted position the following circuit for the starting relay STR, located in the dispatcher's office, is closed:—beginning at the battery 100, wires 101, 102, 103, 104 and 105, winding of the starting relay STR, wire 106, extension 26 of the selector arm 25, wire 185, selecting for message wire 175, wire 176 (see Fig. 1B) slip ring 36, distributor contact 35, contact $d_2$, wire 186, armature 58 of the mechanical stick device MS, wire 187, common return wire $C$ which through wire 110 is connected to the midpoint of battery 100. With this circuit completed the starting relay STR is again energized and the synchronous selector SS as well as the various distributors SD are started upon another cycle of operation, which cycle of operation is repeated so long as contact 58 remains closed and which time depends on the number of turns in worn 52 of the mechanical stick device MS.

During these several revolutions of the contacts 25 and 58 of the selectors and distributors, the following circuit is momentarily closed when these arms reach the contacts $s^1$ and $d^2$:—beginning at the negative terminal of battery 190 (see Fig. 1B), wire 191, contact 192 of the detector track relay DT in its lower position, wire 193, contact $d^2$, distributor arm 35, slip ring 36, wire 176, selecting or message wire 175, contact 31 of the line relay LR, in its left-hand position, wire 174, contact 173 of the master relay MR in its right-hand position, wire 172, slip ring 28, extension 26 of the selector arm 25, contact $s^2$, wire 194, winding of the indicating relay IR, wire 196, common return wire $C$, wire 196 to the midpoint of battery 190. With this circuit completed the indicating relay IR is moved to its left-hand dotted position where it will be held until energized by current of reverse polarity, and thereby illuminating the indicating lamp 1 through a circuit readily traced in the drawings. After the synchronous selector and the various distributors have moved through a number of revolutions, depending on the number of threads in the worn 52, the apparatus is again brought to a stop, but the indicating lamp 1 remains illuminated so long as the indicating relay IR is not restored to its normal position.

If now the train passes off of the detector track circuit and the detector track relay DT again assumes its energized position the contacts 180 and 181 associated with this relay DT are momentarily closed thereby initiating the mechanical stick device MS and again operating the apparatus through a predetermined number of revolutions. With the detector track relay DT in its energized position each rotation of the selector arm 25 and the distributor arm 35 causes the indicating relay IR to be momentarily energized with current of positive polarity, thereby operating it to its right-hand normal position in which position the indicating lamp 1 is extinguished.

It is thus seen that a synchronous selector system has been provided in which a synchronous selector at a dispatcher's office and a plurality of synchronous distributors at the way stations of a railway system are normally held at rest in a certain normal or zero position, that these synchronously operated selectors and distributors may be initiated from the dispatcher's end of the system or from any way station, and that when so initiated they will operate in synchronism through at least two complete revolutions after which they will be automatically brought to stop. Viewing the apparatus from the standpoint of being normally at rest and being inexcitable from any one of the various stations, and if so initiated operating through a predetermined cycle of operation, the system constitutes one in which the apparatus is only operating when required, and at the same time is a system in which a very large number of distinctive controls may be transmitted from various points to various other points through a single revolution of cycle of operation of the apparatus.

In other words, the system has the advantages of a code responsive selector system in that it is normally at rest, and has the advantage of the usual constantly operated synchronous selector system in that it affords the transmission of many distinctive controls during a single revolution of operation. Although the manner in which the switch machine relay SMR is controlled has only been specifically pointed out, it is to be understood that the relays SR and DR are controlled in exactly the same way by the lever SI, as the switch machine relay SMR is controlled by the lever SML, different communicating channels of the synchronous selector system being, however, used. Further, although only a single complete way station has been illustrated it is to be understood that possibly twenty or more such way stations will in practice be used with a single dispatcher's office synchronous unit. Also, the apparatus shown and described contemplatesthat the system will be operated only for a period of say two revolutions, when a lever is operated or when an OS single indication is to be transmitted, the system may on the other hand be continuously operated by omitting these cut-out devices. Similarly, if desired, the entire system may be operated for a few revolutions only for each movement of a lever, and
may operate continuously so long as trains occupy detector track circuits of the railway system, in other words, may be so arranged that when the system is started from the field it will operate continuously so long as required but if started from the dispatcher's office will operate for a few revolutions only.

Having thus shown and described one specific embodiment of the present invention, and having shown many of the devices conventionally, and having shown the specific structure of other devices, it is desired to be understood that the specific exemplification of the invention has been selected for the purpose of describing its nature and its manner of operation, and without the intention of showing the scope of the invention or the exact structure preferably employed in carrying out the invention, and that various changes, modifications and additions may be made without departing from the spirit or scope of the invention or the idea of means underlying the same, except as demanded by the scope of the following claims.

