

June 1 , 1926.

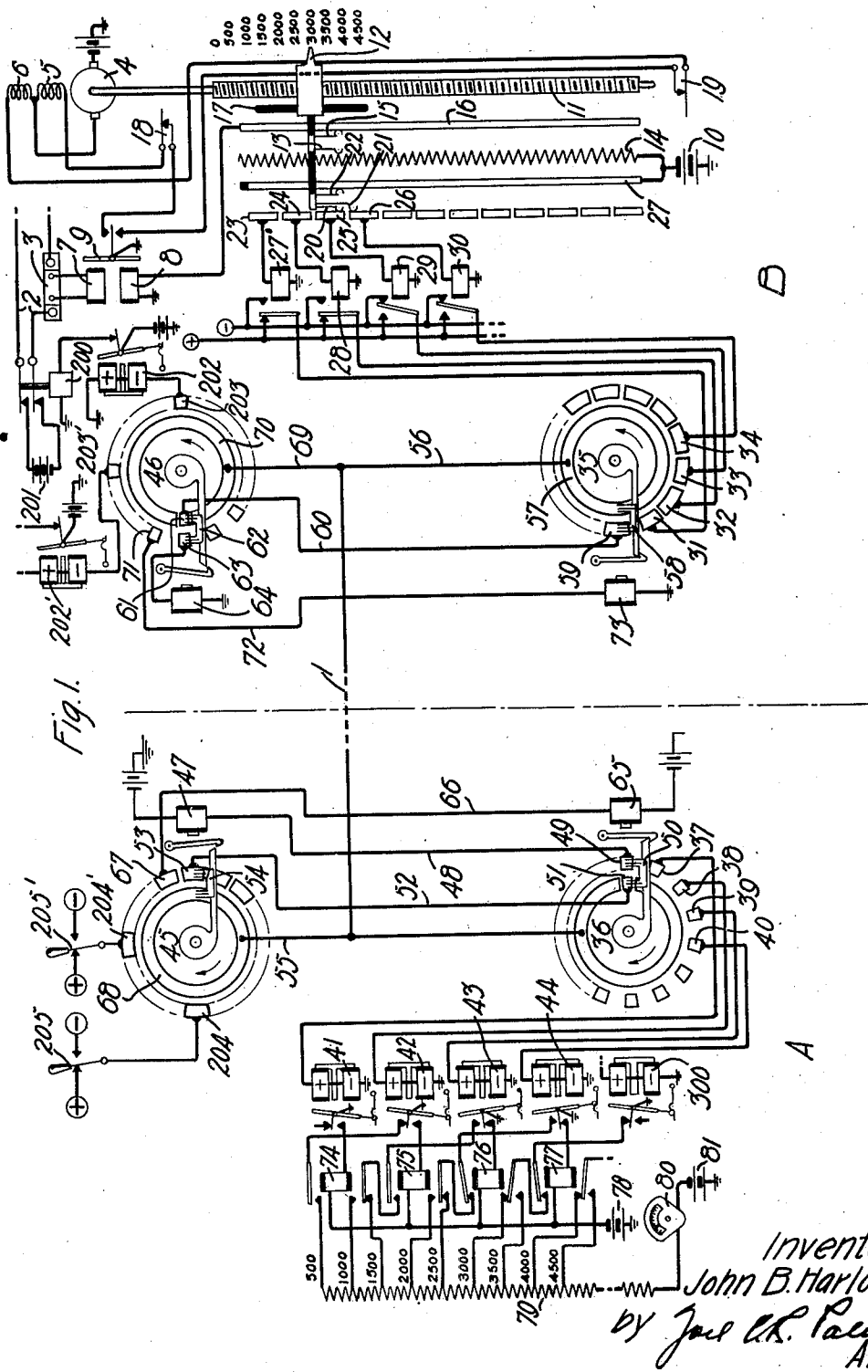
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ELECTRICAL SWITCHING AND INDICATING SYSTEM

