

April 16, 1929.

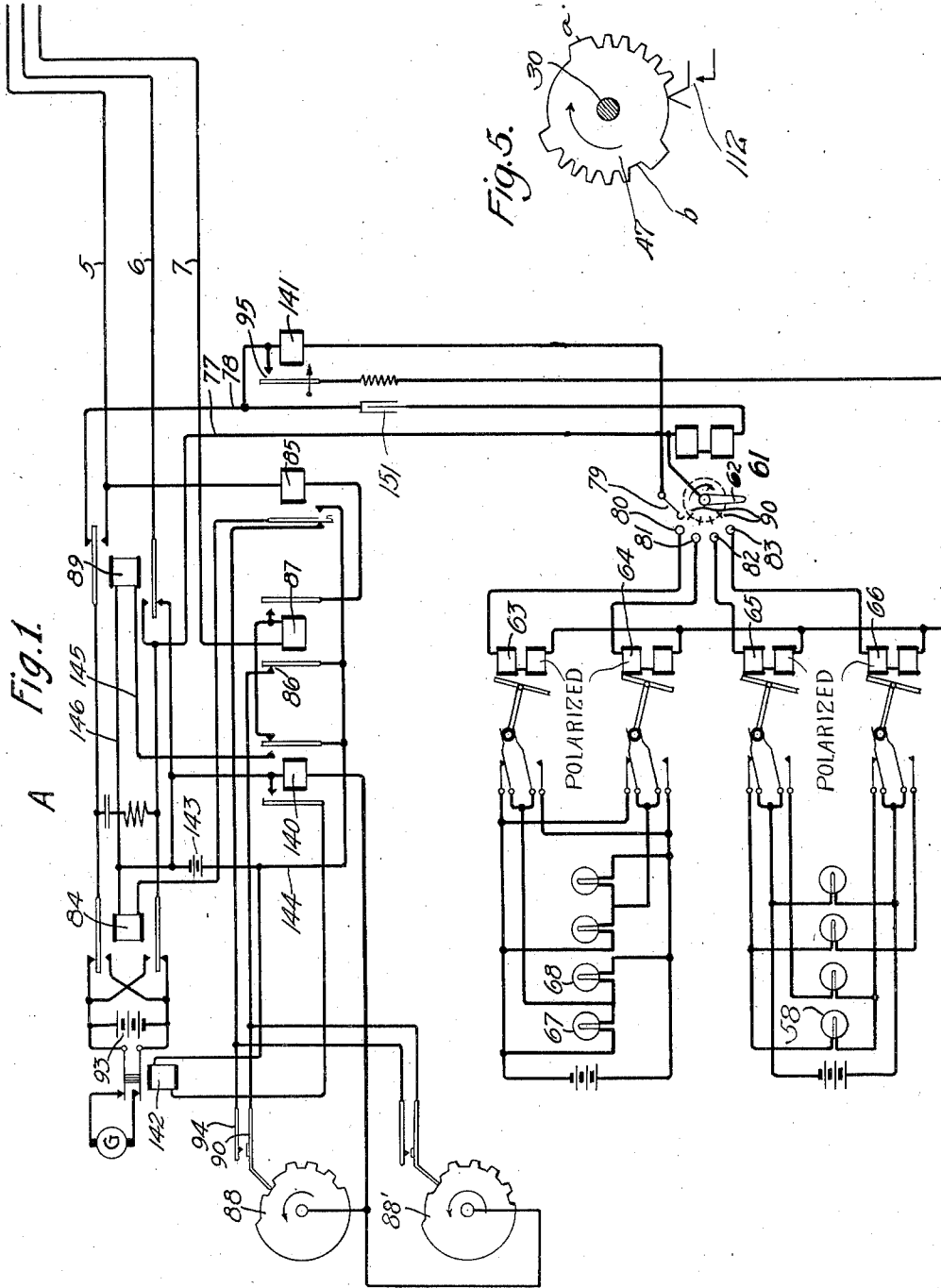
J. C. FIELD

1,709,067

INDICATING SYSTEM

Filed Oct. 22, 1924

3 Sheets-Sheet 1



Inventor:
Joseph C. Field.

