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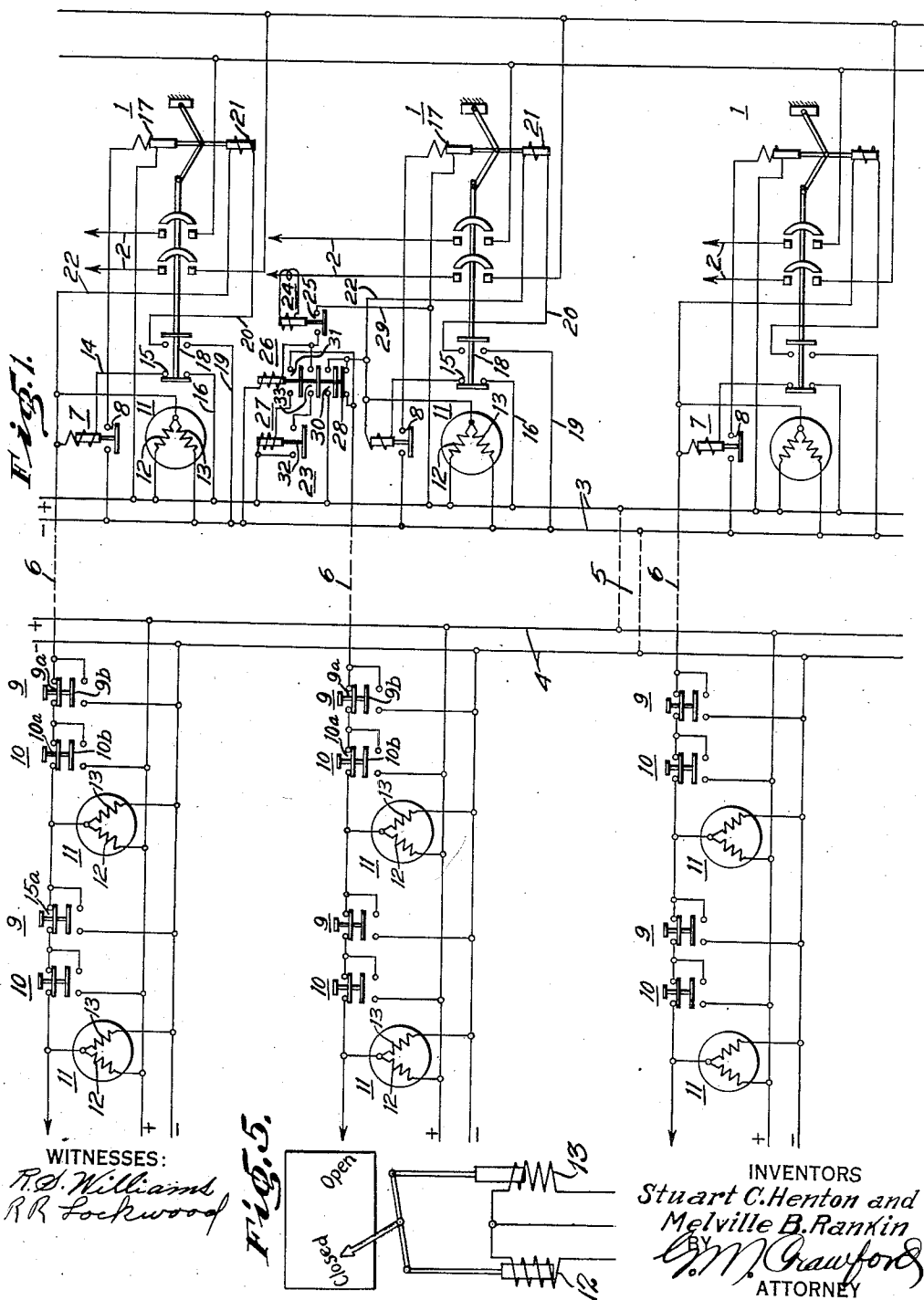
S. C. HENTON ET AL

2,003,047

CONTROL SYSTEM

Filed June 9, 1932

4 Sheets-Sheet 1



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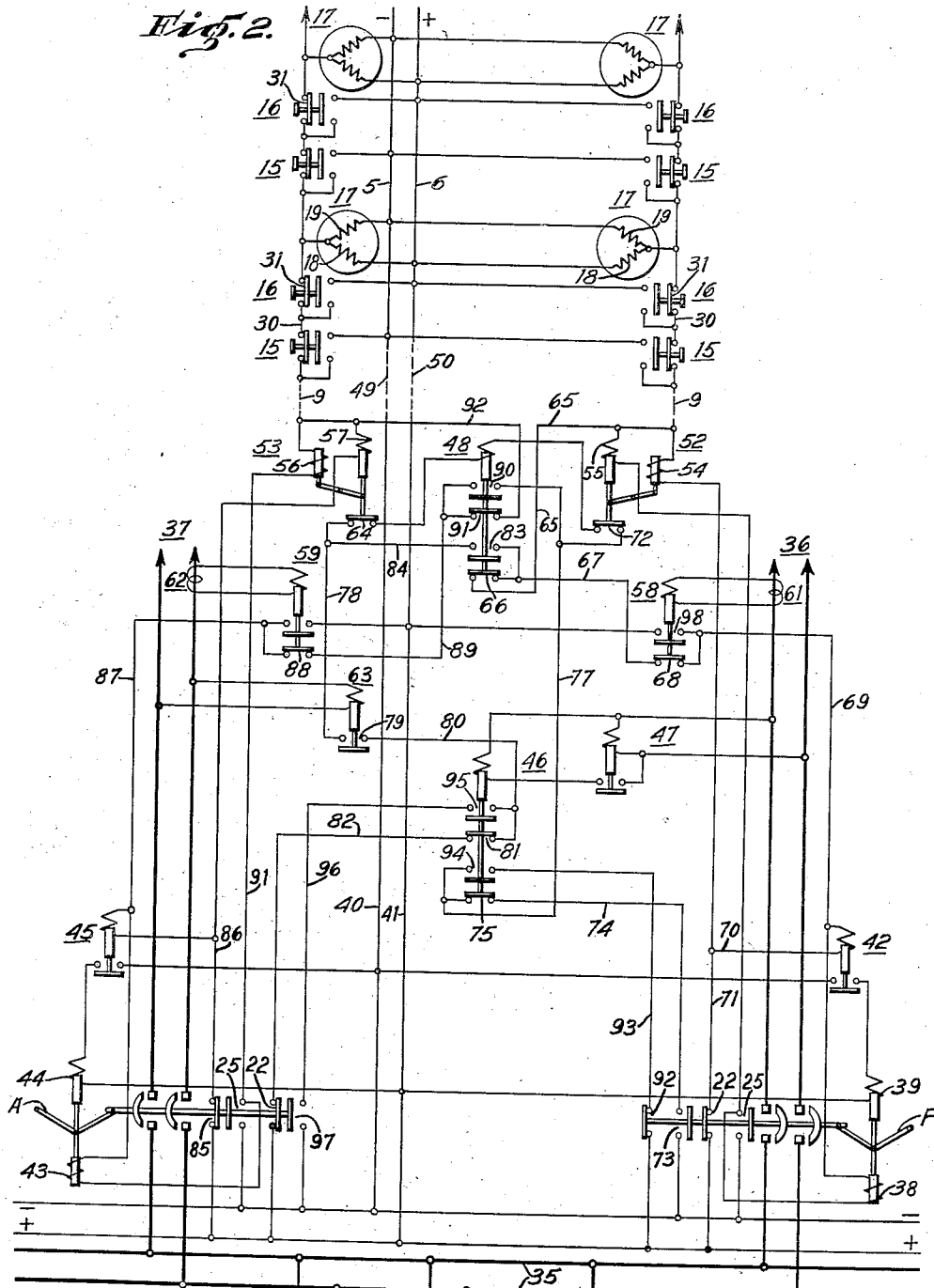
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2,003,047

CONTROL SYSTEM

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4 Sheets-Sheet 2



WITNESSES:
R. S. Williams
R. R. Lockwood

Main
Power
Bus

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May 28, 1935.