Filed Dec. 31 , 1921

2 Sheets-Sheet 1



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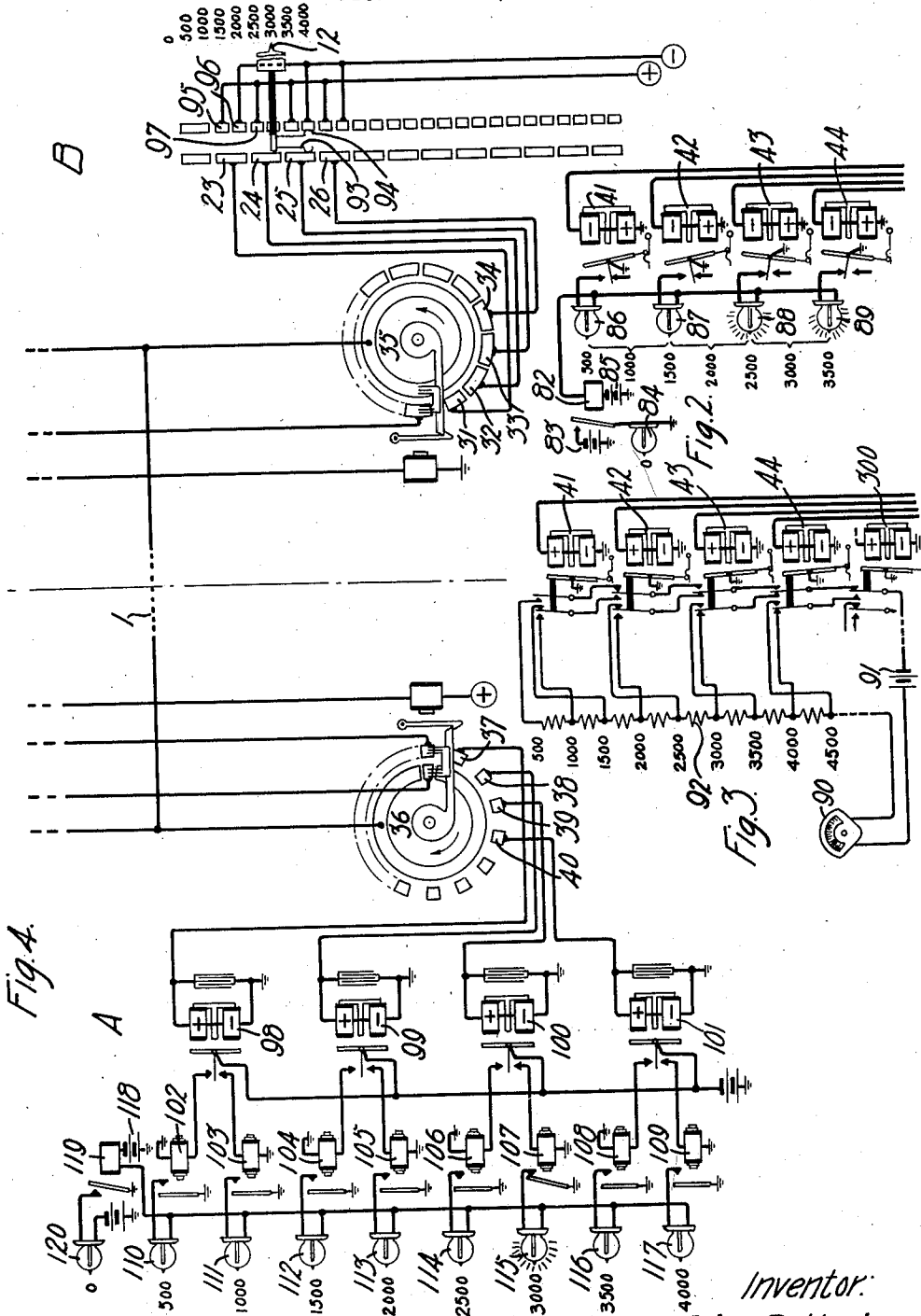
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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ELECTRICAL SWITCHING AND INDICATING SYSTEM.