by

E. W. Adams, Att'y

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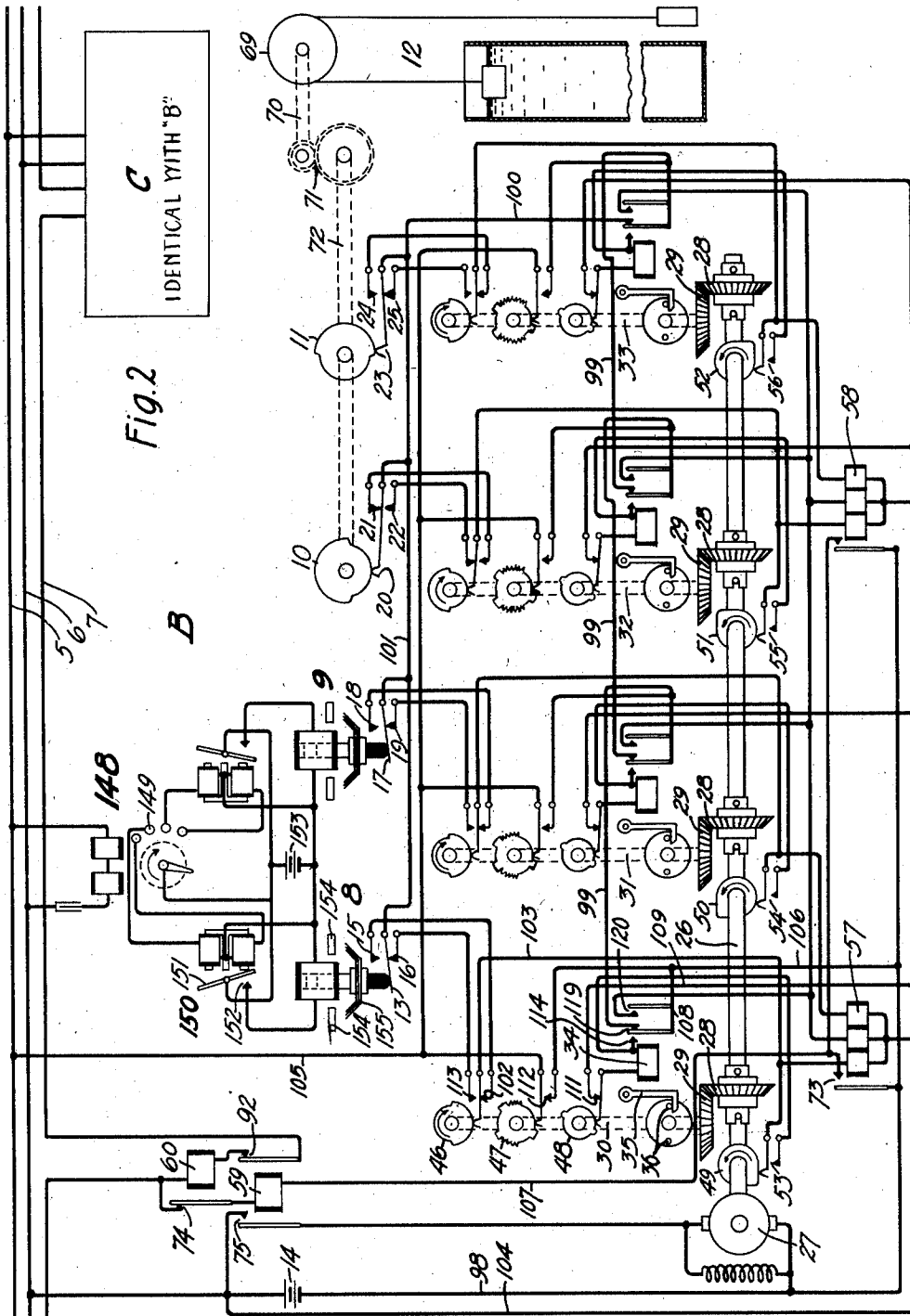
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INDICATING SYSTEM

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5 Sheets-Sheet 2



Inventor:
Joseph C. Field
by *E. Adams* Att'y.