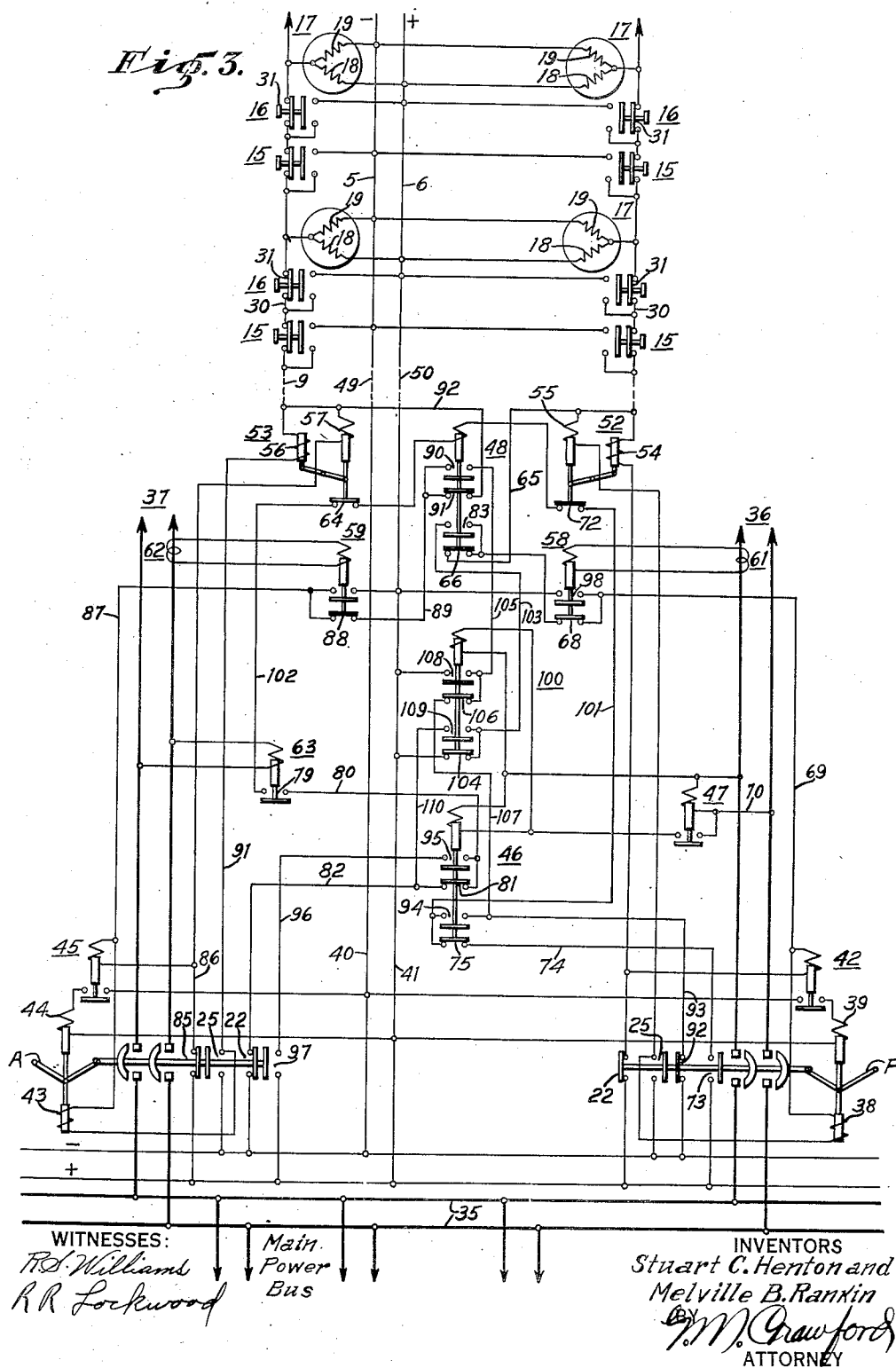
S. C. HENTON ET AL

2,003,047

CONTROL SYSTEM

Filed June 9, 1932

4 Sheets-Sheet 3



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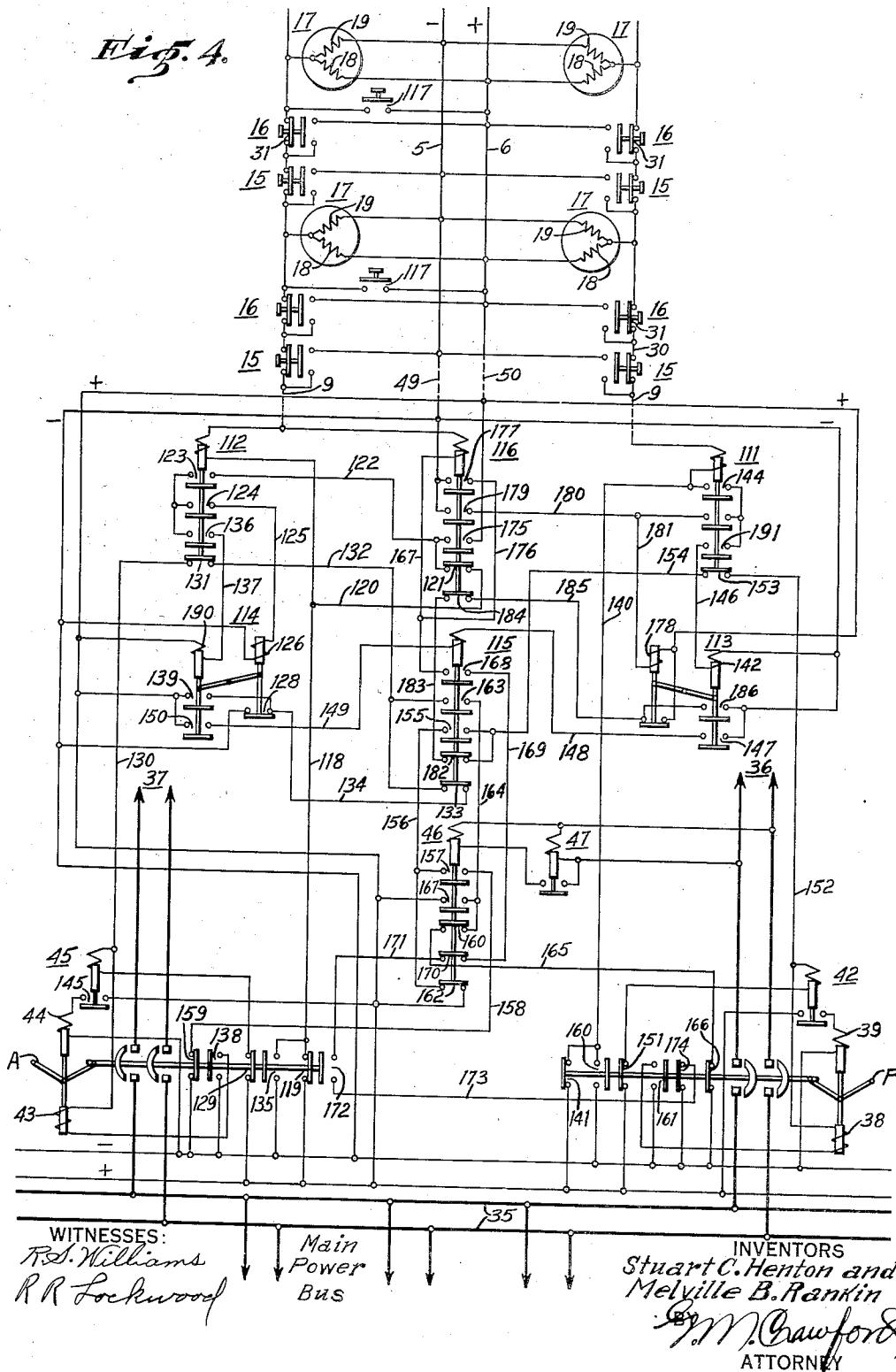
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CONTROL SYSTEM

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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,003,047

CONTROL SYSTEM

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Application June 9, 1932, Serial No. 616,279½

9 Claims. (Cl. 177-311)

Our invention relates, generally, to electrical control systems and it has particular relation to systems for controlling and supervising the operation of electric circuit breakers located at a remote point.

In the past, when it has been desired to control the operation of a limited number of circuit breakers or other apparatus units, located at a point remote from the control station or office where an operator is located, it has been necessary in most instances to use one of the various kinds of supervisory control systems for effecting the continuous supervision and control of the circuit breakers. These systems are, as a general rule quite complicated and expensive to install and maintain in efficient operating condition. Consequently, the expense involved in using such a system is prohibitive in many instances where it is necessary to reduce operating and installation costs to a minimum.

