

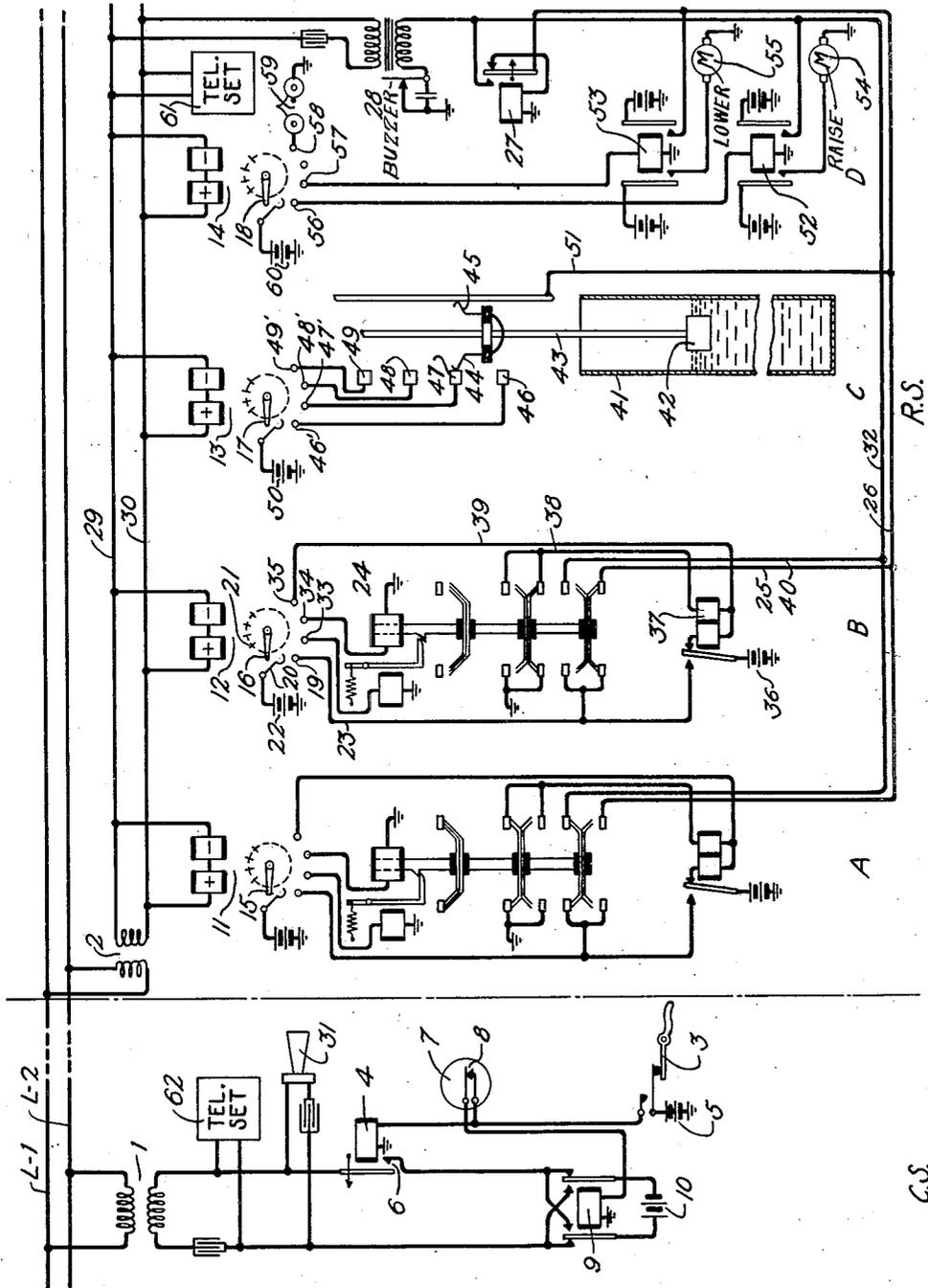
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SUPERVISORY SYSTEM

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## UNITED STATES PATENT OFFICE

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## SUPERVISORY SYSTEM

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This invention relates to remote control and supervisory systems.

The object of this invention is to provide such a system which will be simple and inexpensive, and at the same time enable a central office dispatcher to control power switches or other apparatus at outlying stations and receive answer-back signals indicative of the positions of such apparatus, and also to enable the dispatcher to talk with attendants at such stations.