Application filed December 31, 1921. Serial No. 526,183.

This invention relates in general to electrical switching systems and particularly to remote control and supervisory systems.

An object of the invention is to provide a system for selectively actuating a plurality of devices over a single common line.

Another object of the invention is to provide a system of this type which is positive and rapid in operation and which employs a minimum of operating parts.

The invention is adapted to be used for a variety of purposes where it is desired to automatically transfer current impulses for selectively operating devices located at a distance from the controlling point. In the embodiment of the invention herein disclosed, it is employed to selectively complete circuits for devices which indicate at a central station or controlling station, the current load at a remote station. At the remote station is provided a motor-operated ammeter which is employed to pass a brush over commutator segments and selectively associate them with a source of current. Each commutator segment is associated with a relay or system of relays through the means of rotary distributors and a single line associating the two stations to complete circuits whose ultimate function is to operate a suitable means for indicating at the central station, the current load at the remote station.

The invention in its preferred form is illustrated diagrammatically in the accompanying drawings.

Fig. 1 shows an adaptation of the system for indicating at a central station, the current load at a remote station;

Fig. 2 is a modification of the arrangement of apparatus at the central station;

Fig. 3 shows another modification of the arrangement of the apparatus at the central station;

Fig. 4 is a modified arrangement of the system shown in Fig. 1.

Referring to the drawings in detail in which like reference numerals designate similar parts and directing attention first to Fig. 1, the apparatus to the left of the broken line is situated at a central station A and that to the right of the broken line is situated at a remote station B. Stations A and B are connected by a single line 1.

At the remote station, the bus bars 2 are

provided with a suitable shunt 3 for operating an ammeter or other indicating device or instrument.

The indicator here described is of the motor-driven type and consists of a motor 4 and field windings 5 and 6, which are selectively energized by a relay having two solenoids 7 and 8 and a common armature 9. The solenoid 7 is adapted to be energized by current from the shunt 3, the solenoid 8 being energized by current from a source 10 in a manner hereinafter described. The armature of motor 4 is provided with a shaft having a threaded portion 11, which carries a correspondingly threaded member 12, which moves to and fro along shaft 11 according to the direction of rotation of motor 4. Threaded member 12 is provided with an arm carrying a brush 13, which passes along a slide-wire resistance 14 and a brush 15, which engages with a continuous contact 16 electrically connected to solenoid 8. Brushes 13 and 15 are electrically connected and their purpose is to supply current from the current source 10 to energize the solenoid 8.

Threaded member 12 is provided with an index or pointer which cooperates with a suitably calibrated scale to indicate electrical current. Armature 9 is provided with alternate contacts, one of which, shown above, closes the circuit of field winding 5 and the other of which closes the circuit of field winding 6. Normally solenoids 7 and 8 are automatically balanced so that both field windings 5 and 6 are open circuited. However, when the current carried by the bus bars 2 increases, the solenoid 7 causes the armature 9 to close the circuit of field winding 5 through its upper contact, causing motor 4 to rotate in a direction to carry threaded member 12 downwardly along shaft 11. Brush 13 reduces the resistance of slide-wire resistance 14 in passing downward toward the source of current 10. The increased current from source 10 increases the magnetic strength of solenoid 8 until it is sufficient to cause armature 9 to swing to its open circuit position, opening the circuit of the field winding 5. When the current carried by bus bars 2 decreases, the balance between solenoids 7 and 8 is again upset and armature 9 then closes a circuit through its lower contact to energize field

winding 6. Threaded member 12 is then carried back along shaft 11 and more of the slide wire resistance 14 is included in the circuit of solenoid 8. Motor 4 continues to operate until solenoids 7 and 8 are again magnetically balanced when armature 9 swings to its open circuit position opening the circuit of the field winding 6.

This operation is performed at every fluctuation of the load and the current is thus automatically indicated on the scale associated with the index of threaded member 12 since it is obvious that every position of threaded member 12 must correspond to a definite current value.