If the usual supervisory control systems are not used, it has been necessary to use expensive polarized relays or to use several conductors between the office and the remote point for controlling and supervising each circuit breaker or apparatus unit.

All of these systems have the very serious objection that they are expensive to install, either because of the comparatively large quantity of complicated apparatus necessary for their successful operation, or because of the large number of conductors which must be run between the control office and the sub-station for effecting the desired control and supervision of the apparatus units.

It is, therefore, an object of our invention to provide a remote control system which shall be simple and efficient in operation and which may be readily and economically manufactured and installed.

It is also an object of our invention to provide for controlling the operation of a circuit breaker or other apparatus unit at a remote point by applying different polarities to a single control conductor.

A more specific object of our invention is to provide for controlling and continuously supervising the operation of a circuit breaker located at a remote point over a single control conductor.

Another object of our invention is to provide for automatically transferring a main power bus from one source of supply to another in the event that one of the sources of supply should fail.

Still another object of our invention is to pro-

vide for controlling, over a pair of conductors, the operation and supervision of remotely located circuit breakers which are arranged to automatically transfer a power bus from one source of supply to another in the event that one of the sources of supply should fail.

Another object of our invention is the provision of a system of the above character which operates on opposite polarities without the use of polarized relays the operation of which is unaffected in the event of a single incidental ground at any point on the system or in the event of the reversal of polarity on common direct current supply bus.

Other objects of our invention will, in part be obvious and will, in part appear hereinafter.

The invention, accordingly is disclosed in the embodiment thereof shown in the accompanying drawings and comprises the combination of elements and arrangement of parts that will be exemplified in the embodiment hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view of a remote control system showing a plurality of circuit breakers each of which may be controlled and supervised at a distance over a single control conductor.

Fig. 2 is a diagrammatic view of a remote control system showing a preferred and an auxiliary circuit breaker, together with suitable control apparatus for automatically transferring a main power bus from one source of supply to another in the event that one of the sources of supply should fail, and

Figs 3 and 4 are modifications of the system shown in Fig. 2.

Fig. 5 illustrates, in detail, the construction of the position indicators which may be used for indicating the condition of the circuit breakers.

In order to effect the control and supervision of remotely disposed circuit breakers according to this invention, it is only necessary to provide a common direct-current control bus connecting the sub-station and the office and to supply a single control conductor for each circuit breaker which it is desired to control and supervise.

In order to close a circuit breaker at the sub-station, a negative potential is applied to the con-

trol conductor by means of a suitable control switch, which causes a circuit breaker closing relay to be energized through a closed auxiliary contact on the circuit breaker. The breaker closing relay causes the closing coil of the circuit breaker to be energized which, in turn, operates the circuit breaker to the closed position, and, at the same time, opens the circuit for the breaker closing relay and closes a second circuit in series with the trip coil of the circuit breaker to the control conductor.

In order to indicate the position to which the circuit breaker has been operated, an operation indicator is provided which comprises two windings that are connected together at one end and to the control conductor, the other ends of which are, respectively, connected to the positive and negative control buses. When either of the windings is energized, a color indicator is moved in accordance with the coil which has been energized to indicate the last operation of the breaker. The resistance of the coils of the indicator is relatively high and therefore, they require only a very small amount of current for operation.

When a negative potential is applied to the trip coil on closure of the circuit breaker, the negative potential is also applied to the control conductor. The coil in the position indicator, which is connected to the positive control bus, will then be energized and the corresponding indication of the last operation of the circuit breaker will be obtained. It should be noted, however, that while sufficient current is caused to flow through the indicator to perform the desired indicating operation, this current is not sufficiently large to cause the trip coil to be energized to such an extent as to trip the closed breaker.

When it is desired to open the circuit breaker, it is only necessary to apply a positive potential to the control conductor through the operation of a suitable control switch which energizes the trip coil through auxiliary contact members on the circuit breaker.

When the breaker opens positive potential is applied to the control conductor which will cause the coil in the position indicator that is connected to the negative bus at the office to be energized, thereby operating the indicator to show that the circuit breaker has been opened.

In order to prevent a pumping action on the part of a circuit breaker in the event that it is closed on a fault, a relay system is provided whereby the closing mechanism for the circuit breaker cannot be energized more than once for a single operation of the closing control switch. The relay system is arranged to open the control conductor in the event of a fault to necessitate the return of the close control switch to the "off" position before a subsequent closing operation can be performed.

For a more detailed description of the operation of the above-described system, reference may be had to Fig. 1 of the drawings, in which the numeral 1 indicates a plurality of circuit breakers which are to be controlled in accordance with this invention. As shown in this figure, several circuit breakers may be connected to a common power bus and may be arranged to supply power to any circuits, as may be desired through conductors 2. Since the control circuits and equipment may be in duplicate for each circuit, the same numerals and description will be applicable to each of the circuit breakers shown. It will also be apparent that as many units may

be added as required merely by increasing the number of control units.

In order to supply suitable control current for operating the system, positive and negative control buses comprising conductors 3 at the sub-station and 4 at the office are connected to suitable sources of direct-current. These control buses are connected together by means of conductors 5 which extend as indicated from the office to the sub-station and thus provide a common direct-current control bus.

The only other conductors which connect the office with the sub-station are the single control conductors 6, each of which is associated at the office end with its particular control equipment and at the sub-station end with a circuit breaker and its associated control equipment.

With a view to obviating the necessity for supplying the energizing currents for the closing coils of the circuit breakers over the control conductors 6, auxiliary relays 7 are provided which are so constructed as to hold their contact members 8 closed for an appreciable time after their operating coils have been de-energized.

Closing and tripping operations of the circuit breakers may be effected from the office end by means of suitable control switches 9 and 10, respectively, which are operable to connect the control conductors 6 either to the positive or the negative control bus, depending on whether it is desired to open or close a circuit breaker. As illustrated, the control switches are of the push-button type having normally closed contact members 9a and 10a and normally open contact members 9b and 10b, respectively.

It is to be understood, however, that any other suitable type control switch may be used or a single switch may be used which may be operated to one position to close a breaker and to another position to open the breaker and having a normally closed operating position thereby performing the same function as the normally closed contact members 9a and 10a illustrated.

The position of the circuit breakers is indicated at the office or at any other point by means of position indicators 11 each of which is provided with two operating windings 12 and 13. As shown, winding 12 is connected between the positive control bus and the control conductor 6 while winding 13 is connected between the negative control bus and the control conductor 6. Consequently when a positive potential is impressed upon the control conductor 6, the winding 13 is energized and operates the indicator to one position while if the control conductor 6 is energized with a negative potential the winding 12 is energized to operate the indicator to a different position.

As shown, two complete office control stations are provided each comprising a close switch 9, a trip switch 10 and a position indicator 11 although it is to be understood that only one control station may be used or as many as is desired, since the operation of any switch 9 will close the circuit breaker associated therewith or the operation of any switch 10, will open it.

When it is desired to close a circuit breaker it is only necessary to depress the closing switch 9, thereby applying a negative potential to the control conductor 6 and causing the energization of the circuit breaker relay 7, over a circuit which may be traced from energized conductor 6, through the actuating coil of relay 7, conductor 14, auxiliary contact members 15 of the circuit

breaker 1 and through conductor 16 to the positive side of the control bus 3. The energization of relay 7 causes contact member 8 to be bridged, thereby completing an obvious energizing circuit for the closing coil 17 of the circuit breaker.

The closing of the circuit breaker 1 causes its contact members 15 to be opened and contact members 18, to be closed, thereby applying a negative potential from the control bus 3 through conductor 19, contact members 18, conductor 20, trip coil 21 of the circuit breaker 1, conductor 22 to the control conductor 6. When the control switch 9 is released, a circuit is completed from the energized control conductor 6, through contact members 9a and 10a and coil 12 of the position indicators at each station to the positive bus thereby operating the indicators 11 to show that the breaker has been closed.