What I claim is:

1. A synchronous selector train dispatching system for transmitting distinctive messages from a local office to a plurality of way stations and from any one of said way stations to said office comprising in combination, a central office, a plurality of way stations, a rotatable selector arm at said central office and at each of said way stations but normally held at rest in their zero position and which if operated at a uniform angular velocity engage corresponding stationary contacts simultaneously, means for operating said selector arms in synchronism including a main spring and an escapement, and means controlable from any one of said way stations and from said central office for initiating operation of said means.

2. A synchronous selector train dispatching system for transmitting distinctive messages from a local office to a plurality of way stations and from any one of said way stations to said office comprising in combination, a central office, a plurality of way stations, a rotatable selector arm at said central office and at each of said way stations but normally held at rest in their zero position and which if operated at a uniform angular velocity engage corresponding stationary contacts simultaneously, means for operating said selector arms in synchronism including a main spring and an escapement, which if initiated operates said arms through a predetermined number of revolutions, and means controllable from any one of said way stations and from said central office for initiating operation of said means.

3. A self-stepping synchronous selector train dispatching system comprising in combination, a selector including a rotatable contact arm and electro-magnetic means for rotating said arm in step-by-step fashion, a 3-position relay operated to alternate extreme position in response to stepping of said selector, a polar relay energized in alternate directions in response to operation of said 3-position relay in opposite directions, and means for effecting alternate operation of said electro-magnetic means in response to operation of said polar relay in opposite directions, whereby said selector, 3-position relay and polar relay step each other along and remain in operation at a speed depending on the cumulative retarding effect of these three devices.

4. A self-stepping synchronous selector train dispatching system comprising in combination, a local office selector, a plurality of way station selectors, a line relay for each of said selectors, a line circuit including all of said line relays in series, means for intermittingly energizing said line circuit to operate said selectors in synchronism, message circuits completed consecutively through contacts at said office and at one of said way stations, and other means also controlled by said line circuit for applying electrical energy to said message circuits a moment after they have been completed and removing said energy just before they are opened, whereby the inherent characteristics of the line circuit determine the time of application and removal of energy from said message circuits.

5. A self-stepping synchronous selector train dispatching system comprising in combination, a selector including a rotatable contact arm and electro-magnetic means for rotating said arm in step-by-step fashion, a 3-position relay operated to alternate extreme position in response to stepping of said selector, a polar relay energized in alternate directions in response to operation of said 3-position relay in opposite directions, and means for effecting alternate operation of said electro-magnetic means in response to operation of said polar relay in opposite directions, other selectors operated by a circuit including said polar relay whereby all of said selectors, said 3-position relay and said polar relay remain in operation at a speed depending on the cumulative retarding effect of said first mentioned selector said 3-position relay and said polar relay and whereby said selectors are started, stopped and operated in synchronism.

6. A self-stepping synchronous selector train dispatching system comprising in combination, a selector including a rotatable contact arm and electro-magnetic means for rotating said arm in step-by-step fashion, a 3-position relay operated to alternate extreme position in response to stepping of said selector, a polar relay energized in alternate directions in response to operation of said 3-position relay in opposite directions, and means for effecting alternate operation of said electro-magnetic means in response to operation of said polar relay in opposite directions, whereby said selectors are started, stopped and operated in synchronism.
said electro-magnetic means in response to operation of said polar relay in opposite directions, other selectors operated by a circuit including said polar relay, and a message circuit completed only when said 3-position relay has responded to its last energization and said polar relay has not yet responded to its last energization, whereby all of said selectors are operated in synchronism and said message circuit can be completed only when said selectors are at rest.

7. A self-stepping synchronous selector train dispatching system comprising in combination, a selector including a rotatable contact arm and electro-magnetic means for rotating said arm in step-by-step fashion, a 3-position relay operated to alternate extreme position in response to stepping of said selector, a polar relay energized in alternate directions in response to operation of said 3-position relay in opposite direction, means for effecting alternate operation of said electro-magnetic means in response to operation of said polar relay in opposite directions, said polar relay being slow acting compared with said selector and said 3-position relay, and a message circuit completed when said 3-position relay has responded to its last energization and said polar relay has not yet responded to its last energization, whereby said message circuit can only be completed when said selector is at rest and will be completed for a period of time sufficient to allow a message to be transmitted.