In order to prevent threaded member 12 from being carried beyond threaded portion 11 of the armature shaft, there is provided a tripping member 17, which, when the threaded member 12 reaches one end of the scale, opens a switch 18, and when it reaches the other end of the scale, opens switch 19. Switches 18 and 19 are connected in series with field windings 5 and 6, respectively, and are intended to stop motor 4 when threaded member 12 reaches the limits above referred to.

Threaded member 12 is also provided with a set of brushes 20, 21 and 22, which are electrically connected but insulated from brushes 13 and 15. Brushes 20 and 21 are adapted to pass over a series of commutator segments, of which 23, 24, 25 and 26 are typical. Brush 22 maintains contact with a continuous conductive member 27 connected with source of current 10. Brushes 20, 21 and 22 are adapted to apply current from the source 10 to relays 27', 28, 29 and 30 associated with the commutator segments 23, 24, 25 and 26 respectively. Brushes 20 and 21 are arranged in such a manner that they both contact with commutator segments at intervals corresponding to given current values. For instance, at a load of 2500 amperes, brushes 20 and 21 both contact with the segment 25. When the load increases to a value over 2750 amperes, contacts 20 and 21 bridge segments 25 and 26. When the load increases to 3250 and is less than 3750 amperes, brushes 20 and 21 both rest on segment 26 only. Therefore, when brushes 20 and 21 both rest on the segment 25, which position they assume when the load is approximately 2500 amperes, relay 29 is energized by current flowing from source 10 through continuous contact 27, brush 22, brushes 20 and 21, segment 25, winding of relay 29 to ground. With brushes 20 and 21 in a position corresponding to 3000 amperes, the circuit of relay 30 is similarly closed through segment 26 by brush 21, while relay 29 remains energized since brush 20 remains in contact with segment 25.

The armatures of relays 27', 28, 29 and 30

are connected to successive segments 31, 32, 33 and 34 of a rotary transmitting distributor 35. The corresponding rotary receiving distributor 36 is located at the central station A and its segments 37, 38, 39 and 40 corresponding to segments 31, 32, 33 and 34, respectively, of transmitter 35 are connected to polarized relays 41, 42, 43, and 44 respectively.

Each of relays 27', 28, 29 and 30 is provided with a back contact and a front contact. All of the back contacts are connected with a suitable source of positive current and all of the front contacts are connected with a suitable source of negative current.

Rotary distributors 35 and 36 are operated in synchronism and current impulses are transmitted over line 1 from the contacts of relays 27', 28, 29 and 30 to energize polarized relays 41, 42, 43 and 44, respectively. These impulses will be either positive or negative depending upon whether the relays at the remote station B are energized or not.

Rotary distributors 35 and 36 are operated in the manner described in application Serial No. 508,443, filed by Joseph C. Field, October 18, 1921, Patent No. 1,562,211, Nov. 17, 1925, and the invention of this application is especially adapted to be used in connection with the system there disclosed. As described in that application, there is provided a pair of rotary distributors 45 and 46, which operate to release the set comprising the transmitter 35 and receiver 36, which in turn operate to release the transmitter 45 and receiver 46. The brush arm of each of the distributors, which is frictionally mounted on a continuously rotating shaft, is adapted to be arrested periodically and then released automatically through the instrumentality of the other distributor. Each of the distributors is arranged to have its brush arm stopped once per revolution and then released automatically by the brush arm over the segments to which the release magnet of the other distributor is connected, thereby causing the brush arm thereof to be released. In the normal operation of the system, the brush arm of each of the distributors is arrested periodically and subsequently released by the other distributor located at the same station, thus providing a continuously operating system. When the distributors are in the position shown in Fig. 1, this releasing operation is performed through a circuit which includes a source of current, releasing magnet 47, conductor 48, segment 49, brush arm 50, and segment 51 of the receiver 36, conductor 52, segment 53, brush arm 54, and collector ring 68 of transmitter 45, conductor 55, line 1, conductor 56, collector ring 57, brush arm 58 and segment 59 of transmitter 35, conductor 60, segment 61, brush arm 62, seg-

