Jan. 11, 1927. 1,613,944

J. C. FIELD

SIGNALING SYSTEM

Filed July 9, 1923 2 Sheets-Sheet 1

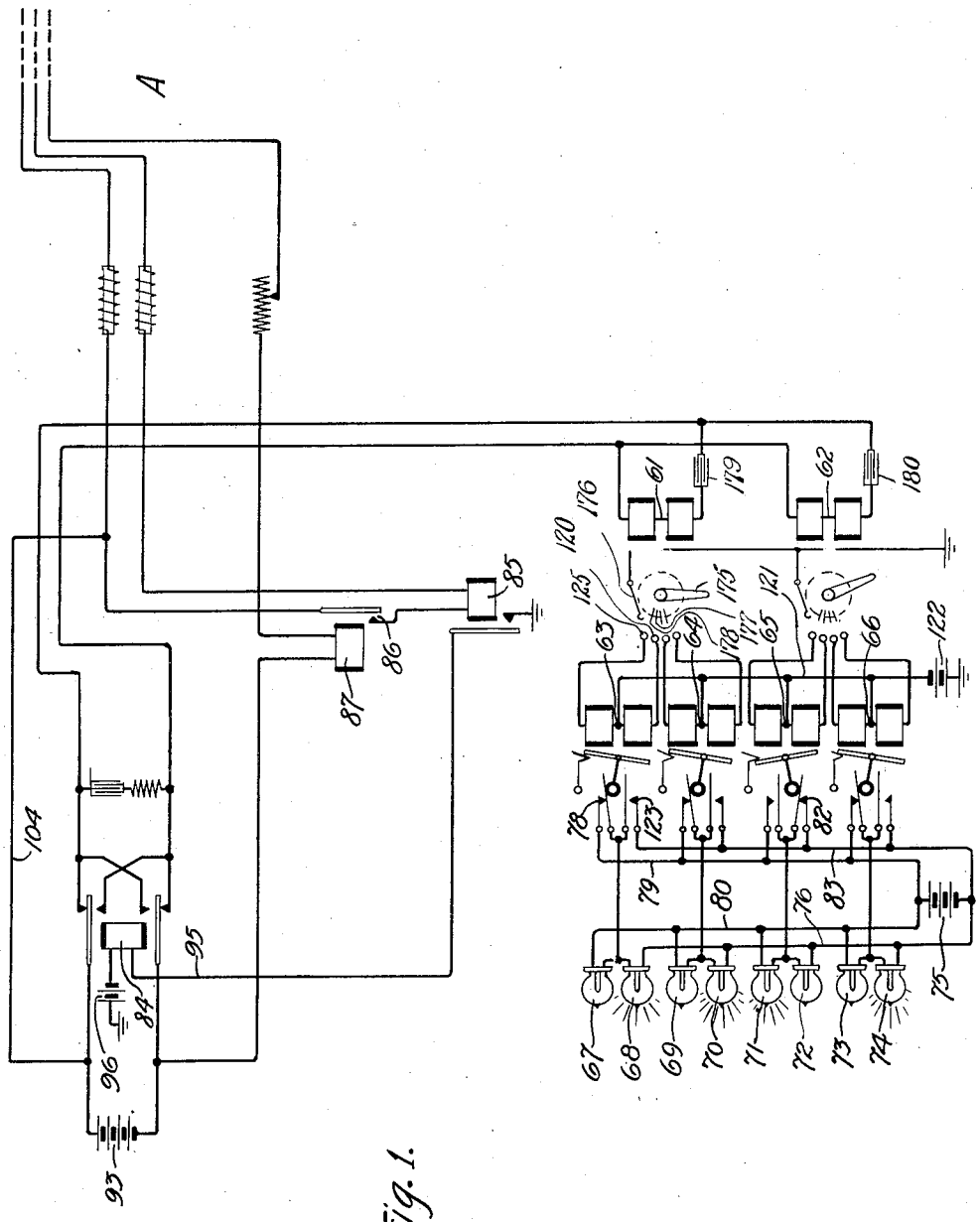


Fig. 1.