When it is desired to open the circuit breaker 1, the trip switch 10 is operated, thereby energizing the trip coil 21 over a circuit which may be traced from the positive side of the control bus 4 to the control wire 6 and through conductor 22 to the trip coil 21 of the circuit breaker 1, thence through conductor 20, contact members 18, and conductor 19 to the negative side of the control bus 3. The circuit breaker 1 is then opened and the contact members 15 located thereon, are bridged, thereby applying positive potential from the positive side of the control bus 3 through conductor 16, contact members 15, conductor 14, winding of relay 7, control conductor 6 to the coils 13 of the position indicators 11 through the normally closed contact members 9a and 10a of the control switches. The positive potential thus applied to the windings 13 of the position indicators causes them to be operated to indicate that the circuit breaker 1 has opened.

Since the position indicators 11 require but a small amount of current for their operation, it will be observed that several of these indicators may be applied, where desired, at various points along the control system. As shown, a position indicator is also provided at the sub-station in addition to the two at the control end in order that an attendant may ascertain the position of the circuit breaker without actually inspecting it.

As many circuit breakers as are desired may be added at the sub-station. For each additional circuit breaker, it will only be necessary to supply one additional conductor between the circuit breaker and the office for effecting both the control and the supervision since the conductors 5 serve to connect the control buses for any number of circuit breakers.

In the event that it is desired to provide for preventing more than a single operation of one of the circuit breakers when the close control switch associated therewith is operated, the trip free relay system, shown generally at 23, may be employed. While the relay system 23 is shown in connection with the middle circuit breaker control unit, it will be readily understood that it may be used in conjunction with either of the other units shown or in conjunction with the systems which will be described hereinafter.

The relay system 23 may comprise a current overload protective relay 24 whose contact members 25 are closed when a predetermined current flows in the conductors 2. In addition to the protective relay 24, a control relay 26 and a lock-out relay 27 are also provided.

The only change involved over the control system described hereinbefore is the connecting of the control conductor 6 through the normally

closed contact members 28 of the relay 26. Under normal operating conditions, the functioning of the control unit with the relay system 23 applied thereto is the same as described above. However, in the event that there is a fault on the conductors 2, the operation will be different and it is described as follows:

Referring now particularly to the middle circuit breaker control unit of Fig. 1 and assuming that negative potential has been applied to the control conductor 6 by the operation of the close control switch 9, the relay 7 will be energized, as hereinbefore set forth, through the closed contact members 28 of the control relay 26, thereby energizing the closing coil 17 and closing the circuit breaker 1.

If there is a fault on the conductors 2, the current overload relay 24 will be energized sufficiently to cause its contact members 25 to close. The energization of relay 24 will complete a circuit for energizing relay 26 which may be traced from the negative side of the control bus 3, winding of relay 26, contact members 25 of relay 24 and conductor 29 to the positive side of the control bus 3.

The energization of relay 26 opens the control conductor 6 at the contact members 29 and completes a circuit for immediately tripping the circuit breaker 1. It also completes a circuit for energizing the lock-out relay 27 and for holding itself closed until the control switch 9 is released.

The circuit for tripping the circuit breaker 1 may be traced from the positive side of the control bus 3, through closed contact members 30 of relay 26, conductor 22, trip coil 21, conductor 20, contact members 18 and conductor 19 to the negative side of the control bus 3.

The circuit for energizing the lockout relay 27 may be traced from the negatively energized control conductor 6, through contact members 31 of relay 26, and winding of relay 27 to the positive side of the control bus 3.

The energization of relay 27 completes a circuit for holding energized the control relay 26 which may be traced from the positive side of the control bus 3 through contact members 32 of relay 27 and contact members 33 of relay 26, and winding of relay 26 to the negative side of the control bus 3.

As long as the control switch 9 remains closed, the relays 26 and 27 will remain energized and no further operation of the circuit breaker 1 can take place until the control switch 9 is released and again closed.

When it is desired to insure that power will be supplied to a customer, it is the usual practice to provide for supplying the power not only from a single preferred feeder circuit but also from a second or auxiliary feeder circuit. It is then desirable to provide for automatically transferring the customer from the preferred circuit to the auxiliary circuit in the event that the power supply should fail on the former circuit. At such time when the power is again applied to the preferred circuit it is desirable to transfer the load back to this circuit automatically.

In a system of this type, provision is made for indicating to an operator at a central control point or office which circuit is supplying power to a customer and, further, provision is made to enable him to control either of the supply circuits so that he may parallel them in some cases, or so that he may cause the auxiliary circuit to be continually the source of power for the customer rather than the preferred circuit.

According to this invention we have provided for securing these desired results by the provision of the remote control system shown in Fig. 2.

This system comprises a main power bus 35 which may be fed either from a preferred feeder circuit 36 or from an auxiliary feeder circuit 37. The preferred feeder circuit 36 is connected to the main power bus 35 through conductors 40 and 41 of the control bus at the substation and conductors 5 and 6 at the office by means of conductors 49 and 50 and control a preferred circuit breaker P, while the auxiliary feeder circuit 37 is connected to the main power bus 35 by means of an auxiliary circuit breaker A.

The preferred circuit breaker P is provided with a trip coil 38 which is disposed to be energized directly from the control circuit and a closing coil 39 which is disposed to be energized from a control bus, comprising conductors 40 and 41, upon the operation of a circuit breaker closing relay 42. In like manner the auxiliary circuit breaker A is provided with a trip coil 43 and a closing coil 44 which is disposed to be energized on operation of a circuit breaker closing relay 45.

The circuit breaker closing relays 42 and 45 are of any suitable type that will remain in the closed position for a short interval after their operating coils have been deenergized. Power may then be applied to the closing coils 39 and 44 for a sufficient length of time to insure that the respective circuit breakers P and A have closed.

In the event that the power supply to the preferred feeder circuit 36 should fail, an actuating relay 46, which has previously been energized on the operation of a voltage delay relay 47, is deenergized thereby causing a transfer relay 48 to be energized. The energization of relay 48 simultaneously causes breaker P to be tripped and circuits to be completed which result in the operation of the auxiliary circuit breaker A to the closed position.

The circuit breakers P and A may be controlled and supervised from the office by the operator in the manner set forth hereinbefore in connection with Fig. 1. As described hereinbefore, as many control points may be provided as are desired by the addition of the necessary number of close and trip switches 15 and 16, respectively. In like manner additional position indicators 17 may also be provided. Suitable connections are made between the office and the circuit breakers by means of conductor 9 provided for each circuit breaker.

With a view to preventing the automatic operation of the transfer relay 48, at the will of the operator, locking relays 52 and 53 are provided. It will be observed when relay 48 is de-energized, that lock-in coil 54 of relay 52 is connected in shunt-circuit relation with the actuating coil of relay 42 while the lock-out coil 55 of relay 52 is connected in shunt-circuit relation with the trip coil 38 of circuit breaker P. It will also be observed, when relay 48 is de-energized, that the lock-in coil 56 of relay 53 is connected in shunt circuit relation with the trip coil 43 of the auxiliary circuit breaker A while the lock-out coil 57 of relay 53 is connected in shunt-circuit relation with the actuating coil of relay 45.

When the operator at the office causes the circuit breaker P to be tripped, the lock-out coil 55 of relay 52 will be energized thereby preventing the energization of relay 48 and the subsequent automatic operation of the auxiliary circuit breaker A. In like manner, when the operator at the office causes the auxiliary circuit breaker A to be operated, the lock-out coil 57 of relay

53 is energized thereby preventing the automatic transfer to the preferred circuit. In order to restore the system for automatic operation, it is necessary for the operator to open the auxiliary circuit breaker A and to close the preferred circuit breaker P. The system will then be so arranged as to automatically transfer from the preferred feeder circuit 36 to the auxiliary feeder circuit 37 when the power is lost on the former and to automatically return to the preferred circuit on return of power thereto.

The voltage delay relay 47 is of the type which is disposed to operate to bridge its contacts a predetermined length of time after power has been applied to the preferred feeder circuit 36. This time delay is desirable in order to insure that the power has been definitely returned to the preferred circuit. The danger of initiating the automatic operation of the system back to the preferred feeder circuit on a return of power thereto for a very short period of time is thus eliminated.

In order to protect the system in the event that a fault should occur, current overload relays 58 and 59 are provided which may be of any well known type suitable for this purpose and are disposed to be connected to the feeder circuits 36 and 37, respectively, by means of current transformers 61 and 62.

In order to prevent an automatic transfer to the auxiliary feeder circuit 37 should it not be energized when power is lost on the preferred circuit 36, an under-voltage relay 63 is provided. This relay is provided with contact members connected in the energizing circuit for the transfer relay 48 which are closed when power is applied to the auxiliary circuit to render the transfer relay 48 operable and are open when the auxiliary circuit is deenergized thereby preventing operation of the transfer relay 48.