ment 63 and release magnet 64 of receiver 46 to ground. Release magnets 47 and 64 release brush arms 54 and 62, respectively, of the set comprising transmitter 45 and receiver 46 and they rotate synchronously. When brush arms 54 and 62 have nearly completed one revolution, they complete a circuit as follows: from a suitable source of current through release magnet 65 of receiver 36, conductor 66, segment 67, brush arm 54, and collector ring 68 of transmitter 45, conductor 55, line 1, conductor 69, collector ring 70, brush arm 62 and segment 71 of the receiver 46, conductor 72 and release magnet 73 of transmitter 35, to ground. Release magnets 65 and 73 then release brush arms 50 and 58, respectively, of receiver 36 and transmitter 35, respectively.

For convenience, the contacts of the relays at station A will be referred to as upper and lower contacts as they appear in the drawing.

Associated with polarized relays 41, 42, 43 and 44 are relays 74, 75, 76 and 77, which are provided for the purpose of interpreting the resulting energization of the polarized relays. The resistance of resistance element 79 is such that when a circuit of the ammeter 80 is closed therethrough, the ammeter will indicate a current of 500 amperes. Suitable taps are provided at intervals on resistance element 79 and when the circuit is completed through the successive taps, the resistance of the circuit of the ammeter 80 varies to give successive current readings, which correspond to those indicated at positions of the successive segments 23, 24, 25, 26, etc. By the circuits as above described, when brushes 20 and 21 bridge two commutator segments, such as 25 and 26, at which position there is a current load of approximately 3,000 amperes on bus bars 2, negative current is supplied through the front contacts of relays 29 and 30, through segments 33 and 34 of rotary distributor 35, brush arm 58, collector ring 57, line conductor 1, collector ring of distributor 36, brush 50, segments 39 and 40, polarized relays 43 and 44 to ground to cause polarized relays 43 and 44 to engage their armatures with their associated lower contacts. With the armatures of polarized relays 43 and 44 in these positions, relays 76 and 77 are both energized. A circuit is then established from source of current 81 through ammeter 80, resistance element 79 to the tap corresponding to the 3,000 ampere load, lower contact of relay 76, upper contact of relay 77, armature of polarized relay 300 to ground. Ammeter 80 then indicates a load of 3,000 amperes on bus bars 2. When brushes 20 and 21 both rest on a single commutator segment, for example 24, relay 28 operates and negative current impulses are sent through its front contact to energize

polarized relay 42 alone. Under these conditions, relay 75 alone is energized. Current then flows from source of battery 81 through ammeter 80, resistance element 79 to the tap corresponding to 1500 amperes, back lower contact of relay 74, upper contact of relay 75, armature of polarized relay 43 to ground. Similar circuits are established when the brushes 20 and 21 are in various positions on the commutator bars 23, 24, 25, 26, to vary the resistance of the circuit of ammeter 80 by completing its circuit through the various taps of the resistance element 79. The polarized relays 41 to 44 are of the two-position type which remain in the position last operated until again energized by a current of opposite polarity, as indicated diagrammatically by the spring latches associated with the armatures of these relays.

In Fig. 2 a simplified form of indicating apparatus is employed at the central station, in which polarized relays 41, 42, 43 and 44 operate as before under the influence of impulses controlled by the relays 27', 28, 29 and 30. When none of the relays 27', 28, 29 or 30 are energized, a relay 82 remains deenergized and in this position a circuit from a source of current 83 is completed through the armature of relay 82 and a lamp 84 to ground. The illumination of lamp 84 indicates a condition of no load on bus bars 2. When relay 41 is energized by current of negative polarity under the control of relay 27' its upper contacts close a circuit from a source of current 85, relay winding 82, a lamp 86, upper contact of polarized relay 41, to ground, lighting lamp 86 and indicating a current load of 500 amperes. The circuit of lamp 84 is then interrupted.

