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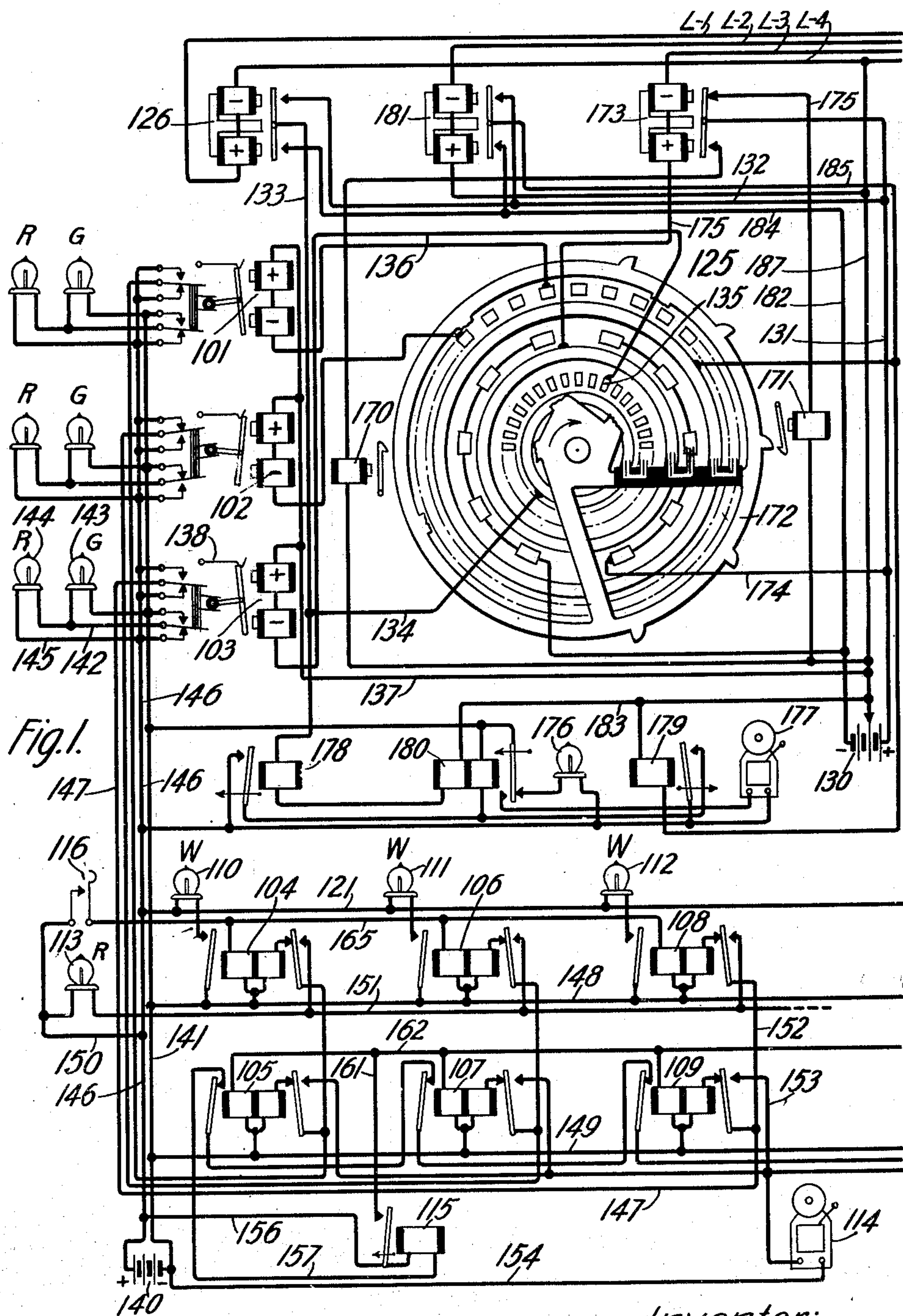
J. C. FIELD