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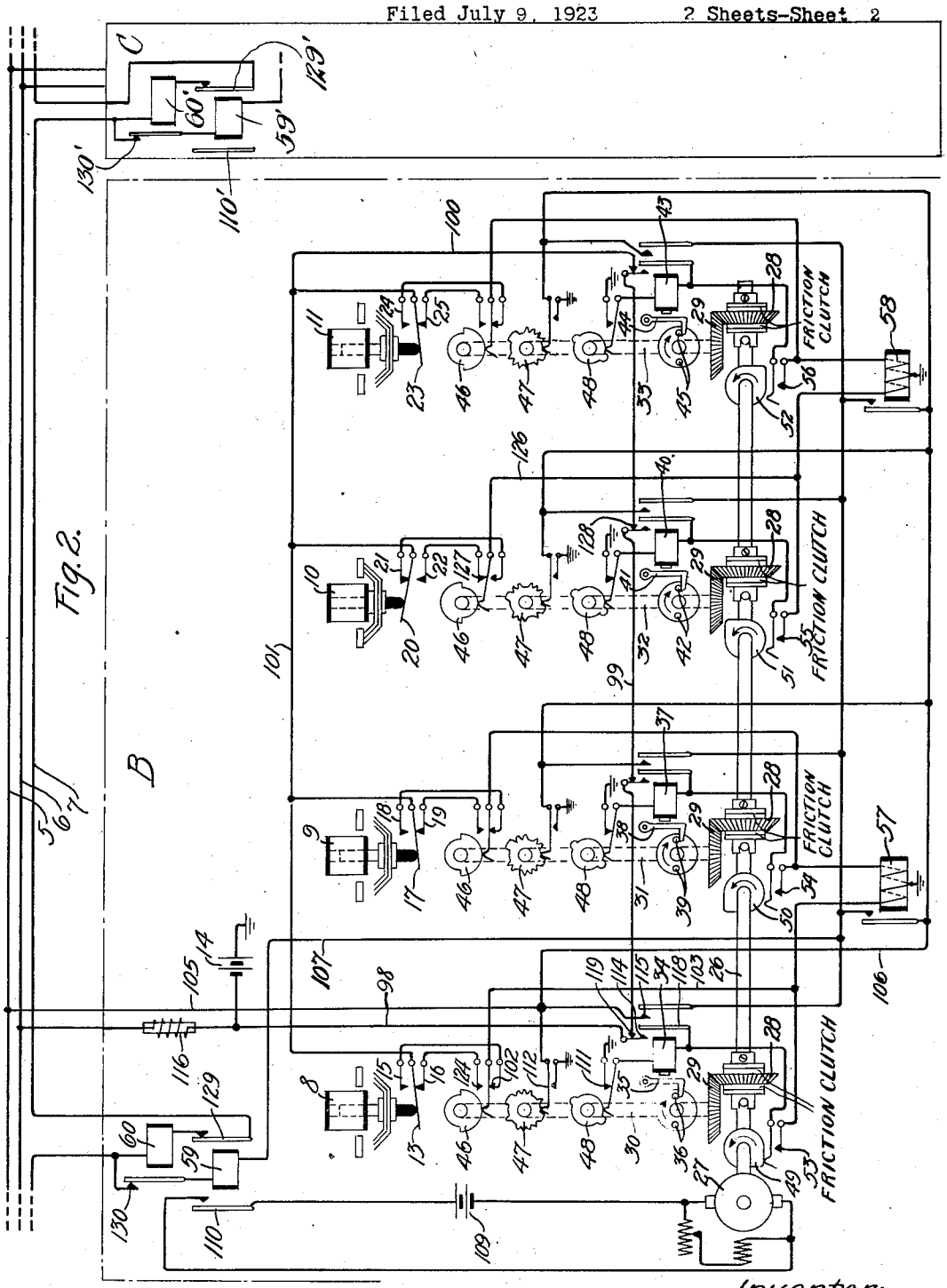


Fig. 2.

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Patented Jan. 11, 1927. 1,613,944

UNITED STATES PATENT OFFICE.

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SIGNALING SYSTEM.

Application filed July 9, 1923. Serial No. 650,267.

This invention relates to signaling systems, and particularly to signaling systems for use in connection with the remote control of power switches and the like.