8. A self-stepping synchronous selector train dispatching system comprising in combination, a selector including a rotatable contact arm and electro-magnetic means for rotating said arm in step-by-step fashion, a 3-position relay operated to alternate extreme position in response to stepping of said selector, a polar relay energized in alternate directions in response to operation of said 3-position relay in opposite directions, means for effecting alternate operation of said electro-magnetic means in response to operation of said polar relay in opposite directions, said polar relay being slow acting compared with said selector and said 3-position relay, other selectors operated by a circuit including said polar relay, and a message circuit completed only when said 3-position relay has responded to its last energization but said 3-position relay has not yet responded to its last energization, whereby said message circuit can only be completed when said selectors are at rest and will be completed for a period of time sufficient to allow a message to be transmitted.

9. In a synchronous selector train dispatching system, the combination with a central office and a plurality of way stations, a synchronous selector of the spring actuated escapement type at said office and at each of said way stations, electro-magnets for each selector for operating its escapement pawl in opposite directions, a 3-position polar relay biased to neutral for each of said way stations for alternately energizing the electro-magnets upon energization of said relays by currents of opposite polarity and for allowing said escapement to operate unrestricted when said relays are de-energized, a 2-position unbiased polar relay for actuating the electro-magnets of selector located at said central office, and a circuit for energizing all of said polar relays, whereby all of said selectors are stepped along in synchronism upon alternate energization of said circuit by current of opposite polarity and whereby the selector in said office is held at rest and the way station selector escapements are free to operate when said line circuit is de-energized.

10. In a synchronous selector train dispatching system, the combination with a central office and a plurality of way stations, a synchronous selector of the spring actuated escapement type at said office and at each of said way stations, electro-magnets for each selector for operating its escapement pawl in opposite directions, a 3-position polar relay biased to neutral for each of said way stations for alternately energizing the electro-magnets upon energization of said relays by currents of opposite polarity and for allowing said escapement to operate unrestricted when said relays are de-energized, a 2-position unbiased polar relay for actuating the electro-magnets of selector located at said central office, and a circuit including all of said polar relays in series, whereby all of said selectors are stepped along in synchronism upon alternate energization of said circuit by current of opposite polarity and whereby the selector in said office is held at rest and the way station selector escapements are free to operate when said line circuit is de-energized.

11. In a synchronous selector train dispatching system, the combination with a central office and a plurality of way stations, a synchronous selector of the spring actuated escapement type at said office and at each of said way stations, electro-magnets for each selector for operating its escapement pawl in opposite directions, a 3-position polar relay biased to neutral for each of said way stations for alternately energizing the electro-magnets upon energization of said relays by currents of opposite polarity and for allowing said escapement to operate unrestricted when said relays are de-energized, a 2-position unbiased polar relay for actuating the electro-magnets of selector located at said central office, a circuit for energizing all of said polar relays, a stop arm for each of said way station selectors for stopping such selector when it has reached the normal position, whereby all of said selectors are stepped along in synchronism upon alternate energization of said circuit by current of opposite polarity and whereby upon de-energization of said line cir-
cuit said central office selector is held at rest and the various way station selectors are free to operate until they are stopped by their stop arms.

12. In a synchronous selector train dispatching system, the combination with a central office and a plurality of way stations, a synchronous selector of the spring actuated escapement type at said office and at each of said way stations, electromagnets for each selector for operating its escapement pawl in opposite directions, a 2-position polar relay biased to neutral for each of said way stations for alternately energizing the electromagnets upon energization of said relays by currents of opposite polarity and for allowing said escapement to operate unrestricted when said relays are de-energized, a 2-position unbiased polar relay for actuating the electromagnets of selector located at said central office, a circuit including all of said polar relays in series, a stop arm for each of said way station selectors for stopping such selector when it has reached the normal position, whereby all of said selectors are stepped along in synchronization upon alternate energization of said circuit by current of opposite polarity and whereby upon de-energization of said line circuit said central office selector is held at rest and the various way station selectors are free to operate until they are stopped by their stop arms.

13. A train dispatching system of the synchronous selector type comprising: a plurality of synchronously operated selectors each including a contact arm having a normal position and which upon initiation of such selectors are operated through one complete revolution; a starting relay which if energized initiates said selectors from their normal position; and means for assuring operation of said selectors through at least two complete revolutions upon momentary completion of a circuit comprising, two stick relays the first of which if energized assures energization of the second stick relay of which said circuit is the pick-up circuit for the first relay, means for picking up the second stick relay when said first stick relay is in its energized position, an energizing circuit for said starting relay including a front contact of said second stick relay, and means for de-energizing said first stick relay at the end of the first revolution of such selector and for de-energizing the second stick relay at the end of the second revolution of such synchronous selector.