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3 Sheets-Sheet 3

Fig. 3.

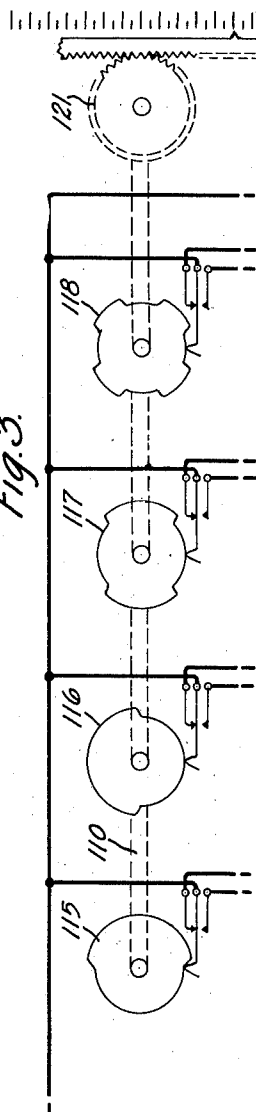
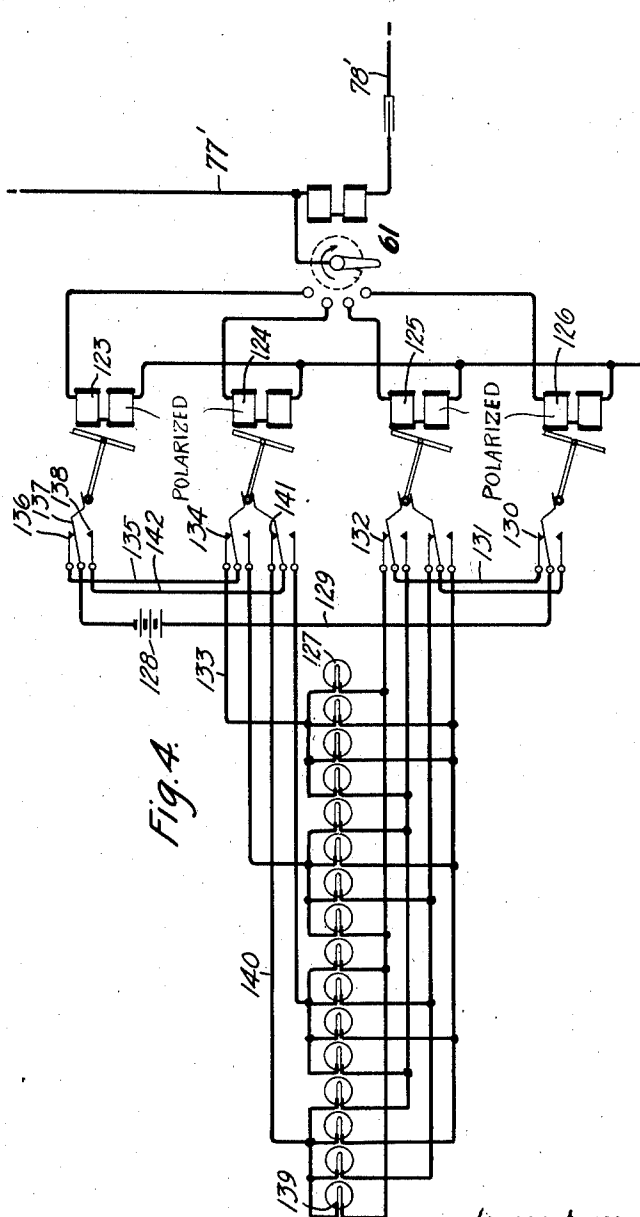


Fig. 4.



by

Inventor:

Joseph C. Field

Swadlow Atty

UNITED STATES PATENT OFFICE.

JOSEPH C. FIELD, OF ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

INDICATING SYSTEM.

Application filed October 22, 1924. Serial No. 745,187.

This invention relates to an indicating system for supervising from a central station the remote operation of circuit breakers, oil switches, water-level conditions or any other auxiliary control devices at outlying substations, and its object is to provide an improved and simplified system of this character.