In accordance with this invention means is provided at the remote station for impressing on a circuit leading back to the central station current variations of different characters, the character of current impressed being determined by the position of the switch or other device at the remote station under supervision. These variations in current distinctively operate an audible signal at the central station connected to this circuit to thereby inform the dispatcher of the condition of the device. The dispatcher is provided with means whereby he can control the position of the device and also with means for discontinuing the signal.

More specifically, the central station is provided with a dial similar to those used in automatic telephone systems to transmit sets of impulses to the selectors at the remote stations, each selector responding to a distinctive code to pick out a terminal connected to contacts on the associated power switch. If the power switch is closed a circuit is closed at the remote station to transmit a distinctive signal back to the dispatcher thus indicating to him the closed position of the switch. If, on the other hand, the switch is open, the selection of said terminal closes a different circuit to transmit a different signal back to the dispatcher thus indicating to him the open position of the switch. Upon determining the position of the switch and desiring to change its position, the dispatcher operates the dial to set the selector ahead to another terminal connected to a magnet which operates and shifts the switch to the other position. In changing its position the switch closes a circuit at the substation to transmit a signal back to

the dispatcher to indicate the response of the switch.

In determining the level of the water at the remote station, a water level indicator is provided and a float having a contact brush which engages one of a series of terminals connected to contacts on the associated selector. These contacts are selected by sets of impulses transmitted from the dial and when the terminal on which the brush rests is selected, a circuit is closed at the substation to transmit a signal back to the dispatcher.

For changing the load on the generators at the substation, the selector associated therewith has raise-load and lower-load devices connected to its contacts which are selected by impulses from the dial and upon operating one of these devices it closes a circuit to transmit back to the dispatcher a distinctive signal.

The invention will be more clearly understood from the following description in connection with the attached drawing showing schematically one embodiment of the invention.

In the drawing the apparatus to the left of the broken line is considered to be at the control station which is designated CS while the apparatus to the right of the line is considered to be at a remote station designated RS. The number of stations which may be controlled is limited only by the operating code of the selectors but only one such station is shown, with the various pieces of apparatus, in order to simplify the drawing.

At the remote station A and B represent two power switches, each of which has sets of auxiliary contacts for purposes to appear hereinafter. C represents a water level indicator for use in connection with the water level in the fore-bay of a hydro-electric plant, etc., and D represents a means of raising and lowering the load and to give telephone communication between the central station and the remote station. The control and answer-back signals are transmitted over a telephone line L-1 and L-2 or other similar conductors. For this purpose and to avoid interruption of the tele-

phone service due to leakage, etc., transformers 1 and 2 are used at the central station and remote stations, respectively.

The code sending apparatus is normally disconnected from the line, a foot-switch 3 being provided which controls the energizing circuit for slow release relay 4 to close the signaling circuit before any code is dialed.

The operation of the system is as follows: Foot-switch 3 is operated thereby closing a circuit from grounded battery 5 through the contacts of foot-switch 3, relay 4 to ground. The armature of relay 4 is attracted, thereby closing a signaling circuit at the front contact 6. When relay 4 closes this circuit at contact 6, an impulse will be transmitted over the line, but this impulse will be an idle impulse and will have no effect on the operation of the system since the selector is so constructed that it will automatically restore itself to normal upon the receipt of this impulse, as shown and described in Patent 1,343,256, issued to applicant June 15, 1920. The foot-switch is maintained operated during the signaling operation. The dial 7 which may be of the type disclosed in Patent #1,161,854 to O. F. Forsberg, November 30, 1915 is then operated by the dispatcher and upon operating makes and breaks contact at 8 opening and closing a circuit from grounded battery 5, contacts of foot-switch 3, contacts 8, relay 9 to ground. Relay 9 is of the well-known pole changing type and each time it is energized or deenergized the polarity of the current from battery 10 through one winding of transformer 1 is reversed.

The current reversals are inductively transmitted over conductors L-1 and L-2 and inductively through transformer 2 to the actuating windings of selectors 11, 12, 13 and 14 at the remote station which may be of the type disclosed in said patent. As explained in the above mentioned patent, contact arms 15, 16, 17 and 18 of the selectors are stepped around in accordance with the impulses transmitted but only one of the selectors is effective in response to the code transmitted. Therefore, upon the cessation of the impulses only one of the contact arms will remain in the advanced position.