The object of the invention is an improved system for indicating at a main control station the open or closed condition of any one of a plurality of power switches located at a distant station and controlled from said main station.

The invention provides impulse transmitters at each remote station driven from a common electric motor for signaling the central station upon the operation of any power switch thereat. Means is also provided for obtaining a lock-out between the transmitters at the different substations and between the transmitters at each station when two or more switches are operated thereat at the same time.

These and other features and advantages of the invention will appear from the following description and the annexed drawing, Figs. 1 and 2 of which, when placed end to end with Fig. 1 at the left, illustrate diagrammatically one embodiment of the invention as applied to a system for indicating the position of power switches.

Referring to the drawing, a plurality of substations B and C are connected with a central control station A by means of line conductors 5, 6 and 7. A plurality of power switches 8, 9, 10 and 11 are located at each of the substations, but for the sake of clearness only the power switches at the station B are shown. The power switch 8 is provided with an associated contact 13 adapted to be connected to a source of current 14 in a manner hereinafter described, and is designed to engage with one or the other of contacts 15 and 16, depending upon whether the switch 8 is closed or open. The power switch 9 is provided with a corresponding contact 17 adapted to engage with either of contacts 18 or 19, while the switch 10 is similarly provided with a contact 20 adapted to engage with contacts 21 and 22, and the switch 11 is provided with a contact 23 and associated contacts 24 and 25. The power switches are merely provided with additional contacts so that, upon opening or closing, a circuit will be completed for momentarily effecting the operation of indicating mechanism as will be hereinafter described.

An impulse transmitter is provided at each substation, and includes a main shaft 26 adapted to be driven by a motor 27 through a suitable reduction gear, not shown. A plurality of bevel gears 28, one for each power switch, are mounted on the shaft 26 and are frictionally driven thereby in any suitable manner. The gears 28 each mesh with corresponding bevel gears 29 which are mounted, respectively, on unit cam driving shafts 30, 31, 32 and 33. A trip magnet 34 is associated with the impulse unit of the switch 8 and controls a latch 35 which is adapted, when the magnet is deenergized, to hold the shaft 30 against rotation through its engagement with studs 36 suitably secured to the shaft 30. The rotation of shaft 31 is controlled by a trip magnet 37 and an associated latch 38 which is adapted to engage either of studs 39 when the relay 37 is deenergized. Similarly, the rotation of the shaft 32 is governed by a trip magnet 40, a latch 41 and catch studs 42, while the rotation of shaft 33 is governed by trip magnet 43, latch 44 and studs 45. It will readily be seen that the energization of any of the magnets 34, 37, 40 or 43 will cause the release of its shafts 30, 31, 32 or 33, as the case may be, permitting the shaft to be driven by the main shaft 26 through one of the frictionally driven gears 28. Each of the cam shafts 30, 31, 32 and 33, in addition to means for supporting the catch studs, is also equipped with three cams 46, 47 and 48. The main shaft 26 is provided with a plurality of cams 49, 50, 51 and 52, so disposed that when the shaft is rotating the cams will operate contacts 53, 54, 55 and 56, respectively, in succession. Relays 57 and 58 are provided, one for each pair of power switches. A relay 59 is provided for the purpose of controlling the circuit of the motor 27, and a line relay 60 is also provided which is controlled by the signaling apparatus at the substation C or any other substation beyond the substation B for preventing the operation of the signaling apparatus at station B. The substation C and all other substations on the line are similarly equipped with apparatus corresponding to that employed at station B.

A plurality of selectors 61 and 62 are located at the central control station A, one selector preferably being provided for every two power switches at the substations. These selectors are provided with code settings and