A feature of the invention is the provision at the central station of a circuit arrangement including polarized relays operated by a single selector to illuminate the indicating lamps, instead of the plurality of selectors formerly necessary to operate the same number of lamps.

More specifically a pole changer relay is provided at the central station which is intermittently operated due to a change of position of the device at the substation under supervision, and transmits impulses of alternate polarity to the selector magnet which steps ahead over contacts connected to polarized relays, each of which controls a pair of lamps, one indicating the closed position and the other the open position of the device under supervision. After reaching the contact determined by the code transmitted, the selected polarized relay is operated in one direction or the other depending upon whether the pole changer relay is operated or inert at the end of the code of impulses, which in turn is determined by whether the device under supervision is moving to its open or closed position.

Other features will appear from the following description together with the accompanying drawings.

Fig. 1 and Fig. 2 of the drawings, placed end to end with Fig. 1 at the left, illustrate diagrammatically one embodiment of the invention in which Fig. 1 represents the central or control station while Fig. 2 represents the remote station. Fig. 3 represents a modified form of the apparatus at the remote station for initiating indications of the water level, etc., Fig. 4 represents the indicating apparatus at the central station for use with the modified form of Fig. 3, and Fig. 5 is an enlarged view of the impulse wheel for transmitting impulses to operate the answer back signals.

Referring to the drawings, the central station A in Fig. 1 is connected electrically with a plurality of substations B, C of Fig. 2 by means of line conductors 5, 6 and 7. At each

substation are located power switches, etc., but to avoid confusion only the apparatus at substation B is shown in detail. At this station, in addition to power switches 8 and 9 are cams 10 and 11 connected with the water level or other indicating apparatus 12 which will be described more in detail hereinafter.

The movable member of power switch 8 is provided with a contact arm 13 adapted to be connected with a battery 14 in a manner hereinafter to be described and which is designed to make contact with either contacts 15 or 16 depending upon whether power switch 8 is closed or open. Power switch 9 is provided with corresponding contact 17 designed to engage with either contacts 18 or 19. Cam 10 is provided in the same way with contact 20 designed to engage with either contact 21 or 22 and cam 11 is provided with contact 23 designed to engage with either contact 24 or 25. These contacts are provided to establish a circuit momentarily to start the operation of the indicating mechanism which will be described more in detail hereinafter.

The operation of the system is as follows: The switch 8 at the remote station is considered open as shown and the green light 68 at the control station lighted, red light 67 being short circuited. Supposing it is desired to close switch 8, the operator at the central station causes impulse wheel 88 to be rotated in the direction of the arrow causing relay 140 to operate over a circuit which may be traced from battery 143, relay 140, impulse wheel 88, contact arm 90, contact 86 and left armature of relay 87, to battery 143. Relay 140 in operating closes a circuit at its left armature from battery 143 through relay 142. Relay 142 upon operating removes the charging generator from battery 93 so that this battery is free from grounds or other potentials which may arise from the charging generator during the transmission of impulses from wheel 88. Upon the operation of relay 140 its right armature is also attracted closing a circuit for relay 89 which circuit may be traced from battery 143, conductor 144 right armature and right front contact of relay 140, conductor 145, relay 89, conductor 146 to battery 143. Relay 89 upon energizing attracts both of its armatures and connects battery 93 to line conductors 5 and 6.

As impulse wheel 88 continues to rotate, contact is made and broken between contact arms 90 and 94 and relay 84 is energized and deenergized over a circuit which may be traced from battery 143, conductor 144, left armature and back contact 86 of relay 87, contact arms 90 and 94, back contact and armature of relay 85, relay 84, to battery 143.

With the energization and deenergization of relay 84, the direction of current impressed on line conductors 5 and 6 is alternated. These alternating impulses actuate a selector device 148 in the manner shown in Patent No. 1,378,943 of May 24, 1921 to J. C. Field. This selector device is provided with a code setting and is preferably of the type disclosed in Patent No. 1,343,256 granted to J. C. Field, June 15, 1920, but any suitable selector may be used.