14. A train dispatching system of the synchronous selector type comprising: a plurality of synchronously operated selectors each including a contact arm having a normal position and which upon initiation of such selectors are operated through one complete revolution; and means for assuring operation of said selectors through at least two complete revolutions upon momentary completion of a circuit comprising, two stick relays the first of which if energized assures energization of the second stick relay of which said circuit is the pick-up circuit for the first relay, means for picking up the second stick relay when said first stick relay is in its energized position, means for initiating said selectors effective when said second relay assumes its energized condition, and means for de-energizing said first stick relay at the end of the first revolution of such selector and for de-energizing the second stick relay at the end of the second revolution of such synchronous selector.

15. A synchronous selector for train dispatching systems comprising, a rotatable contact arm, a main spring for driving said arm, an escapement mechanism including an escapement wheel and a pallet, electromagnets for operating said escapement mechanism, means for energizing one of said electromagnets for either a short or a longer period, and contacts closed if said electro-magnet is energized for such longer period but not closed if said one electro-magnet is energized for a short time only.

16. A synchronous selector train dispatching system comprising, a central office, a plurality of way stations, a synchronous selector at said office and at each of said way stations, said selectors being normally at rest and when initiated operating in synchronism through one revolution, and means at said central office and at each of said way stations for initiating operation of said selector, said means including means for repeating the initiation of said selectors at the end of the first revolution of said selectors.

17. A synchronous selector train dispatching system for transmitting distinctive message from a local office to a plurality of way stations and from any one of said way stations to said office comprising in combination, a central office, a plurality of way stations, a rotatable selector arm at said central office and at each of said way stations but normally held at rest in their zero position and which if operated at a uniform angular velocity engages corresponding stationary contacts simultaneously, means for operating said selector arms in synchronism, means controllable from any one of said way stations and from said central office for initiating operation of said means, and means for controlling signals and indicating track occupancy by said distinctive messages.

18. A synchronous selector train dispatching system comprising, a central station, a plurality of way stations, a stepping circuit for effecting operation of all of said selectors in synchronism, said selectors being normally at rest in their zero position and being initiated by control means at said central station, a message wire for completing a plurality of
message circuits successively during operation of said selectors and affording an initiating circuit when said selectors are in their zero position for actuating said control means.

19. A synchronous selector centralized traffic controlling system comprising, a central office and a plurality of way stations, a stepping circuit and a message wire connecting said office and way stations, selector apparatus at said office and at each of said way stations, a stepping relay group for operating said selectors in synchronism comprising three separate relay devices the first of which operates the second through the medium of said stepping circuit the second of which directly operates the third and the third of which directly operates the first, a plurality of message circuits established successively through the medium of said selectors and each including said message wire, and control relays controlled over said message circuits.

20. A synchronous selector centralized traffic controlling system comprising, a central office and a plurality of way stations, a stepping circuit and a message wire connecting said office and way stations, selector apparatus at said office and at each of said way stations, a stepping relay group for operating said selectors in synchronism comprising three separate relay devices the first of which operates the second through the medium of said stepping circuit the second of which directly operates the third and the third of which directly operates the first, a message circuit established by said selectors and including said message wire and contacts of said first and said second relay device.

21. A synchronous selector centralized traffic controlling system comprising, a central office and a plurality of way stations, a stepping circuit and a message wire connecting said office and way stations, selector apparatus at said office and at each of said way stations, a stepping relay group for operating said selectors in synchronism comprising three separate relay devices the first of which operates the second through the medium of said stepping circuit the second of which directly operates the third and the third of which directly operates the first, adjustable means for changing the operating characteristics of one of said relay devices, a plurality of message circuits each including said message wire established successively by said selectors, and control relays controlled over said message circuits.

In testimony whereof I affix my signature.

RICHARD C. LEAKE.
DISCLAIMER


Hereby enters this disclaimer to claims 16 and 18 of said Letters Patent, which are in the following words, to wit:

"16. A synchronous selector train dispatching system comprising, a central office, a plurality of way stations, a synchronous selector at said office and at each of said way stations, said selectors being normally at rest and when initiated operating in synchronism through one revolution, and means at said central office and at each of said way stations for initiating operation of said selector, said means including means for repeating the initiation of said selectors at the end of the first revolution of said selectors."

"18. A synchronous selector train dispatching system comprising, a central station, a plurality of way stations, a stepping circuit for effecting operation of all of said selectors in synchronism, said selectors being normally at rest in their zero position and being initiated by control means at said central station, a message wire for completing a plurality of message circuits successively during operation of said selectors and affording an initiating circuit when said selectors are in their zero position for actuating said control means."

[Official Gazette March 15, 1934.]