At a current load of 3000 amperes relays 29 and 30 both operate as before described, causing polarized relays 43 and 44 to be energized with current of negative polarity, thus closing their upper contacts. In this position, lamps 88 and 89 are lighted through completion of their circuits at the upper contacts of polarized relays 43 and 44, respectively. The lighting of both lamps 88 and 89 indicates a load of 3000 amperes on bus bars 2. Similarly, the lighting of lamps 87 and 88 together indicates a load of 2000 amperes, lamp 88 alone, a load of 2500 amperes, lamp 89 alone, a load of 3500 amperes, etc.

Fig. 3 shows a modification of Fig. 2, wherein an ammeter is employed instead of lamps as an indicating means. As before, polarized relays 41, 42, 43 and 44 are controlled by the relays 27', 28, 29 and 30, respectively, at the remote station. There is an ammeter 90 provided, having a circuit including a source of current 91 and a resistance element 92, having taps at various

points similar to resistance element 79 of Fig. 1. When relays 27', 28, 29 and 30 stand unoperated, polarized relays 41, 42, 43 and 44 are energized by positive impulses from the back contacts of relays 27', 28, 29 and 30 transmitted by rotary distributors 35 and 36, and in this position the circuit of the ammeter 90 includes the front inner contacts of relays 42, 43 and 44 and stands open at the inner back contact of relay 41. When relay 41 is operated by a negative impulse under the influence of relay 27', its armature closes this circuit, which then includes all of the resistance of element 92. The second tap on the resistance element 92 is connected through the outer front contact of relay 41 to the inner back contact of relay 42, so that when relay 42 alone is energized by negative current, the circuit of ammeter 90 is closed through this tap, to indicate a current load of 1500 amperes. Similarly the circuit of ammeter 90 is closed through the fourth and sixth taps when relays 43 and 44, respectively are operated alone by negative current impulses. When two relays are simultaneously operated, such as 43 and 44, circuits are established as shown in the drawing. In such case, the circuit of ammeter 90 is closed through the inner back contact of relay 44 and outer back contact of relay 43 connected with the sixth tap on the resistance element 92, reducing the resistance of the ammeter circuit to indicate a current of 3000 amperes. Other taps of resistance element 92 are connected in circuit with ammeter 90 in a similar manner upon operation of the other polarized relays. The arrangement of Fig. 3 is somewhat simpler than that of Fig. 1 in that the use of the relays 74, 75, 76 and 77 is eliminated.

In the modification shown in Fig. 4, the threaded member 12 carries two brushes 93 and 94. Brush 93 contacts with successive segments 23, 24, 25, 26, etc. while brush 94 is adapted to pass over segments 95, 96, 97, etc. the alternate ones of which are connected with a source of positive current, the others being connected with a source of negative current. Segments 95, 96 and 97 are smaller than 23, 24, 25 and 26, there being two of the former to each one of the latter. As brushes 93 and 94 pass over their respective segments, segments 23, 24, 25 and 26 will be alternately connected with the source of positive current, and the source of negative current, depending upon the position of brush 94. Commutator segments 23, 24, 25 and 26 are connected directly to the segments 31, 32, 33, 34 of transmitting distributor 35 respectively, and current impulses are transmitted over the line 1, to the corresponding segments of the receiving distributor 36. Segments 37, 38, 39 and 40 are connected directly to polarized relays 98, 99, 100 and 101, respectively. With each of the polar-

ized relays 98, 99, 100 and 101 are associated two quick-operating, slow-release relays. Relay 98 is provided with a relay 102 which operates upon the energization of relay 98 by positive current, and a relay 103, which it operates when energized by negative current. Polarized relays 99, 100 and 101 similarly operate the relays 104 and 105, 106, and 107, 108 and 109, respectively. Relays 102, 103, 104, 105, 106, 107, 108, 109 are adapted to close through their contacts the circuits of lamps 110, 111, 112, 113, 114, 115, 116 and 117, respectively. A common lead from a source of current 118 supplies current to light these lamps. When any one of the said lamps are lit, current energizes a relay 119, which is in circuit therewith causing the circuit of a lamp 120 to open at the back contact of relay 119. Lamp 120 is lit, therefore, when relay 119 is deenergized, at which time the current load on bus bars 2 is zero.