Impulse wheel 88 is arranged to give the proper number of impulses or alternations to step the contact arm of selector 148 around until it makes contact with stud 149. This closes a circuit for the upper winding of relay 150 from battery 153. Armature 151 is thereby attracted toward the upper winding of relay 150 and closes a circuit through contact 152 for energizing the operating winding of power switch 8. This circuit may be traced from battery 153 through armature 151, contact 152, winding of power switch 8 to battery 153. The movable member of power switch 8, carrying brush 155 moves upward until brush 155 makes contact with blocks 154 closing a power circuit not shown.

Contacts 90 and 94, Fig. 1, are held in engagement after the code of impulses is sent until the wheel 88 has returned to its initial position when the contact is broken. Upon the disengagement of these contacts, relay 84 is deenergized causing its armature to return to the unoperated position whereupon a pulse is transmitted to selector 148 of Fig. 2, having opposite polarity to that of the previous pulse. This last pulse steps the selector wheel one step to permit its release and return to normal as described in the above mentioned patent to Field 1,343,256.

A series of events is inaugurated upon the operation of any power switch such as 8 which will be described in detail later. A series is also started if the water level changes sufficiently to move cams 10 and 11 to cause either contacts 20 or 23 to engage with either 21 or 24 respectively.

The float, counter balance and water are indicated diagrammatically at 12. The float and counter balance are joined by a flexible means over pulley 69. The motion given pulley 69 is transmitted to cams 10 and 11 by means of shaft 70, gears 71 and shaft 72. It is readily seen that a change in

water level will cause a movement of pulley 69. The direction of rotation of pulley 69 determines whether the contacts associated with cam 10 or those associated with cam 11 are caused to engage.

Cams 10 and 11 are arranged on shaft 72 so that for each quarter of a revolution of this shaft, which corresponds to a definite change in water level, the contacts will be changed which will give an indication at the central office of this change.

Upon the closing of switch 8, contact arm 13 engages contact 15 closing a circuit for relay 57 which may be traced from battery 14, conductor 98, conductors 106, 108 contact 119 of releasing magnet 34, conductor 99, back contacts of left-hand armatures of the other release magnets, conductors 100, 101, contact arms 13, 15, contact 102, conductor 103, left hand winding of relay 57, conductor 104 to battery 14. Relay 57, when energized, attracts its left armature which makes contact at 73 closing a circuit through the windings of relay 59 at the substation and relay 87 at the control station. This circuit may be traced from battery 14, conductor 98, contact 73, conductor 107, winding of relay 59, left armature and contact of relay 60, line conductor 7, winding of relay 87, right back contact of relay 140, battery 143, lower contact and lower armature of relay 89, line conductor 6 to battery 14.

Relay 59, in energizing, attracts both armatures. At its right armature it breaks contact at 92 thereby disconnecting any other remote station such as C from the central station A over line conductor 7. No signals can then be transmitted from any other station until station B has completed its cycle and relay 59 is deenergized, as will be explained later. In the same way if signals are to be sent from station C relay 60 will be energized over line conductor 7 which relay upon attracting its armature breaks contact at 74 so that no indications can be transmitted from station B until relay 60 releases.

Upon attracting its left armature, relay 59 makes contact at 75 for starting motor 27 from current supplied by battery 14.

Motor 27 drives a shaft 26 on which are frictionally mounted bevel gears 28. These gears mesh with bevel gears 29 which in turn drive auxiliary shafts 30, 31, 32 and 33.

On shaft 26 and associated with each of the auxiliary shafts are mounted cams 49, 50, 51 and 52 arranged to actuate contacts 53, 54, 55 and 56, in the manner and for the purpose described in U. S. patent to Field, 1,613,944 of January 11, 1927. As the shaft 26 rotates, cam 49 closes contact 53 actuating release magnet 34 over a circuit from battery 14, conductor 98, 106, contact 119, conductors 99, back contacts of left hand armature of the other release magnets, conductors

100, 101, contact arms 13, 15, contact 102, conductor 103, contact 53, winding of release magnet 34, contact 111, conductors 109, 104 to battery 14. Cams 49, 50, 51 and 52 are set 90° apart on shaft 26 so that in case of simultaneous operation of two or more devices the indications will be sent in sequence and not confused.