are preferably of the type disclosed in Patent No. 1,343,256, granted to J. C. Field June 15, 1920, but any other suitable selector may be employed. The selectors 61 and 62 are each adapted to control the operation of a pair of mechanically locking relays 63, 64 and 65, 66, respectively, the armatures of each of which control the circuits of a pair of electric lamps. Two lamps are required to indicate the position of a given power switch, one for the open and one for the closed position. The lamps 67 and 68 serve to indicate the position of power switch 8, and the lamps 69 and 70 serve to indicate the position of power switch 9. Similarly, lamps 71 and 72 are allotted to power switch 10 and lamps 73 and 74 to power switch 11. One or the other of each of these pairs of lamps is normally lighted, current being supplied thereto by a battery 75. The circuit for lamp 68, for example, extends from the negative side of battery 75, through conductor 76, lamp 68, contact 78 of relay 63, conductor 79 to the positive side of battery 75. The circuit of the lamp 71 may be traced from the positive side of battery 75, through conductor 80, lamp 71, contact 82 of relay 65, conductor 83 to the negative side of battery. Thus, the attendant at the control station A, by observing the lamp that is lighted, is informed of the position of any given switch. In practice, it is preferred to have the lamps 67, 69, 71 and 73 red, and the lamps 68, 70, 72 and 74 green. The lighting of a green lamp informs the attendant that a certain power switch is open, while the lighting of a red lamp will indicate that a particular switch has been moved to the closed position. The selectors 61 and 62, controlling the lamp circuits, are operated by a relay 84, which, in turn, is controlled by a relay 85 operated by signaling impulses from the substations B and C. The circuit of the relay 85 is normally broken at contact 86, which contact is controlled by a relay 87 which is adapted to be energized during the period when impulses are being received from the substations.

The operation of the system is as follows: The main contacts of the power switch 8 are considered to be open, the green indicating lamp 68 at the central station A being lighted as shown on the drawing. When the switch 8 is closed, contact 13 is moved into engagement with contact 15, thus completing an energizing circuit for the relay 57 which may be traced from ground, through battery 14, conductors 98, 99, 100 and 101, contacts 13 and 15, contact 102, which is held closed by the cam 46, conductor 103, winding of relay 57 ground. The operation of the relay 57 establishes an energizing circuit for the relay 59 which may be traced from the positive side of battery 93 at control station A, conductor 104, line conductor 5, conductors 105 and 106, armature of relay 57, conductor 107, winding of relay 59, armature of relay 60, line conductor 7, winding of relay 87 to the negative side of battery 93. The operation of the relay 59 closes the circuit of the motor 27 extending from the negative side of battery 109, through field winding of motor 27, armature 110 of relay 59, to the positive side of battery 109. At the same time, relay 59 attracts its armature 129, thus breaking the circuit of line conductor 7 and preventing the transmission of signals from substation C or any other substation beyond the station B during the time that the apparatus at substation B is functioning. As pointed out above, the rotation of shaft 26 causes the associated cams 49, 50, 51 and 52 to close their respective contacts in succession. The closure of the contact 53 now completes an energizing circuit for the trip magnet 34 which may be traced from ground, through contact 111, winding of magnet 34, contact 53, conductor 103, contact 102, which remains closed during a quarter revolution of cam 46, contacts 15 and 13 of power switch 8, conductors 101, 100 and 99, passing through the closed contacts of trip magnets 43, 40, 37 and 34, conductor 98, battery 14 to ground. The trip magnet 34 is thereupon locked up electrically over a circuit extending from ground, through contact 111, winding of trip magnet 34, armature 118, contact 114, conductor 98, battery 14 to ground. Likewise, an energizing circuit for the relay 87 is established over a circuit extending from the positive side of battery 93, conductor 104, line conductor 5, conductor 105, contact 115, and outer armature of trip magnet 34, conductor 107, winding of relay 59, thereby locking up relay 59, armature of relay 60, line conductor 7, winding of relay 87 to the negative side of battery 93. The energization of relay 87 closes the contact 86. Upon energizing, the trip magnet 34 attracts its armature latch 35, which releases the catch lugs 36 and permits the shaft 30 to be driven by the main shaft 26 through the gears 28 and 29. The other shafts 31, 32 and 33, however, are prevented from rotating by the latches 38, 41 and 44, which remain in engagement with their respective catch lugs. The trip magnet 34 in energizing attracts its armature 118, thereby opening the contact 119 and breaking the energizing circuit of all the other trip magnets 37, 40 and 43, and thereby prevents the operation of the impulse transmitting units associated with the power switches 9, 10 and 11, should any of these power switches operate in the meantime, until the operation of the mechanism associated with the power switch 8 is completed. As the shaft 30 rotates, the code impulse wheel 47 alternately makes