With a view to more fully describing the nature of the remote control and automatic changeover system shown in Fig. 2 of the drawings, a detailed description of its function and operation will be given. It will be assumed that power is applied to both the preferred feeder circuit 36 and to the auxiliary feeder circuit 37. It will also be assumed that the lock-in coil 56 of the locking relay 53 has been energized by some previous operation so that the contact members 64 of this relay are bridged.

When the close switch 15 associated with the preferred feeder circuit at the control station is depressed by the operator, a negative potential is applied from the control bus conductor 9, conductor 65, through contact members 66 of the transfer relay 48, conductor 67, lower contact members 68 of overload relay 58, conductor 69, the actuating coil of the circuit breaker-closing relay 42, conductors 70 and 71, and auxiliary contact members 22 on the preferred circuit breaker P to the positive control bus. The circuit breaker-closing relay 42 will then be energized and in turn the closing coil 39 of the preferred circuit breaker P will be energized over an obvious circuit, thereby causing the circuit breaker P to be actuated to the closed position.

At the same time that the actuating coil of the relay 42 is energized it will be observed that the lock-in coil 54 of relay 52 is also energized since it is in shunt circuit relation with this coil as hereinbefore set forth. The energization of the lock-in coil 54 insures that contact members 72 of the locking relay 52 will be closed so

that the system will be arranged or set up for automatic change-over operation.

Upon closure of the circuit breaker P, auxiliary contact members 25 of the circuit breaker will be bridged, thereby applying negative potential from the control bus to the trip coil 38 of this circuit breaker and back over the circuit previously traced, in connection with the energization of the actuating coil of relay 42, to the operation indicator 17 at the office where the coil 18 of the indicator will be energized, thereby indicating to the operator that the circuit breaker P is now in the closed position.

If for some reason the power fails on the preferred feeder circuit 36, the voltage-delay relay 47 and the actuating relay 46 will immediately become de-energized. A circuit will then be set up for energizing the transfer relay 48 which may be traced from the negative control bus through the bridged contact members 73 of the circuit breaker P, conductor 74, contact members 75 of the actuating relay 46, conductor 77, contact members 72, the operating coil of relay 48, contact members 64 of relay 53, conductor 78, bridged contact members 79 of the under-voltage relay 63, conductor 80, contact members 81, conductor 82 and bridged contact members 22 of circuit breaker A to the positive control bus.

The transfer relay 48 is thus energized and operates to complete a trip circuit for the preferred circuit breaker P which may be traced from the negative control bus through bridged contact members 25 on the circuit breaker P, trip coil 38, conductor 69, contact members 68, conductor 67, contact members 83 of transfer relay 43, conductors 84 and 78, contact members 79, conductor 80, contact members 81, conductor 82, and contact members 22 of the auxiliary breaker A to the positive side of the control bus.

At the same time the operation of the transfer relay 48 effects the energization of the control relay 45 for auxiliary breaker A over a circuit which may be traced from the positive control bus, contact 35 of the auxiliary circuit breaker A, conductor 86, actuating coil of relay 45, conductor 27, contact members 88 of over-load relay 59, conductor 89, contact members 90 of the transfer relay 48, conductor 77, contact members 75, conductor 74 and contact members 73 on the preferred circuit breaker P to the negative control bus. The closing coil 44, of the auxiliary circuit breaker A, will then be energized with the result that this circuit breaker will be closed.

As soon as the circuit breaker P has been tripped, contact members 73 will be opened with the result that the transfer relay 48 will be de-energized. A circuit will then be established for transmitting the indication of the position of the auxiliary circuit breaker A to the office by means of a circuit which may be traced from the negative bus through contact members 25 on the auxiliary circuit breaker A, trip coil 43, conductor 87, contact members 88, conductor 89, contact members 91 of transfer relay 48, conductor 92, conductor 9, control switches 15 and 16, and coil 18 of position-indicator 17 to the positive control bus, thereby indicating that the auxiliary circuit breaker A has been operated to the closed position.

In the event that power is again applied to the preferred feeder circuit 36 the voltage-delay relay 47 will be energized and after a predetermined length of time its contact members will close to complete an obvious circuit for energizing the actuating relay 46. The transfer relay 48 will

then be energized over a circuit which may be traced from the positive control bus through contact members 92 of the preferred circuit breaker P, conductor 93, contact members 94 of the actuating relay 46, conductor 77, contact members 72, actuating coil of relay 43, contact members 64, conductor 78, contact members 79, conductor 80, contact members 95 of the actuating relay 46, conductor 96 and contact members 97 of the auxiliary circuit breaker A to the negative side of the control bus. The trip coil of circuit breaker A will then be energized over a circuit which may be traced from the negative side of the control bus, contact members 25 of the auxiliary circuit breaker A, trip coil 43, conductor 87, contact members 88, conductor 89, contact members 93, conductor 77, contact members 94, conductor 93 and contact members 92 to the positive side of the control bus.

At the same time the circuit breaker relay 42 will be energized over a circuit which has been traced hereinbefore.

Suitable indications will be given back to the office over circuits which have been traced hereinbefore.

In the event that the operator wishes to parallel the preferred circuit 36 with the auxiliary feeder circuit 37, the control switch 15 that is associated with the auxiliary breaker is depressed thereby causing the energization of relay 45 over a circuit which may be traced from the negative control bus at the office, conductors 9 and 92, contact members 91, conductor 89, contact members 88, conductor 87, actuating coil of relay 45, conductor 86, and contact members 85 to the positive side of the control bus. The auxiliary circuit breaker A will then be actuated to the closed position as hereinbefore described.

At the same time that the actuating coil of relay 45 is energized the lock-out coil 57, of the locking relay 53, is also energized over a circuit which extends from the energized conductor 9, through the lock-out coil 57, conductor 86, and contact members 85 to the positive control bus. Automatic change-over operation of the system will then be precluded until such time as the operator depresses the control switch 15 associated with the auxiliary circuit breaker A to actuate this circuit breaker to the open position.

In the event that an overload occurs on the preferred feeder circuit 36, the over-load relay 58 will be actuated and contact members 98 on this relay will be closed to establish a trip circuit for circuit breaker P which extends from the positive side of the control bus, contact members 98, conductor 69, trip coil 38, contact members 25 to the negative side of the control bus. The circuit breaker P will then be automatically opened, but since power is still applied to the preferred circuit and relays 46 and 47 are energized, no automatic transfer to the auxiliary feeder circuit will take place. In like manner, if power is being supplied over the auxiliary feeder circuit, the current overload relay 59 will serve to trip out the circuit breaker A in the event of an overload.

In order to insure that either the auxiliary circuit breaker A or the preferred circuit breaker P has been tripped prior to the closing of the other breaker, the system shown in Fig. 3 may be utilized. This system is identical with that shown in Fig. 2 with the exception that an interlocking relay 100 is added together with certain changes in the circuits by means of which automatic operation is effected. In addition, the

transfer relay 48 is arranged so as to remain in the energized position for a short interval of time after its actuating coil has been de-energized.

Briefly, the function of the interlocking relay 100 is to connect the trip coil of either circuit breaker directly to the positive potential rather than to necessitate the circuit being completed through the auxiliary contacts on the other circuit breaker. The actuating coil of relay 100 is connected in parallel-circuit relation with the actuating coil of relay 45 and is disposed to be energized in response to the operation of the under-voltage relay 47.

In describing the function of the interlocking relay 100, it will be assumed that the system has been operating with the preferred circuit breaker P closed and supplying power to the main power bus from the preferred feeder circuit 36. It will also be assumed that contact members 72 and 64 on relays 52 and 53, respectively, are closed and that the voltage relay 63 is energized from the auxiliary feeder circuit 37.

In the event of a power failure on the preferred feeder circuit 36, relays 46, 47 and 100 will be de-energized immediately. As a result of the de-energization of relay 46, the transfer relay 48 will be energized over a circuit which may be traced from the positive control bus through contact members 73 of the preferred circuit breaker P, conductor 74, contact members 75, conductor 101, contact members 72, actuating coil of relay 48, contact members 64, conductor 102, contact members 79, conductor 80, contact members 81, conductor 82 and contact members 22 to the negative side of the control bus.