1,747,821

SUPERVISORY SYSTEM

Filed July 29, 1926

2 Sheets-Sheet 1



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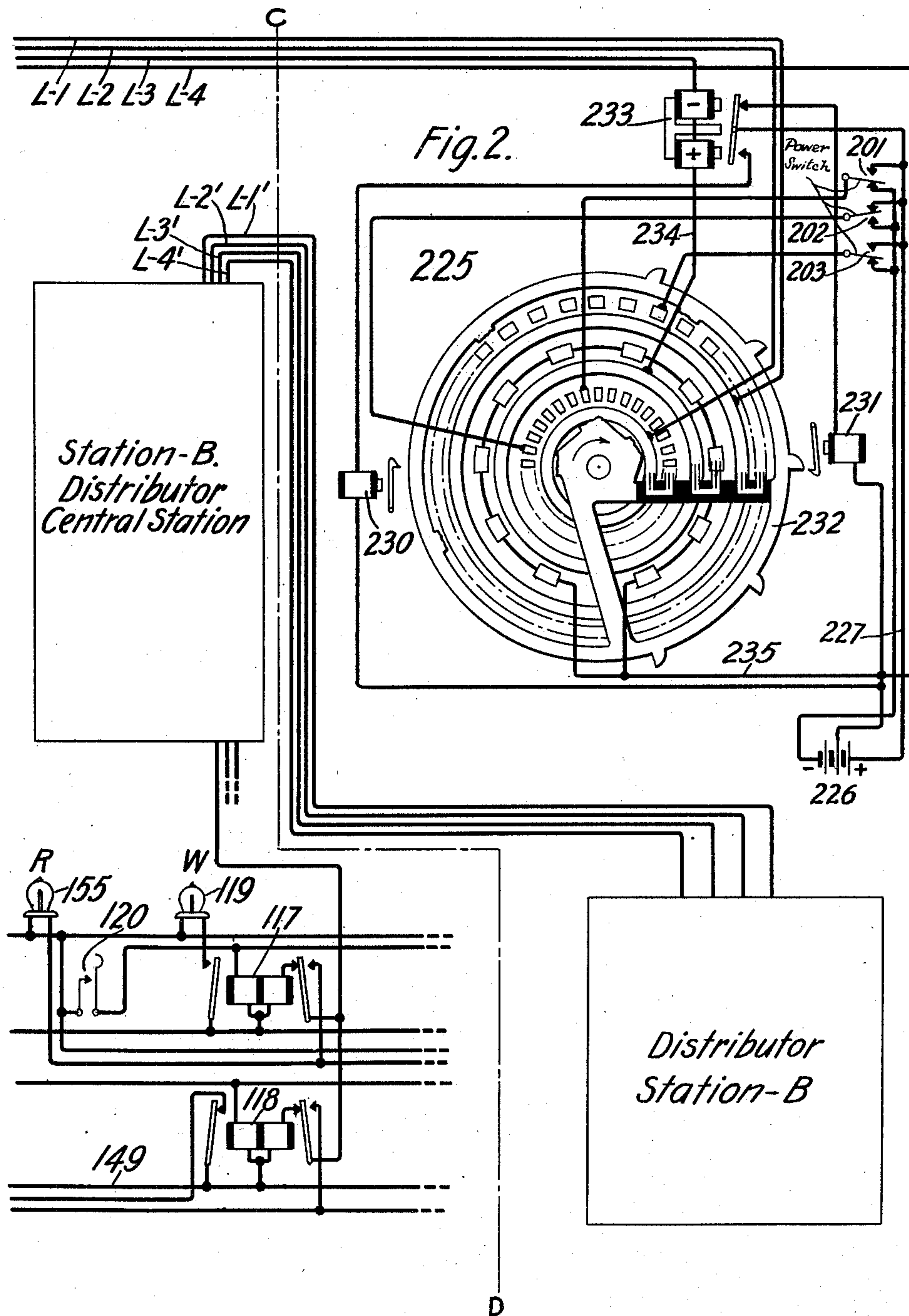
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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SUPERVISORY SYSTEM

Application filed July 29, 1926. Serial No. 125,708.

This invention relates to supervisory systems and more especially to such systems using synchronized rotary distributors.

5 An object of the invention is to indicate at a central station the operation, location and condition of devices such as power switches, etc., at several remote stations.

10 Another object is to indicate the failure of any of the line wires connecting the remote stations with the central station or the failure of the distributors to properly function.