As threaded member 12 passes downwardly, brush 94 successively contacts with the segments 95, 96, 97, etc. and connects the segments 23, 24, 25 and 26 each with a source of positive current and then with a source of negative current. Relays 98, 99, 100 and 101 operate correspondingly, causing the lamps 110, 111, 112, 113, 114, 115, 116 and 117 to light successively.

Transmitting distributor 45 and receiving distributor 46 are used for the purpose of controlling power switches at station B from station A. One such switch 200 is here shown, which is adapted to connect a current source 201 with bus bars 2. Switch 200 is controlled by a polarized relay 202 associated with a segment 203 of receiver 46. Current to energize polarized relay 202 is supplied through segment 204 from a switch 205, having alternate contacts connected with sources of positive and negative current.

Another switch 205' which is similar to switch 205, is associated with segments 204' of transmitter 45 and segment 203' of receiver 46 to control polarized relay 202', which in turn controls the connection of another source of current (not shown) to bus bars 2. If desired, the sources of current 201 and others similar thereto (not shown) may be automatically connected and disconnected to bus bars 2 in the manner disclosed in my copending application Serial No. 519,161, filed Dec. 1, 1921. When employed in connection with the system disclosed in that application, this system has special utility since the operator may connect and disconnect additional sources of current, regardless of the automatic controlling devices depending upon the current load as indicated to him by the means above described. In such systems there are usually a great number of devices to be controlled,

each of which requires one or more segments of the distributors allotted to their sole use. The number of segments which a rotary distributor may have, is necessarily somewhat limited, and, therefore, it is desirable to economize by employing as few as possible for any one purpose. In the various arrangements of the invention, as above described, for every segment employed there are two signals provided, thereby doubling the capacity of the system.

What is claimed is:

1. In an electrical switching system, a control station and a remote station, an indicating device at the remote station, a plurality of relays at said remote station selectively actuated upon the actuation of said device, a pair of synchronized distributors, one at each station, a circuit connecting the same, said relays upon actuation impressing current of a definite polarity upon the corresponding segments of the distributor at the remote station, said current being transmitted to the corresponding segments of the distributor at said control station, a plurality of polarized relays at said control station associated with the distributor thereat, said polarized relays being selectively actuated in accordance with the current applied to the segments of said control station distributor, a meter, a series of resistances associated therewith, a series of relays selectively actuated by said polarized relays to variably connect said resistances to said meter to indicate the action of said device at the remote station.

2. In an indicating system, a control station and a remote station, an indicating device at the remote station, movable contact arms actuated thereby, commutating segments with which said contact arms make

contact, relays connected to said segments, synchronous rotary distributors, one at each station, a circuit connecting the same, said contact arms in conjunction with said commutating segments controlling the energization of said relays in groups to impress current on the corresponding segments of said distributors, relays at the control station associated with the distributor thereat actuated in accordance with the current impressed on the segments of said control station distributors, and means controlled by said relays to indicate at the control station the condition of the indicating device at said remote station.

3. In an indicating system, a control station and a remote station, an indicating device at the remote station, movable contact arms actuated thereby, commutating segments with which said contact arms make contact, relays connected to said segments, synchronous rotary distributors, one at each station, a circuit connecting the same, said contact arms in conjunction with said commutating segments controlling the energization of said relays in groups to impress current on the corresponding groups of segments of said distributors, relays at the control station associated with the distributor thereat actuated in groups in accordance with the current impressed on the groups of segments of said control station distributor, and means controlled by said latter relays to indicate at the control station the condition of the indicating device at said remote station.

In witness whereof, I hereunto subscribe my name this 30th day of December A. D., 1921.

JOHN B. HARLOW.