The preferred circuit breaker P will then be automatically tripped over a circuit which may be traced from the negative control bus, contact members 25 of circuit breaker P, trip coil 38, conductor 69, contact members 68 and 83, conductor 103, contact members 104 of the interlocking relay 100, to the positive side of the control bus. In response to the opening of the preferred circuit breaker P a circuit will be completed for energizing the closing relay 45 to effect the closing of the auxiliary circuit breaker A.

The circuit for energizing relay 45 may be traced from the positive control bus, contact members 25 of the auxiliary circuit breaker A, conductor 86, actuating coil of relay 45, conductor 87, contact members 88, conductor 89, contact members 90 of the transfer relay 48, conductor 105, contact members 106, conductors 107 and 93 and contact members 92 which are closed when the preferred circuit breaker P is open, to the negative control bus.

It will be observed that the circuit for closing the auxiliary circuit breaker A is not completed until the preferred circuit breaker P has been opened and contact members 92 on this circuit breaker have been bridged.

The usual indications for showing that the preferred circuit breaker P has been opened and the auxiliary circuit breaker A has been closed will be transmitted back over the respective control circuits to the operation indicators 17 at the office, as hereinbefore described. The transfer relay 48 will also be de-energized because of the opening of contact members 73 of the preferred circuit breaker P.

In the event that power returns to the preferred feeder circuit 36, the main power bus will be automatically transferred from the auxiliary feeder circuit 37 back to the preferred feeder circuit 36. A predetermined time after power has

been returned to the preferred feeder circuit 36, the voltage delay relay 47 will be actuated to its closed position thereby energizing the actuating relay 45 and the interlocking relay 100.

As a result of the energization of the relay 46 the transfer relay 48 is energized over a circuit which may be traced from the positive control bus, contact members 97 of the auxiliary circuit breaker A, conductor 96, contact members 95, conductor 88, contact members 79, conductor 102, contact members 64, actuating coil of relay 48, contact members 72, conductor 101, contact members 84, conductor 93 and contact members 92 of the preferred circuit breaker P, to the negative control bus.

The closing of transfer relay 48 establishes a circuit for tripping the auxiliary circuit breaker A which may be traced from the negative control bus, through contact members 25 of the auxiliary circuit breaker A, trip coil 43, conductor 87, contact members 88, conductor 89, contact members 90, conductor 105, and contact members 108 of the interlocking relay 100 to the positive control bus.

When the circuit breaker A is tripped, a circuit is established for energizing the closing relay 42 associated with circuit breaker P, which may be traced from the positive control bus, contact members 22 of the preferred circuit breaker P, actuating coil of relay 42, conductor 69, contact members 68 and 83, conductor 103, contact members 109 of the interlocking relay 100, conductors 109 and 82, and contact members 22 of circuit breaker A to the negative control bus.

It will be again observed that it is necessary for the auxiliary circuit breaker A to be in the open position and for its contact members 22 to be bridged before the preferred circuit breaker P may be closed.

Referring now to Fig. 4 of the drawings, the electrical control system shown is especially adapted for automatic operation of the transfer feeder system in which it is desired to arrest the operation of the automatic transfer system and to operate both feeder circuits in parallel.

In general, this system comprises, at the office, closing switches 15 and trip switches 16 together with operation indicators 17 associated with the preferred and auxiliary feeder circuits as described hereinbefore. In addition, the control bus, comprising the positive and negative conductors 5 and 6, is provided at the office and is connected to the corresponding control bus at the sub-station by means of conductors 49 and 50. In addition, control conductors 9 are provided for connecting the control apparatus associated with each individual circuit at the office and at the sub-station.

At the sub-station, a preferred circuit breaker P is provided having a trip coil 38 and a closing coil 39. In order to actuate the circuit breaker P to the closed position, a circuit breaker closing relay 42 is provided. An auxiliary circuit breaker A is also provided at the sub-station having a trip coil 43 and a closing coil 44 together with a circuit breaker closing relay 45.

It will be observed that the preferred circuit breaker P is disposed to connect the main power bus 35 to the preferred feeder circuit 36 while the auxiliary circuit breaker A is disposed to connect the main power bus 35 to the auxiliary feeder circuit 37.

In order to render the system automatically responsive to the voltage applied to the preferred feeder circuit 36, the under voltage relay 47 is

provided, the contact members of which are disposed to be bridged a predetermined length of time after voltage has been applied to its actuating coil. The bridging of the contact members of relay 47 effects the energization of the coil of the actuating relay 48, the function of which will be set forth hereinafter.

The manual operation of the circuit breakers may be effected by means of main control relays 111 and 112 which serve to energize the double-coil lock out relays 113 and 114. The operation of the lockout relays 113 and 114 serves to energize a transfer relay 115, the function of which will be set forth hereinafter.

In the event that it is desired to arrest the automatic operation of the system when the auxiliary circuit breaker A is closed and to prevent the preferred circuit breaker P from closing on return of power to the preferred circuit 36, an automatic arresting relay 116 is provided which may be actuated by means of a push-button switch 117 located at the office.

In order to more clearly set forth the operation of this system, the operation necessary to cause the closing and tripping of the auxiliary circuit breaker A will be described. It will be assumed that power is applied to both the preferred feeder circuit 36 and the auxiliary feeder circuit 37 and that both preferred circuit breaker P and the auxiliary circuit breaker A are open.

The operator now depresses the close switch 15, associated with the auxiliary circuit at the office, and thereby applies negative potential from the control bus 5 through conductor 9 to the actuating coil of the relay 112 through conductor 118, contact members 119 of the auxiliary circuit breaker A to the positive control bus. The main control relay 112 is then closed to energize the right-hand coil of lockout relay 114 over a circuit which may be traced from the positive control bus, contact members 119 of the auxiliary circuit breaker A, conductors 118 and 120, contact members 121 of the arresting relay 116, conductor 122, contact members 123 and 124 of the main control relay 112, conductor 125, and actuating coil 126, to the negative control bus. The right-hand contacts 128 of relay 114 will then be closed. However, no further operation will be accomplished until the operator releases the close switch 15.

When the operator releases the close switch 15, relay 112 is de-energized and opened to complete a circuit for energizing the circuit breaker closing relay 45 which may be traced from the positive control bus, through contact members 129 of the auxiliary circuit breaker A, actuating coil of relay 45, conductor 130, contact members 131 of relay 112, conductor 132, contact members 133 of relay 115, conductor 134 and contact members 135 to the negative control bus. The contact members 145 of relay 45 are thus closed to energize the closing coil 44 of the auxiliary circuit breaker A over an obvious circuit.

The indication, that the auxiliary circuit breaker A has closed, will be transmitted to the office from the sub-station over a circuit which may be traced from the negative control bus, through contact members 135 of the auxiliary circuit breaker A, conductor 118, actuating coil of relay 112, conductor 9 and coil 18 of operation inductor 17, to the positive control bus. The energization of coil 18 operates the indicator 17 to show that the auxiliary circuit breaker A has been closed.

In order to open the auxiliary circuit breaker

A, after it has once been closed, the operator depresses the trip switch 16, that is associated with the auxiliary circuit breaker A at the office and applies positive potential from the control bus to the conductor 9 and through the operating coil of relay 112, conductor 118 and contact members 135 of the auxiliary circuit breaker A, to the negative control bus at the sub-station.

Relay 112 is thus energized and closes, to establish a circuit for energizing the left-hand coil 190 of relay 114 which may be traced from the negative control bus, through contact members 135 of the auxiliary circuit breaker A, conductors 118 and 120, contact members 121 of relay 115, conductor 122, contact members 123 and 133 of relay 112, conductor 137, and actuating coil 190 to the positive control bus. The left-hand contact members of relay 114 are then closed through the energization of the left-hand actuating coil 190. However, no further action takes place until the operator releases the trip switch 16 and it has returned to the normal position at which time the main control relay 112 is de-energized.

A circuit is then completed for tripping the auxiliary circuit breaker A which may be traced from the negative control bus, through contact members 138 of the auxiliary circuit breaker A, trip coil 42, conductor 139, contact members 131, which are bridged when relay 112 is de-energized because of the release of the trip switch 16, conductor 132, contact members 133, conductor 134, and contact members 139 of relay 114, to the positive control bus. The auxiliary circuit breaker A is then opened and the corresponding indication is shown on the indicator 17 associated with the auxiliary circuit breaker at the office in the same manner as heretofore described in connection with the closing of this circuit breaker.