15 The first object is preferably accomplished by providing interacting relays and signals so arranged that a signal common to the system is actuated upon the operation of any device in the system, another signal indicates the station in which the operated device is located, a third signal indicates the group at the station and a fourth signal indicates the condition of the device after its operation.

20 The second object is also attained through the interaction of relays and a signaling means and in a preferred form of the invention the signaling means consists of an audible and a visible signal, but either one alone may be used.

25 The invention will be better understood from the following description in connection with the attached drawing in which Fig. 1 illustrates schematically part of the apparatus and circuits at the central station and Fig. 2 illustrates schematically the remainder of the central station apparatus and the apparatus and circuits at one of the remote stations, the apparatus to the right of line CD being at the remote stations and that to the left of the line being at the central station. The square in the lower right of Fig. 2 indicates the apparatus at another remote station and the rectangle at the left of Fig. 2 indicates the corresponding apparatus at the central station. The drawings are so arranged that if Fig. 2 is placed at the right of Fig. 1 a general schematic diagram of the system is given.

30 Referring now to Fig. 2 the switch arrangements 201, 202, and 203 are associated with devices such as circuit breakers,

switches, etc. and are so arranged that upon the operation of the devices the middle arm of the switch arrangement changes its position. The switch arrangements shown are considered associated with devices in different groups at the same station. For example, if the remote station is known as station A, switch 201 is considered associated with a device in group 1, switch 202 with a device in group 2, etc.

35 At the central station Fig. 1, there are polarized relays 101, 102 and 103 corresponding to switches 201, 202 and 203 respectively. These polarized relays have two sets of contacts, the lower set controlling the lighting of a pair of lamps, one red and one green, which indicate the condition of the devices at the remote station. The upper contacts of each of these polarized relays control the operation of a pair of double winding, normally energized relays 104—105, 106—107, and 108—109. Relays 104, 106 and 108 each control a corresponding white lamp 110, 111, and 112 respectively and a common red lamp 113. The relays 105, 107 and 109 control a common bell 114 and a common slow release relay 115 which controls the reenergization of relays 105, 107 and 109. A key 116 controls a circuit to reenergize relays 104, 106 and 108.

40 The bell 114 and relay 115 are common to the system. For a second remote station, such as station B, there is another red lamp, a reset key and a set of relays and white lamps, only one pair of relays 117 and 118, one white lamp 119, red lamp 155 and the reset key 120 being represented in Fig. 2.

45 The distributors used are of the continuously rotating type, provided with three rows of segments, one row of which is utilized for synchronizing the distributors, the other two being used for receiving and distributing the incoming current impulses. One form of such distributors is described in U. S. Patent 1,496,875 to J. C. Field, dated June 10, 1924.

50 The operation of the system is as follows: Assume that the device at the remote station associated with switch 203 operates, moving the middle arm from engagement

with the lower contact to engage with the upper contact. The potential on the segment of the outer row connected to the middle arm is therefore changed from negative to positive. When the outer brush of distributor 225 connects with this segment, a positive pulse is sent from battery 226 through conductor 227, upper contact and middle arm of switch 203, corresponding segment on outer row of the distributor 225, associated collector ring, line wire L—1, polarized relay 126 at the central station Fig. 1, line wire L—4 to battery 226.

The armature of relay 126 is thereby attracted toward the lower winding, making contact with the upper contact and impressing positive potential on the collector ring of the inner row of segments of distributor 125. The distributor brush at this instant bridges the collector ring with the segment connected to polarized relay 103. An energizing circuit is thereby established for relay 103 extending from battery 130 through conductor 131, conductor 132, upper contact and armature of relay 126, conductor 133, conductor 134, collector ring of inner row of segments, inner brush of distributor arm, segment 135, conductor 136, polarized relay 103, conductor 137 to battery.

The armature of relay 103 is arranged to remain in the position to which it is last operated and when it is energized with current of positive polarity as described above, the armature is attracted toward the upper winding where it is held by latch 138 or an equivalent means.