When energized, magnet 34 attracts latch 35 which permits shaft 30 to rotate by the disengagement of latch 35 from one of the lugs 36 on a disc keyed to the shaft 30. Magnet 34 in attracting its right armatures closes locking circuits for both itself and relay 57 and locks out the apparatus associated with the other auxiliary shafts by breaking contact 119. The locking circuit for magnet 34 may be traced from battery 14, conductors 104, 109 contact 111, winding of magnet 34, contact 114 and right inner armature of magnet 34, conductors 108, 106, conductor 98 to battery 14. The locking circuit of relay 57 may be traced from battery 14, conductor 104, middle winding of relay 57, front contact 120 and outer right armature of magnet 34, conductors 108, 106, 98 to battery 14.

When shaft 30 rotates, cam 47 operates its associated contact arms to send a code of pulses back to the central station A. The pulses alternately energize and deenergize relay 85 which in turn energizes and deenergizes relay 84. Relay 84 being a pole changing relay impresses pulses of opposite polarity from battery 93 on the selector 61 to step its contact arm 62 around to one of the contacts 80, 81, 82 or 83 to energize, with a current of a definite polarity, one of the controlling relays 63, 64, 65 or 66, as more fully explained later. These last mentioned relays being of the polarized type act in accordance with polarity of the current through their windings to control the lighting of the indicator lamps 67, etc.

One of the pulsing cams such as 47 on shaft 30 is shown in more detail in Fig. 5. The cam is shown in its position of rest and as shaft 30 rotates contact is made at 112 due to the raised portions of the cam. It will be noticed that the last raised portion *a* is somewhat longer than the preceding ones and when this part causes contact at 112, relay 84, Fig. 1, is maintained operated for a longer period. This long pulse is impressed on selector 61 but due to condenser 151 becoming charged a pulse of the same length as the preceding one is given to the selector. This pulse being the final one of the code brings the selector wheel into such a position that upon the cessation of this pulse, spring 79 engages one of the pins 90 and holds arm 62 in engagement with contact 80 as described in detail in said Patent No. 1,343,256. Assuming that when contact 112, Fig. 2, is made a posi-

tive pulse is sent from battery 93, Fig. 1, through the selector, then when the long contact is made the selector gets its last step which is due to a positive pulse. When contact 112 is next opened as the code wheel comes to rest after making half a revolution, a negative pulse is sent by relay 84 retracting which steps the selector one step to remove spring 79 from engagement with pin 90, so that the selector arm 62 returns to its normal position.

Considering now the other half of the cam, it will be seen that the first contact made at 112 is long. Therefore, the selector wheel will be moved one step and upon the cessation of current flow due to condenser 151, the arm will return to its original position. In this way the series controlled by this half starts the selector stepping movement with a negative pulse instead of a positive pulse. In the same way the final long pulse is negative instead of positive as in the other case, but in this case another positive pulse must be given in order to return the selector wheel to the starting position before shaft 30 comes to rest with contact 112 open.

It will therefore be seen that in one case when the arm 62 is in contact with contact 80 a positive pulse is sent through relay 63 and in the other case a negative pulse is sent through the relay. The same condition holds when arm 62 contacts with 81, 82 or 83 to send either positive or negative current through relays 64, 65 or 66, respectively.

With the conditions as shown on the drawings, shaft 30 rotates causing cam 47 to operate its associated contact arms intermittently operating relay 85 over a circuit which is traced from battery 14, conductors 98, 106, contact 112, conductor 105, line conductor 5, relay 85, right armature and front contact of relay 87, right back contact and armature of relay 140, conductor 144 battery 143, lower contact and lower armature of relay 89, line conductor 6, to battery 14. Relay 85 is thus alternately energized and deenergized and through its left back contact and armature energizes and deenergizes relay 84 over a circuit from battery 143, conductor 144 front contact and armature of relay 85, relay 84 to battery 143. Relay 84 when operating alternates and polarity of the current from battery 93 to operate the selector 61 over conductors 77 and 78. Selector arm 62 is stepped around to contact 80 in accordance with the code for which cam 47 is arranged.