In order to close the preferred circuit breaker and to set up the system for automatic operation after the auxiliary circuit breaker has been tripped, manually, as previously described, the operator closes one of the close switches 15 associated with the preferred circuit breaker at the office. The closure of the switch 15 applies negative potential from the control bus 5 to conductor 9 and the actuating coil of main control relay 111 through conductor 140, and contact members 141 of the preferred circuit breaker P to the positive control bus. The energization of relay 111 causes the right-hand actuating coil 142 of relay 113 to be energized over a circuit which may be traced from the positive control bus, contact members 141 of preferred breaker P, conductor 140, contact members 144 and 191 of the relay 111, conductor 146 and actuating coil 142 to the negative control bus.

The operation of relay 113 establishes an energizing circuit for the transfer relay 115 which extends from the negative control bus through contact members 147 of relay 113, conductor 148, actuating coil of relay 115, conductor 149 and contact members 150 on relay 114 to the positive side of the control bus. No further operation takes place until the "close" switch 15 has been released at which time the actuating coil of relay 111 is de-energized to permit the opening of the relay.

Relay 111 closes its contact members 153 when the close switch 15 is released, to establish a circuit for energizing the circuit breaker closing relay 42 which may be traced from the positive side of the control bus, contact members 151 of the preferred circuit breaker P, actuating coil of

relay 42, conductor 152, contact members 153, conductor 154, contact members 155 of the transfer relay 115, conductor 156, contact members 157 of relay 46, conductor 158 and contact members 159 of the auxiliary circuit breaker A to the negative control bus. The closure of the preferred circuit breaker P will cause a negative potential to be applied to the control wire 9 through the contacts 160 on the preferred circuit breaker P to operate the corresponding indicator 17 at the office in the same manner as described hereinbefore.

In the event that the power supply should fail on the preferred feeder circuit 36, it is the function of this system to automatically transfer the main power bus to the auxiliary feeder circuit 37 in order to insure that a continuity of supply will be maintained on the main power bus. When the power supply fails on the preferred feeder circuit 36, the actuating relay 46 will be immediately de-energized. A circuit will then be set up for tripping the preferred circuit breaker P which may be traced from the negative control bus, contact members 161 of the preferred circuit breaker P, trip coil 38, conductor 152, contact members 153, conductor 154, contact members 155, conductor 156, and contact members 157 of relay 46, to the positive control bus.

At the same time a circuit is set up for energizing the circuit breaker closing relay 45 which may be traced from the positive control bus, contact members 129 of the auxiliary circuit breaker A, actuating coil of relay 45, conductor 130, contact members 131, conductor 132, contact members 163 of relay 115, conductor 164, contact members 165 of relay 46, conductor 165 and contact members 166 of the preferred breaker P, to the negative control bus.

It will be observed that the auxiliary circuit breaker A is prevented from closing until the preferred circuit breaker P has been opened and its contact members 166, are closed.

The energization of relay 45 will cause the energization of the closing coil 44 over an obvious circuit and the auxiliary circuit breaker A will then be closed.

When the power is again applied to the preferred feeder circuit 36, the voltage delay relay 47 will be energized and a predetermined time thereafter its contact members will be closed to energize the actuating relay 46.

When the actuating relay 46 closes, a circuit is set up for tripping the auxiliary circuit breaker A which may be traced from the negative control bus through contact members 138 of the auxiliary circuit breaker A, trip coil 43, conductor 130, contact members 131, conductor 132, contact members 163, conductor 164, contact members 167 of relay 46, to the positive control bus.

The closure of contact members 159 of the auxiliary circuit breaker A energizes the closing relay 42 to effect the closure of the preferred circuit breaker P. The energizing circuit for relay 42 may be traced from the positive control bus, through contact members 151 of the preferred circuit breaker P, actuating coil of relay 42, contact members 153, conductor 154, contact members 155, conductor 156, contact members 157 of relay 46, conductor 158 and contact members 159 of the auxiliary circuit breaker A, to the negative side of the control bus.

The corresponding operation indicators at the office will be operated to indicate that the auxiliary circuit breaker A has opened and that the

preferred circuit breaker P has closed in the same manner as set forth hereinbefore.

In the event that it is desired to arrest the automatic operation of the system after the auxiliary circuit breaker A has been closed to prevent the preferred circuit breaker P from being automatically closed upon reapplication of power to the preferred feeder circuit 36, the automatic arresting relay 116 is operated.

The circuit for energizing this relay 116 is established by the operator depressing a push button 117 at the office which applies positive potential through conductor 9 to the actuating relay 116, thence through conductor 167, contact members 168 of relay 115, conductor 169, contact members 170 of relay 46, conductor 171, contact members 172 of the auxiliary circuit breaker A, conductor 173 and contact members 174 on circuit breaker P to the negative control bus.

At the same time that the arresting relay 116 is energized, the main control relay 112 is also energized on the application of positive potential to the conductor 9 through the actuating coil of relay 112, conductor 118 and contact members 135 of the auxiliary circuit breaker A to the negative side of the control bus.

Operation of relay 112 establishes an energizing circuit for the right-hand coil 126 of relay 114 which may be traced from the positive control bus, through contacts 175 of relay 116, conductor 122, contact members 123 and 124, conductor 125, and actuating coil 126 to the negative control bus. Contact members 150 of relay 114 are thereby opened and transfer relay 115 is de-energized. The de-energization of relay 115 opens contact members 168 through which the energizing circuit for the actuating coil of relay 116 was completed. However, the actuating coil of relay 116 is connected directly to the negative side of the control bus over a circuit which extends from the actuating coil of relay 116, conductors 167 and 176 and contact members 177 to the negative side of the control bus. The relay 116 is thereby maintained energized after relay 115 has been de-energized.

It will also be observed that the left-hand coil 178 of relay 113 will be energized upon energization of relay 116 over a circuit which may be traced from the negative control bus through contact members 179 of relay 116, conductors 180 and 181, and actuating coil 178 to the positive side of the control bus.

The opening of contact members 150 of relay 114 and 147 on relay 113 due to the energization of relay 116 serves to insure that the transfer relay 115 will be de-energized with the result that automatic transference of the system back to the preferred feeder circuit 36 is prevented on reapplication of power thereto.

When the operator releases the push button 117, relays 112 and 116 will be immediately de-energized.

It will now be observed that any action on the part of relay 46, when power is again applied to the preferred feeder circuit, will not initiate the automatic transfer back to the preferred feeder circuit because relay 115 is de-energized.

In the event that it is desired to parallel the preferred feeder circuit 36 with the auxiliary feeder circuit 37 when the automatic transfer has been arrested, as previously described, the operator depresses the "close" switch 15, that is associated with the preferred circuit breaker at the office, thereby energizing relay 111 over a circuit which has been previously traced. The right-

hand coil 142 of relay 113 is then energized over a circuit which may be traced from the positive control bus through contact members 141 of the preferred circuit breaker P, conductor 140, contact members 144 and 191, conductor 146 and relay coil 142 to the negative control bus. No further action will take place until the operator releases the "close" switch 15 at which time relay 141 will be de-energized.

A circuit will then be completed for actuating the circuit breaker relay 42 which may be traced from the positive control bus through contact members 151 of the preferred circuit breaker P, actuating coil of relay 42, conductor 152, contact members 153, conductor 154, contact members 182 of relay 115, conductor 183, contact members 184 of relay 116, conductor 185, and contact members 186, to the negative control bus. The preferred circuit breaker P will then be closed and the corresponding operation indication sent back to the office as previously described.

When it is desired to again condition the system for automatic operation, the operator depresses the "trip" switch 16, associated with the auxiliary circuit breaker, thereby causing the auxiliary circuit breaker A to be opened as previously described and, at the same time, causing the left-hand coil 135 of relay 114 to be energized. The transfer relay 145 will then be again energized and the circuits will be set up for automatic transference from the preferred circuit to the auxiliary feeder circuit in the event that power should fail on the preferred feeder circuit. In addition, the circuits will again be set up for automatically transferring from the auxiliary feeder circuit back to the preferred feeder circuit when power is returned to the latter circuit.