Relay 103 in operating changes its lower group of contacts so that one of the associated lamps is extinguished and the other lighted. In the position shown green lamp 143 is lighted but after the operation of relay 103 as just described, the green lamp is extinguished and the red lamp 144 is lighted over a circuit from battery 140 through conductor 141, upper and middle contacts of lower group of relay 103, conductor 142, red lamp 144, conductor 145, conductor 146 to battery.

Relays 108 and 109 which correspond to the group in which the device having switch 203 is located, are held normally energized by current from battery 140, through conductor 146, lower and middle contacts of upper group of relay 103, conductor 147, then in parallel through the right armatures and front contacts of relays 108 and 109, conductors 148 and 149 respectively, conductor 141 to battery. The other group pairs of relays 104—105, 106—107 and 117—118 are held up over similar circuits.

When relay 103 operates there is a momentary open in the circuit just traced when the middle contact of the upper group of this relay leaves the lower contact and before it makes with the upper contact, the upper and

lower contacts being strapped and joined to the same battery lead 146. Relays 108 and 109 are thereby released, the left armature of relay 108 contacting with its back contact to close a circuit for the white lamp 112 from battery 140, conductor 141, conductor 148, left armature and back contact of relay 108, white lamp 112, conductor 121, conductor 146 to battery. This white lamp indicates the group in which the device is located at the remote station.

The right armatures of relays 108 and 109 leave their front contacts and make with their back contacts thereby closing a circuit for the red lamp 113 and bell 114, from battery 140, conductor 146, conductor 150, red lamp 113, conductor 151, back contact and right armature of relay 108, conductor 152, right armature and back contact of relay 109, conductor 153, bell 114, conductor 154 to battery. This red lamp indicates the station in which the device is located, the bell being common to the system. For station B, relays 117 and 118 of Fig. 2 upon release, light white lamp 119 for the group, red lamp 155 for the station, and bell 114 common to the system over circuits similar to those just traced.

Slow release relay 115 is normally energized over a circuit from battery 140 conductor 156, relay 115, conductor 157, front contacts and left armatures of relays 105, 107, 109 and 118, conductor 149 to battery. It is understood that there may be many more relays corresponding to 105, 107, etc. and the circuit just traced includes front contacts and armatures of these relays also.

When relay 109 releases, its left armature opens the holding circuit for relay 115 which when fully released, after an appreciable time, closes a circuit through the left winding of relay 109 from battery 140, conductor 156, armature and back contact of relay 115, conductor 161, conductor 162, left winding of relay 109, conductor 149 to battery. The right armature of relay 109, when this relay is again energized, opens the circuit for the red lamp and the bell and closes the holding circuit through its right winding. The left armature closes the energizing circuit for the slow release relay 115.

The operator at the central station having learned of the operation of the device at the remote station, operates key 116 which closes an energizing circuit for relay 108, from battery 140, conductor 146, conductor 150, contacts of key 116, conductor 165, left winding of relay 108, conductor 148, conductor 141 to battery. At its right armature, relay 108 again establishes the holding circuit through its right winding and at its left armature opens the circuit of the white group lamp 112. The system is then in the condition it was previous to the operation of the device and switch arrangement 203, except that the green and red lamps 143 and 144 now

correspond to the new position of the device.

For each remote station there is a pair of distributors, one distributor being at the central station and the other at the remote station. Also there are four line wires connecting each remote station with the central station. For the proper operation of the system, the distributors must run in synchronism and the line wires must not open.

The distributors, for example, 125 and 225 are kept in synchronism by providing each with a pair of electromagnets 170—171 and 230—231 respectively. These magnets have latches arranged to engage projections on the outer edge of the brush carrying wheels 172 and 232 and are operated by pulses controlled by the middle row of segments of each distributor and polarized relays 173 and 233, one at each station. Each distributor wheel is provided with five projections, evenly spaced on one half of the periphery. With a magnet on each side, the wheels are normally synchronized ten times per revolution and as each distributor wheel completes a revolution in about five seconds they are synchronized approximately every half second.