and breaks its associated contact 112, thus sending a series of impulses over the line, causing the relay 85 to be alternately energized and deenergized over a circuit extending from ground, through contact 112 of impulse wheel 47, conductor 105, line conductor 5, armature and contact 86 of relay 87, winding of relay 85, line conductor 6, impedance coil 116, battery 14 to ground. The operation of relay 85 causes the relay 84 to operate over a circuit extending from ground through armature of relay 85, winding of relay 84 and battery 96 to ground. Relay 84 is of the pole changer or current reversal type, and each time it is energized and deenergized, it impresses an impulse on the windings of the selectors 61 and 62 over a circuit extending from one side of battery 93, armature of relay 84, windings of selectors 61 and 62, armature of relay 84 to the opposite side of battery 93. Each operation of relay 84 serves to alternate the polarity of the current applied to the selectors, each reversal of the polarity serving to move the contact arms of the selectors forward one step. Owing to the particular code setting of the impulse wheel 47 on the shaft 30, the contact arm of selector 61 is now stepped around until it engages contact 120, thus closing an energizing circuit for the lower winding of relay 63 which extends from ground through contact arm and contact 120 of selector 61, lower winding of relay 63, conductor 121, battery 122 to ground.

Selectors 61 and 62 are of the type described in the before-mentioned Patent No. 1,343,256, granted to J. C. Field, June 15, 1920. This patent also describes the operation of each selector and of a number of selectors connected in parallel.

While the selector wheel is being stepped around, due to the impulses controlled by relay 84, contact is made between catch spring 176 and pins 177, 178, etc., on the wheel for only about .005 second, which interval is too brief to permit actuation of any of the relays 63, 64, etc.

Cams 47 are arranged to send a long impulse at the end of a given series, and this long impulse charges condensers 179 and 180 so that no current flows through the selector windings, and hence its armature returns to normal, thereby permitting catch spring 176 to engage one of the pins 177, 178, etc., for an appreciable time. This closes a circuit from ground, through catch spring 176, pin 178, wheel and contact arm 175 of selector 61, contact 120, lower winding of relay 63, conductor 121, to grounded battery 122. The lower winding of relay 63 being energized, the armature of the relay is attracted toward it, thus opening the contact 78, breaking the energizing circuit of the lamp 68, and closing contact 123, thereby lighting the lamp 67 over a circuit which extends from the positive side of battery 75 through conductor 80, lamp 67, contact 123, conductor 83 to the negative side of battery 75. The lighting of the lamp 67 informs the attendant at the central station that the power switch 8 at the substation B has been closed. When contact is broken at 112 as cam 47 continues to rotate, relay 85 is deenergized which, in turn, deenergizes relay 84, permitting its armatures to return to the unoperated position, and thereby sending a single pulse through the windings of the selector. This pulse moves the selector wheel one step, throwing catch spring 176 out of engagement with pin 178, allowing the selector wheel to return to normal, as explained more fully in the above mentioned patent.

Upon the completion of one half a revolution of the shaft 30 at substation B, cam 48 momentarily opens the contact 111, thus breaking the energizing circuit of the trip magnet 34 and allowing the latch 35 to fall back and engage one of the catch lugs 36. At the same time, the deenergization of the trip magnet 34 opens contact 115, thus breaking the energizing circuit of the relay 59. Deenergization of the relay 59 allows its armature 110 to fall back, thus breaking the circuit of the motor 27 and stopping rotation of the shaft 26. The shaft 30 comes to a stop with the cam 46 in the up position, thus opening the contact 102 and preventing the further operation of the mechanism thus described until the power switch 8 is again operated. If the power switch 8 is now moved from the closed position to the open position shown in the drawing, the switch contact 13 will be moved into engagement with the contact 16, thus completing an energizing circuit for the relay 57, which may be traced from ground, through winding of relay 57, conductor 103, contact 124, which is now closed due to the fact that the cam 46 is in the up position, contacts 16 and 13 of switch 8, conductors 101, 100, 99 passing through the closed contacts of the trip magnets 43, 40, 37 and 34, conductor 98, battery 14 to ground. The operation of the relay 57 will again close a circuit for starting the motor 27 and the apparatus will function as before. When the power switch 8 is opened, however, a different series of code impulses will be transmitted over the line due to the code setting provided on the other half of the cam 47, permitting the selector 61 to step its contact arm around to a position where it will engage the contact 125, thus moving the armature of relay 63 to the position shown in the drawing, extinguishing the lamp 67 and lighting the lamp 68.