Since certain further changes may be made in the above construction and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, circuit breakers at the second station for connecting a preferred feeder circuit and an auxiliary feeder circuit to a main power bus, control and signalling means at the first station individual to each circuit breaker at the second station, said signalling means being responsive to different polarities, a control conductor for connecting each circuit breaker to the corresponding control and signalling means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the former circuit and for transferring the main power bus back to the preferred feeder circuit from the auxiliary feeder circuit on return of voltage to the preferred feeder circuit, control means actuated by the movement of the circuit breakers for applying different polarities from the control bus to the control conductors to actuate the signalling means for indicating the positions of the circuit breakers, locking relay means at the second station and operable from the first station over the control conductor individual to the preferred feeder circuit for preventing the automatic transfer of the main power to the auxiliary feeder

circuit by opening the energizing circuit to said transfer relay means when the preferred feeder circuit is tripped from the first station, and a second locking relay means at the second station and operable from the first station over the control conductor individual to the auxiliary feeder circuit for preventing the automatic transfer of the main power bus to the preferred feeder circuit by opening the energizing circuit to said transfer relay means when the auxiliary circuit breaker is closed from the first station.

2. In a power control system, in combination, a main power bus, preferred and auxiliary feeder circuits, a preferred circuit breaker and an auxiliary circuit breaker for connecting the preferred and auxiliary feeder circuits respectively to the main power bus, voltage relay means responsive to the voltage applied to the preferred feeder circuit for opening the preferred circuit breaker and closing the auxiliary circuit breaker on failure of voltage on the preferred feeder circuit and for opening the auxiliary circuit breaker and closing the preferred circuit breaker on return of voltage to the preferred feeder circuit, and interlocking relay means connected to be energized on energization of the preferred feeder circuit for preventing the closure of the auxiliary circuit breaker prior to the opening of the preferred circuit breaker when the interlocking relay is de-energized by maintaining the energizing circuit to the auxiliary circuit breaker open and for preventing the closure of the preferred circuit breaker prior to the opening of the auxiliary circuit breaker when the interlocking relay is energized by maintaining the energizing circuit to the preferred circuit breaker open.

3. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, a preferred circuit breaker and an auxiliary circuit breaker for connecting a preferred feeder circuit and an auxiliary feeder circuit respectively to a main power bus, control and signalling means connected to the control bus at the first station and individual to each circuit breaker at the second station, said signalling means being responsive to different polarities, a control conductor for connecting each circuit breaker to the corresponding control and signaling means at the first station, voltage relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the preferred feeder circuit and for transferring the main power bus back to the preferred feeder circuit on return of voltage to said circuit, interlocking relay means connected to be energized on energization of the preferred feeder circuit for preventing the closure of the auxiliary circuit breaker prior to the opening of the preferred circuit breaker when the interlocking relay is de-energized by maintaining the energizing circuit to the auxiliary circuit breaker open and for preventing the closure of the preferred circuit breaker prior to the opening of the auxiliary circuit breaker when the interlocking relay is energized by maintaining the energizing circuit to the preferred circuit breaker open, and control means actuated by the movement of the circuit breakers for applying different polarities from the control bus to the control conductors to actuate the signalling means at the first station for indicating the positions of the circuit breakers.

4. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, a preferred circuit breaker and an auxiliary circuit breaker for connecting a preferred feeder circuit and an auxiliary feeder circuit, respectively, to a main power bus, control and signalling means at the first station connected to the control bus and individual to each circuit breaker at the second station, said signalling means being responsive to different polarities, a control conductor for connecting each circuit breaker to the corresponding control and signalling means at the first station, a main control relay at the second station individual to each circuit breaker and disposed to be energized over the control conductor on operation of the control means at the first station, a lockout relay at the second station individual to each circuit breaker and disposed to be energized on operation of the main control relay for setting up a closing circuit for its associated circuit breaker, said closing circuit being completed on de-energization of the main control relay, control means actuated by the movement of the circuit breakers for applying different polarities from the control bus to the control conductors to actuate the signalling means at the first station for indicating the positions of the circuit breakers, voltage relay means connected to be energized on energization of the preferred feeder circuit for opening the preferred circuit breaker and closing the auxiliary circuit breaker on failure of voltage on the feeder circuit and for opening the auxiliary circuit breaker and closing the preferred circuit breaker on return of voltage to the preferred feeder circuit, an automatic arresting relay at the second station for preventing the transfer of the main power bus from the auxiliary feeder circuit to the preferred feeder circuit by opening the energizing circuit to said voltage relay means, and additional control means at the first station for initiating the operation of the automatic arresting relay.

5. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, circuit breakers at the second station for connecting a preferred feeder circuit and an auxiliary feeder circuit to a main power bus, control and signalling means at the first station individual to each circuit breaker at the second station, said signalling means being responsive to different polarities, a control conductor for connecting each circuit breaker to the corresponding control and signalling means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the former circuit and for transferring the main power bus back to the preferred feeder circuit from the auxiliary feeder circuit on return of voltage to the preferred feeder circuit, control means actuated by the movement of the circuit breakers for applying different polarities from the control bus to the control conductors to actuate the signalling means for indicating the positions of the circuit breakers, and locking relay means at the second station operable from the first station over the control conductor individual to the preferred feeder circuit for preventing the automatic transfer of the main power bus to the auxiliary

feeder circuit by opening the energizing circuit to said transfer relay means when the preferred feeder circuit is opened from the first station.

6. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, circuit breakers at the second station for connecting a preferred feeder circuit and an auxiliary feeder circuit to a main power bus, control and signalling means at the first station individual to each circuit breaker at the second station, said signalling means being responsive to different polarities, a control conductor for connecting each circuit breaker to the corresponding control and signalling means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the former circuit and for transferring the main power bus back to the preferred feeder circuit from the auxiliary feeder circuit on return of voltage to the preferred feeder circuit, control means actuated by the movement of the circuit breakers for applying different polarities from the control bus to the control conductors to actuate the signalling means for indicating the positions of the circuit breakers, and locking relay means at the second station operable from the first station over the control conductor individual to the auxiliary feeder circuit for preventing the automatic transfer of the main power bus to the preferred feeder circuit by opening the energizing circuit to said transfer relay means when the auxiliary feeder circuit is closed from the first station.

7. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, a preferred and an auxiliary circuit breaker at the second station for respectively connecting a preferred and an auxiliary feeder circuit to a main power bus, control means at the first station individual to each circuit breaker at the second station, a control conductor connecting each circuit breaker to the corresponding control means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the preferred feeder circuit and for transferring the main power bus back to the preferred feeder circuit on return of voltage thereto, locking relay means at the second station operable from the first station over the control conductor individual to the preferred feeder circuit for preventing the automatic transfer of the main power bus to the auxiliary feeder circuit by opening the energizing circuit to said transfer relay means when the preferred feeder circuit is opened from the first station, and a second locking relay means at the second station operable from the first station over the control conductor individual to the auxiliary feeder circuit for preventing the automatic transfer of the main power bus to the preferred feeder circuit by opening the energizing circuit to said transfer relay means when the auxiliary circuit breaker is closed from the first station.

8. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, a preferred and an auxiliary circuit breaker at the second station for respectively connecting a preferred and an auxiliary feeder circuit to a main power

bus, control means at the first station individual to each circuit breaker at the second station, a control conductor connecting each circuit breaker to the corresponding control means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the preferred feeder circuit and for transferring the main power bus back to the preferred feeder circuit on return of voltage thereto, and locking relay means at the second station operable from the first station over the control conductor individual to the preferred feeder circuit for preventing the automatic transfer of the main power bus to the auxiliary feeder circuit by opening the energizing circuit to said transfer relay means when the preferred feeder circuit is opened from the first station.

9. In a power control system, in combination, a first station, a second station, a direct current control bus connecting the stations, a preferred and an auxiliary circuit breaker at the second

station for respectively connecting a preferred and an auxiliary feeder circuit to a main power bus, control means at the first station individual to each circuit breaker at the second station, a control conductor connecting each circuit breaker to the corresponding control means at the first station, relay means responsive to the voltage applied to the preferred feeder circuit for transferring the main power bus from the preferred feeder circuit to the auxiliary feeder circuit on failure of voltage on the preferred feeder circuit and for transferring the main power bus back to the preferred feeder circuit on return of voltage thereto, and locking relay means at the second station operable from the first station over the control conductor individual to the auxiliary feeder circuit for preventing the automatic transfer of the main power bus to the preferred feeder circuit by opening the energizing circuit to said transfer relay means when the auxiliary feeder circuit is closed from the first station.

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