In the position of the brush carrying wheels illustrated, the middle brush of each distributor bridges one of the segments in the middle row with the corresponding collector ring. In this position current flows from the positive pole of battery 130, Fig. 1, through conductor 131, conductor 174, right-hand segments of the middle row of distributor 125, middle brush, collector ring, conductor 175, relay 173, line wire L—3, relay 233 at the remote station Fig. 2, conductor 234, middle collector ring, middle brush, middle row of segments, conductor 235, line wire L—4 conductor 187 to battery 130 at the central station. The armatures of relays 173 and 233 are attracted toward the lower windings. At the central station this action closes a circuit from battery 130, conductor 131, armature and upper contact of relay 173, conductor 175, magnet 171 to battery. At the remote station a circuit is closed from battery 226, through conductor 227, armature and upper contact of relay 233, conductor 235, magnet 231 to battery. Both magnets attract their respective latches so that they do not engage the projections on the rim of the brush carrying wheels which are therefore permitted to continue to rotate. The brushes are arranged to contact with the segments an instant before the corresponding projections would engage the latch. It will be seen that if one of the wheels contacts with its segment before the second wheel contacts with the corresponding segment, no current will flow and the first brush carrying wheel will be held by the magnet latch until the second wheel has caused its brush to contact with the corresponding segment.

In case the wheels are out of synchronism

more than the distance between two segments they will remain out of phase by one step indefinitely unless some means is provided to avoid such a condition. In the system illustrated this condition is guarded against by having one half the synchronizing segments of the controlling distributor (in this case distributor 125) connected to a source of opposite polarity to that of the other half. Specifically the left segments of distributor 125 are connected to the negative pole of battery 130, while the right segments are connected to the positive pole.

If the brush wheel 172 of distributor 125 leads that of distributor 225 by more than one space the wheel 172 will be held on the first segment of the left half until the brush of wheel 232 contacts with the last segment on the right half of distributor 225. A negative pulse is then sent over the circuit traced above operating relays 173 and 233 causing the operation of magnets 170 and 230 respectively. This will permit wheel 172 to advance but since wheel 232 is held by the latch of magnet 231, which magnet is not actuated, wheel 232 will be held. This condition will exist until the brush of wheel 172 contacts with a segment on the right half which is connected to the positive pole of the battery. Magnet 231 will then be operated, permitting wheel 232 to advance one step until its brush contacts with the first segment on the left half when the latch of magnet 230 will engage its first projection and hold the wheel. Wheel 172 then advances as before until its brush again contacts with the first segment on the left half. The wheels will now be in synchronism and magnets 170 and 230 will be actuated simultaneously, permitting the wheels to advance together.

To notify the operator that the wheels are out of synchronism, a normally lighted lamp 176 and a bell 177 are provided. Two slow release normally energized relays 178 and 179 and a double winding relay 180 are provided to control the operation of the lamp and bell. These relays in turn are controlled by the action of line relays 126 and 181.

In the distributors employed in the present system, there are 100 segments in the outer row and 50 segments in the inner row. For an installation of 100 devices all of the segments in the inner row are utilized while only half of the segments in the outer row are required, hence every other segment in the outer row is a blank. In such an installation the segments in the inner row are connected to a source of either positive or negative polarity while in the outer row every other segment is so connected depending upon the position of the corresponding devices.

Relay 178 is connected in shunt with the armature of relay 126 and relay 179 is in shunt with the armature of relay 181, the left winding of relay 180 being in series with

relay 178. Relay 178 is arranged to hold up over current reversals with an open between reversals while relay 179 is arranged to hold up only over current reversals. The armature of relay 180 directly controls the extinguishing of the lamp and the ringing of the bell when it is energized and this relay becomes energized upon the release of either relay 178 or 179 or a continued pulse through relay 180.

To better understand the operation of the apparatus just described the following facts should be kept in mind. If either one of the distributors stops so that the middle brush is not on a segment in the middle row, the second distributor will also stop since there can be no circuit through the releasing magnets. If the control distributor 125 stops with its middle brush on a synchronizing segment a continuous current of one polarity will flow holding energized the corresponding release magnets, for example, 171 and 231, permitting distributor 225 to operate until its wheel is held by the latch of magnet 230. If the controlled distributor 225 stops with the middle brush on a synchronizing segment, controlling distributor 125 will continue to rotate but relay 126 will be held continuously operated or relay 178 will be released as explained hereinafter.