As arm 62 is being stepped around, selector arm 79 makes momentary contact with selector disc pins 90, but the time of contact is too short to permit actuation of slow acting relay 141. When contact arm 62 stops on contact 80 selector arm 79 remains in

contact with one of the selector disc pins 90 sufficiently long to cause relay 141 to operate, over the following: battery 93, front contact of 84, conductor 78, relay 141, arm 79, arm 62, conductor 77, lower armature of relay 84 to battery. In operating relay 141 closes contact 95 which closes a circuit from battery 93 through front contact of relay 84, conductor 78, contact 95, relay 63, contact 80, arm 62, conductor 77, lower armature of relay 84 to battery 93. Since the polarity of the current is now opposite to that which actuated relay 63 on the previous operation of the power switch 8 it is again actuated, changing the contacts controlling the indicating lamps so that lamp 67 is lighted and lamp 68 short circuited.

After shaft 30 has completed a quarter of a revolution cam 46 has moved into a position where contact is made at 113 and broken at 102. This prepares the circuits associated with the contacts actuated by power switch 8 for again operating upon the opening of switch-8.

When the code of pulses just sent by cam 47 is completed shaft 30 has rotated sufficiently to cause cam 48 to actuate its associated contact arm to open contact 111. This breaks the energizing circuit for release magnet 34 and permits latch 35 to engage one of the studs 36 thereby bringing shaft 30 to rest. In deenergizing, magnet 34 also breaks contacts at 114 and 120 and makes contact at 119. The breaking of contact 114 breaks the locking circuit for magnet 34 at another point while breaking contact 120 breaks the locking circuit for relay 57. In making contact 119, the circuit is prepared for the operation of any of the apparatus associated with either switch 9 or cams 10 and 11.

Relay 57 when deenergized releases its armature breaking contact at 73 of the circuit through the relay 59 at station B and relay 87 at the control station A. Both armatures of relay 59 release when it is deenergized. The left armature breaks contact at 75 removing the current from the motor 27 which then comes to rest. At its right armature relay 59 makes contact at 92 which closes a circuit through line conductor 7 from any other substation such as "C" to the control station "A".

At its left armature relay 87 upon deenergizing makes contact at 86 preparing the circuit for the next operation of an impulse wheel such as 88'. The energizing circuit for relay 141 is broken by arm 79 disengaging from disc pin 90, as the selector restores as already described. The energizing circuit for relay 63 besides being broken at the selector is broken at contact 95 of relay 141. Since relay 63 is of the polarized type, as mentioned above, it remains in its operated position when the energizing cur-

rent is removed and hence no change occurs in the indication lamp circuits.

The entire system is then prepared for the next operation either from a remote station or from the control station and the operation upon the opening of switch 8 will be repeated again as described above. A similar series of events will occur if the other power switch 9 is operated or if the water-level changes sufficiently to cause the contacts associated with either cam 10 or cam 11 to change position.

Referring to the water-level or gate-opening indicating system, this feature of the invention is arranged to operate independently of any control exercised at the central station, that is, instead of giving an indication in response to the throwing of a power switch or the distant operation of some other control device, it is arranged to transmit indications automatically to the central station whenever predetermined degrees of change of the water-level take place.

With the two cams 10 and 11 shown in Fig. 2, cooperating with the two lower contacts on selector 61, at the central station, the four indicating lamps in the lower bank can be controlled to give the indications for four points of water level or gate opening. The operation of the control relays through selector 61 in response to different positions of the cams 10 and 11, is similar to the operation of return indication apparatus by the power switch 8 as already described. It will be seen that in the position of the cams shown in Fig. 2, indicating lamp 58 at the left hand end of the bank will be lighted.

In Figs. 3 and 4, is shown an arrangement whereby sixteen indications may be obtained through the operation of a four point selector. In Fig. 3, four cam members 115, 116, 117 and 118 on a single shaft 110, rotated through a gear 121 meshing with a rack 122 connected to a gate or other member whose position is desired to be known, are arranged to operate suitable switch members to initiate impulse transmitting operations.