Assume that selector 12 corresponds to the code sent. Contact arm 16 then rests on point 19 and holding arm 20 engages pin 21 to hold the mechanism in the advanced position as described in detail in said Field patent. In this position, a circuit is closed from grounded battery 22, holding arm 20, pin 21, wheel, and contact arm 16, contact point 19, conductor 23, lower contacts of lower auxiliary group on power switch 24, conductor 25, conductor 26, armature and back contact of slow release relay 27, winding of relay 27 to ground. Upon

the operation of relay 27, the armature is attracted, opening its energizing circuit and closing a circuit through the armature and front contact through buzzer 28 causing the buzzer to operate. The buzzer through its secondary winding transmits rapid vibrations over conductors 29 and 30 through transformer 2, line conductors L-1, and L-2, transformer 1, to howler 31 at the central station to give an audible signal.

As mentioned above, relay 27 when energized attracts its armature thereby opening its energizing circuit permitting its armature to slowly drop back which again closes its energizing circuit. The alternate operation of relay 27 causes the intermittent operation of the buzzer and hence the howler. The intermittent audible signal notifies the dispatcher that power switch 24 is open. If the power switch had been closed, the upper contacts of the lower auxiliary group would have been closed and the circuit from battery 22 would have passed from conductor 23 through the closed contacts to conductors 40, 32, directly to buzzer 28 and the audible signal given would have been continuous instead of intermittent.

If it is not desired to operate the switch, the foot-pedal 3 is released. This opens the circuits for relays 4 and 9. Since relay 4 is of the slow release type, relay 9 will cause a pulse to be transmitted to the selector before the transmitting circuit controlled by relay 4 is opened. This pulse causes the selector wheels to move out of engagement with the holding arm 20 and drop back to the unoperated position, as described in detail in said Field patent.

Having ascertained the condition of the switch, the dispatcher may proceed to operate the switch as desired. To open the switch when the contact arm 16 of selector 12 is on point 19 the dispatcher dials 1 which produces two impulses and advances the contact arm 16 to contact point 33 thereby energizing relay 63 which attracts its associated armature. The armature is adapted to engage a switch in the plunger rod of the power switch 24 when the power switch is closed. Since, however, the drawing shows the power switch open, assume that it is desired to close it. To do this, the dispatcher dials 2 thus sending 4 impulses to move the contact arm 16 from contact point 19 to contact point 34. The winding of the solenoid is thus energized from battery 22 over an obvious circuit thereby drawing the solenoid plunger up where it is held by the catch on the armature of relay 63.

When the solenoid plunger moves up, the holding circuit of relay 37 is momentarily opened. This circuit extends from grounded battery 36, armature and front contact of

relay 37 through both windings of the relay, conductor 38, upper auxiliary contacts to ground. Upon the opening of this circuit, the armature of relay 37 falls back making contact at its back contact, closing a circuit from grounded battery 36, armature and back contact of relay 37, upper contacts of lower auxiliary group, conductors 40 and 32 to buzzer 28. This causes a continuous audible signal at the central station as explained above notifying the dispatcher that the switch has operated and is now closed. To stop the signal the dispatcher dials 1 which moves the contact arm to contact point 35 closing a circuit from grounded battery 22, holding arm 20, wheel and contact arm 16, contact point 35, conductor 39, right hand winding of relay 37, conductor 38, upper auxiliary group of contacts to ground. Relay 37 upon energizing attracts its armature, opening the buzzer circuit at its back contact and closing its holding circuit at its front contact.

If a power switch should be opened or closed either automatically or manually, the energizing circuit of relay 37 corresponding to that switch is momentarily opened, causing the deenergization of the relay as explained above and, as further explained, the signal will be either continuous or intermittent depending upon the condition of the switch. The dispatcher is therefore notified of such operation. To determine which switch has operated, he dials the code of each selector which controls a switch and advances the contact arm to the contact point corresponding to point 35 on selector 12. The cessation of the signal notifies the dispatcher that the switch dialed is the one that has operated.

To determine water level, for example, in the fore-bay of a hydro-electric plant, as mentioned above, an arrangement such as shown at C is used. The reservoir 41 is connected to the water whose height it is desired to know. A float 42 in the reservoir has a rod 43 attached carrying two brush contacts 44 and 45 which are connected electrically. Brush contact 44 is arranged to contact with contacts 46, 47, 48 and 49 which are connected to selector contacts 46', 47', 48' and 49', respectively. The number of contacts on the selector may be increased and a reducing motion introduced between the float and brush contact 44 so that contact 44 is always on one of the contact points 46, 47, etc. In the drawing, the arrangement is simplified to avoid confusion.