From the above it will be seen that in the event either or both distributors stop, the outer brush will necessarily be on either a live or a dead segment. If on a live segment relay 126 will be held energized and the armature will maintain a circuit from battery 130, either conductor 131 or 182, conductor 132 or 184, upper or lower contact and armature of relay 126, conductor 133, relay 178, left winding of relay 180, conductor 183 to battery. Relay 180 is thereby energized and its armature opens the circuit for lamp 176 and closes the circuit for bell 177 from battery 140, the paths of which are obvious. If the brushes had stopped on a dead segment, relay 126 would have remained unenergized permitting relay 178 to slowly release.

When released, relay 178 closes an obvious circuit from battery 140, through the right winding of relay 180, which when energized, causes lamp 176 to be extinguished and bell 177 to ring. This last condition also exists in case line wire L—1 becomes open so that no pulses are received by relay 126.

If line wire L—2 opens so that relay 181 receives no pulses, relay 179 is deenergized since it is normally energized over a circuit closed by the armature of relay 181 contacting with either its upper or lower contact. This circuit may be traced from battery 130, either conductor 131 or 182, conductor 132 or 184, upper or lower contact and armature of relay 181, conductor 185, relay 179, conductor 183 to battery. Here also when relay 179 releases, its armature

closes an obvious circuit for the energization of relay 180 thus extinguishing lamp 176 and ringing bell 177. In the case of failure of line wire L—3 the distributors would cease to be properly synchronized and would therefore stop, giving rise to one of the conditions first explained. It is obvious that the failure of line L—4 would give rise to any or all of the above conditions and the signals would be given since this would be the same as opening all of the other line wires L—1, L—2 and L—3.

What is claimed is:

1. In a supervisory system a central station and a plurality of remote stations, groups of devices at each of the remote stations, a pair of lamps at the central station for each device, signaling means at the central station comprising a polarized relay for each device at the remote stations the direction of current therethrough depending upon the condition of the device after its operation, a pair of normally operated relays for each group of devices, means whereby said normally operated relays are deenergized upon the operation of said polarized relay, a lamp at the central station for each group of devices and a lamp at the central station for each station, means whereby one of said pair of relays upon deenergization lights one of said group lamps indicative of the group of devices and in conjunction with the second relay of the pair, lights a station lamp indicative of the station in which the operated device is located, a slow releasing normally energized relay and a bell common to the system controlled by the second of said pair of relays, means whereby the bell is caused to ring and the slow releasing relay is deenergized upon the deenergization of said second relay of the pair, said slow releasing relay upon complete deenergization closing an energizing circuit for said second relay of the pair which relay upon reenergization closes a holding circuit for itself, opens the bell and said second lamp circuit and closes an energizing circuit for the slow release relay and a manually operated key which, when operated, closes an energizing circuit for said first relay of the pair which relay upon reenergization closes a holding circuit for itself and opens the circuit for said group lamp.

2. In a supervisory system a central station and a remote station, devices at the remote station, signal means at the central station for said devices, a pair of rotary distributors, one at each station for distributing pulses to the signal means, four line wires connecting said stations, two of said line wires forming parts of the signaling circuits, one of said line wires forming a part of the distributors synchronizing circuit, the fourth being a common return for the other three, a polarized relay at the central station included in each signaling circuit, a normally energized slow

releasing relay at the central station for each
polarized signal relay, arranged to hold up
over current reversals with momentary open-
ing between the reversals, said normally ener-
gized slow releasing relay controlled by its
5 corresponding polarized signal relay, a dou-
ble wound slow-to-operate relay, one winding
of which is in series with the winding of one
of the normally energized slow releasing re-
lays, the circuit through the second winding
10 being controlled by either of the two normal-
ly energized relays so that the double wind-
ing relay is energized upon complete release
of either of the two normally energized relays
or a long continued current through the wind-
15 ing of one of the normally energized relays,
circuits connecting the two normally ener-
gized relays and contacts of the respective
polarized signal relays so that the double
winding relay is energized upon failure of
20 any line wire or if either distributor fails to
operate, a signal device controlled by said
double wound relay, said signal device being
caused to operate upon the energization of
25 said double wound relay.

In witness whereof, I hereunto subscribe
my name this 26th day of July, A. D., 1926.

JOSEPH C. FIELD.

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