When the signaling mechanism associated with the switch 8 has completed the opera-

tion described above, any other unit of the motor driven impulse key may be operated if the contact on the power switch associated therewith has been closed in the meantime. As pointed out above, during the rotation of the shaft 30, the release of any of the shafts 31, 32 or 33 was prevented, due to the fact that the energizing circuits of the trip magnets 37, 40 and 43 was broken at the contact 119 by the operation of the trip magnet 34. If now, the power switch 10 is opened, the relay 58 will be energized over a circuit extending from ground, through winding of relay 58, conductor 126, contact 127 associated with cam 46, switch contacts 22 and 20, which are now in engagement, conductors 101, 100, 99, passing through the closed contacts of the trip magnets 43, 40, 37 and 34, conductor 98, battery 14 to ground. The operation of the relay 58 establishes a circuit for starting the motor 27 similar to the circuit described in connection with the relay 57. As soon as the trip magnet 40 is operated by the closure of contact 55 by cam 51, the contact 128 is opened, thus breaking the energizing circuit on the trip magnets 43, 37 and 34 and preventing their operation until the unit associated with the power switch 10 has completed its operation. The transmission of code impulses by the cam 47 of the shaft 32 serves to operate the selector 62 thereby extinguishing the lamp 71 and lighting the lamp 72 in the manner described above.

As pointed out above, the energizing circuit of the relay 59, controlling the energizing circuit of the motor 27 includes the line conductor 7. Similarly, the energizing circuit of the relay 59 located at substation C or any other substation also includes the conductor 7 and consequently when the relay 59 at substation C or any other subsequent substation is operated, its energizing circuit will pass through the relay 60 at the substation B which is included in the line conductor 7. The operation of the relay 60 at substation B will open the contact 130, thus breaking the energizing circuit of the relay 59 and preventing the operation of the motor 27 at station B until the operation of the signaling mechanism at the substation C is completed.

What is claimed is:

1. A signaling system comprising a central station and a remote station, a plurality of switches at said remote station, a motor driven cam shaft controlled by the operation of said switches, an impulse transmitter allotted to each of said switches and frictionally driven by said cam shaft, a latch cooperating with each of said impulse transmitters to hold them against operation by said cam shaft, an electromagnet associated with each of said switches and energized by the operation thereof to release said latches to permit said cam shaft to drive said transmitters, means controlled by the operation of each of said electromagnets to prevent the operation of the other electromagnets, and means controlled by each of said impulse transmitters for deenergizing its associated latch-controlling electromagnets.

2. A signaling system comprising a central station and a remote station, a plurality of switches at said remote station, a motor driven cam shaft operated upon the operation of any one of said switches, an impulse transmitter allotted to each of said switches and frictionally driven by said cam shaft, a latch cooperating with each of said impulse transmitters to hold them against operation by said cam shaft, an electromagnet associated with each of said switches and energized by the operation thereof to release the associated latch to permit said cam shaft to drive said transmitters, means controlled by the operation of each of said electromagnets to prevent the operation of the other electromagnets, means controlled by each of said impulse transmitters for deenergizing its associated latch-controlling electromagnet, and means controlled by each of said impulse transmitters for stopping the operation of said motor driven cam shaft.

3. A signaling system comprising a central station and a plurality of remote stations, a plurality of switches at each of said remote stations, a motor driven cam shaft at each of said remote stations, means controlled by each of said switches for signaling said central station, means for coupling the same to said cam shaft, means controlled by the operation of each of said signaling means at each remote station for preventing the operation of the other signaling means thereat until the first operated means has completed its operation, and means controlled by the operation of the motor driven cam shaft at each remote station for preventing the operation of the motor driven cam shafts at all other remote stations until the operation at the first operated station is completed.

In witness whereof, I hereunto subscribe my name this 3 day of July A. D. 1923.

JOSEPH C. FIELD.