In Fig. 4 is shown an arrangement whereby the sixteen lamps may be controlled by the four polarized relays 123, 124, 125 and 126 corresponding to the four contacts of the selector. This is achieved by the use of double contacts for relays 123 and 126 and quadruple contacts controlled by the relays 124 and 125. The operation of the selector 61 by means of impulses transmitted by code discs from the substation where the cam shaft 110 is located, is the same as the impulse transmitting operations already described. In the cam setting shown in Fig. 3, the lamp 127 at the extreme right hand end of the bank will be lighted over the following circuits, from battery 128, through conductor 129, contact 130, conductor 131, con-

tact 132, lamp 127, conductor 133, contact 134, conductor 135, contact 136 to battery 128.

If now relay 123 is operated, contact will be made between spring 137 and contact 138.

5 This will cause lamp 139 at the extreme left of the bank to be lighted over a circuit which may be traced from battery 128, through conductor 129, contact 130, conductor 131, contact 132, lamp 139, conductor 140, contact 141, conductor 142, contact 138, contact spring 137 to battery 128.

10 It will be seen from the above and by reference to Fig. 4 that the two contacts associated with relay 123 select two of the four banks of lamps depending upon the position of the contacts associated with relay 124. The contacts associated with relay 126 select two of the four lamps in each bank and the contacts associated with relay 125 selects the lamp required. More briefly relay 123 selects two banks of four lamps each, relay 124 selects one of these two banks, relay 126 selects two lamps in the bank and relay 125 selects the one lamp.

25 What is claimed is:

1. In a signaling system, a central station, a substation, means at the substation individual to each condition for transmitting to the central station a code of impulses, a pair of signals at the central station, a polarized relay therefor, a pole changing relay at the central station controlled by said impulses, a source of current at said central station, a selector at said central station actuated by impulses of alternate polarity from said source governed by said pole changing relay to select one of said polarized relays, said polarized relay being responsive to the polarity of the last impulse from the pole changing relay to selectively operate said signals.

2. In a signaling system, a central station, a substation, devices to be supervised thereat, an impulse transmitter associated with each device and automatically actuated by the movement of the device, an impulse circuit extending from the substation to the central station and including said transmitter, a pole changing relay controlled by the impulses transmitted upon the movement of each device, a pair of signals for each device, a polarized relay for controlling each pair of signals, a selector at said central station actuated by the pole changing relay to select one of said polarized relays, the last impulse

from the pole changing relay to the selector magnet serving to give the selector its final step to pick out the desired polarized relay and also to cause said relay to operate the corresponding signal.

3. In a signaling system, a central station, a substation, devices thereat to be supervised, a circuit including an impulse transmitter at the substation actuated by the movement of said devices and a relay at the central station responsive thereto, a pole changing relay at the central station controlled by said relay, a selector at the central station, a circuit at the central station including the contacts of said pole changing relay and the selector driving magnet, a pair of signals at the central station for each device, a polarized relay for controlling each pair of signals, and means governed by the actuated or inert condition of said pole changing relay at the termination of a series of impulses for actuating the corresponding signal.

4. In a signaling system, a central station, a sub-station, devices to be supervised thereat, an impulse transmitter associated with each device and automatically actuated by the movement of the device, an impulse circuit extending from the substation to the central station and including said transmitter, a pole changing relay controlled by the impulses transmitted upon the movement of each device, a pair of signals for each device, a polarized relay for controlling each pair of signals, a source of current at said central station, a selector at said central station actuated by impulses of alternate polarity from said source governed by said pole changing relay to select one of said polarized relays, a slow to operate relay at the central station, the last impulse from the pole changing relay to the selector being longer than the others, this impulse giving the selector its final step and also operating said slow relay, said slow relay completing the circuit of the selected polarized relay, the polarity of the last impulse determining the direction of movement of said polarized relay armature to selectively operate the pair of signals.

In witness whereof, I hereunto subscribe my name this 18th day of October A. D., 1924.

JOSEPH C. FIELD.