If the dispatcher desires to know what the water level is he dials the code of selector 13 to bring the contact arm 17 to the first contact point 46'. In the position shown, no signal will be given. The dispatcher then dials 1 to advance the arm 17 one step to contact 47'. In this position, a circuit is

closed from grounded battery 50 through holding arm and wheel of selector 13, contact arm 17, contact 47', contact 47, brush contacts 44 and 45, conductors 51 and 25, armature and back contacts of slow release relay 27, winding of relay 27 to ground. As described above, an intermittent audible signal is then given at the central station. This notifies the dispatcher that the point dialed corresponds to the water level. The selector is then returned to its unoperated position by releasing the foot-switch 3 as explained above.

The apparatus represented at D controls load conditions of generators, etc. and also permits telephone communications between stations. Relay 52, through its left armature and contact and motor 54, and relay 53 through its left armature and contact and motor 55 control the field rheostat of a generator (not shown) or equivalent apparatus. Motor 54, when operated, increases, and motor 55 decreases, the load carried by the generator, as shown for example in application of L. E. Coon, Serial No. 46,274, filed July 27, 1925. The operation of this apparatus is the same as for the other arrangements described above, that is, the dispatcher dials the code of selector 14 to advance the contact arm 18 to the contact point 56 if it is desired to increase the load carried by the generator. Relay 52 is energized over an obvious circuit and when energized attracts both its armatures. At its left armature it closes an obvious circuit to operate the motor 54 which increases the load. At its right armature, a circuit, also obvious, is closed to actuate the buzzer 28 directly. In this position, a continuous audible signal is given. In the same way, if it is desired to lower the load, contact arm 18 is advanced to contact point 57 whereupon relay 53 is operated which in turn operates motor 55 to lower the load carried by the generator. In this position, an intermittent audible signal is transmitted due to the actuation of the buzzer 28 through the contacts of slow release relay 27. Here again, when the load has been adjusted to the desired value which the dispatcher knows by glancing at the instruments connected to the power line at his station, release of the foot-switch at the central station advances the selector wheel out of engagement with the holding arm permitting the wheel to return to the unoperated position.

To hold telephone conversation, the dispatcher dials the code to advance contact arm 18 to point 58. This causes bell 59 to ring by current from battery 60. When the attendant at the remote station answers through the telephone set represented at 61, the dispatcher, who is already at his telephone set 62, hears his voice and releases foot-switch 3 permitting the selector wheel

to return to its unoperated position breaking the bell circuit.

It is understood that various modifications may be made in the system described above without departing from the spirit and scope of the invention and it is not intended to limit it to the specific arrangement shown except as defined by the appended claims:

What is claimed is:

10 1. In combination, a central station, a remote station, a circuit connecting the same, a switch at said remote station having a number of positions, a pair of devices associated with said circuit at the remote station  
15 for impressing current variations of different character on said circuit, an audible signal device at the central station responsive thereto, a selector at the remote station operated from the central station over said circuit for selecting said switch, a circuit closed by said selector and including one or the other of said devices according to the position of said switch to set the device in operation, a relay normally operated over a  
20 circuit including its own front contact and contacts of the switch, a circuit including a source of current and a back contact of said relay closed by the switch changing its position and including the corresponding device,  
25 and a circuit including a contact of said selector closed thereby under the control of the central station for operating said relay to open said signaling circuit.

35 2. In combination, a central station, a remote station, a circuit connecting the same, a switch at said remote station having a number of positions, a pair of devices associated with said circuit at the remote station for impressing current variations of  
40 different character on said circuit, an audible signal device at the central station responsive thereto, a selector at the remote station operated from the central station over said circuit for selecting said switch, a circuit  
45 closed by said selector and including one or the other of said devices according to the position of said switch to set the device in operation, a relay normally operated over a circuit including its own front contact and  
50 contacts of the switch, and a circuit including a source of current and a back contact of said relay closed by the switch changing its position and including the corresponding device.

55 In witness whereof, I hereunto subscribe my name this 12th day of November A. D., 1925.

JOSEPH C. FIELD.

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