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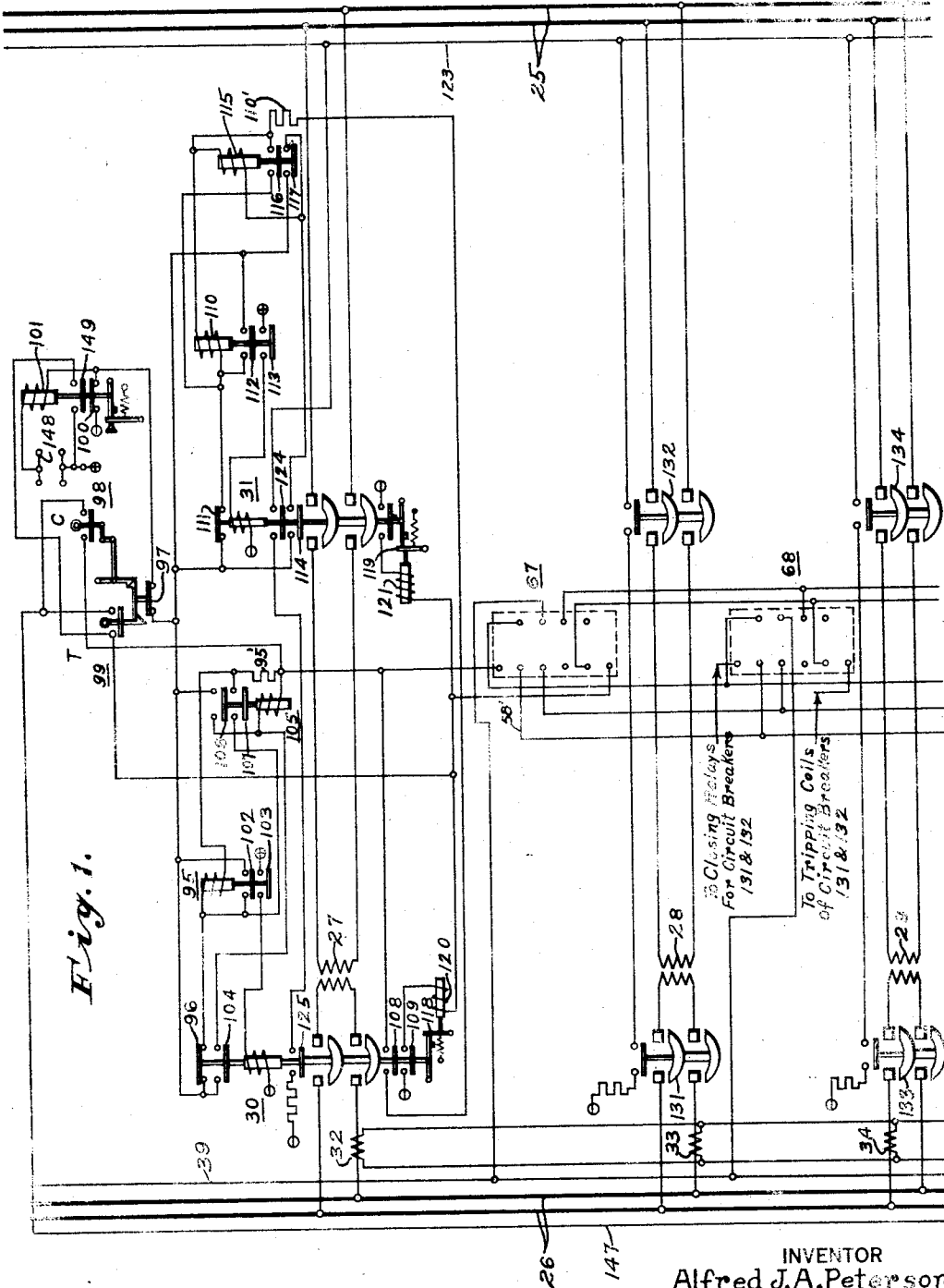
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1,789,155

AUTOMATIC STATION CONTROL

Filed May 27, 1929

2 Sheets-Sheet 1



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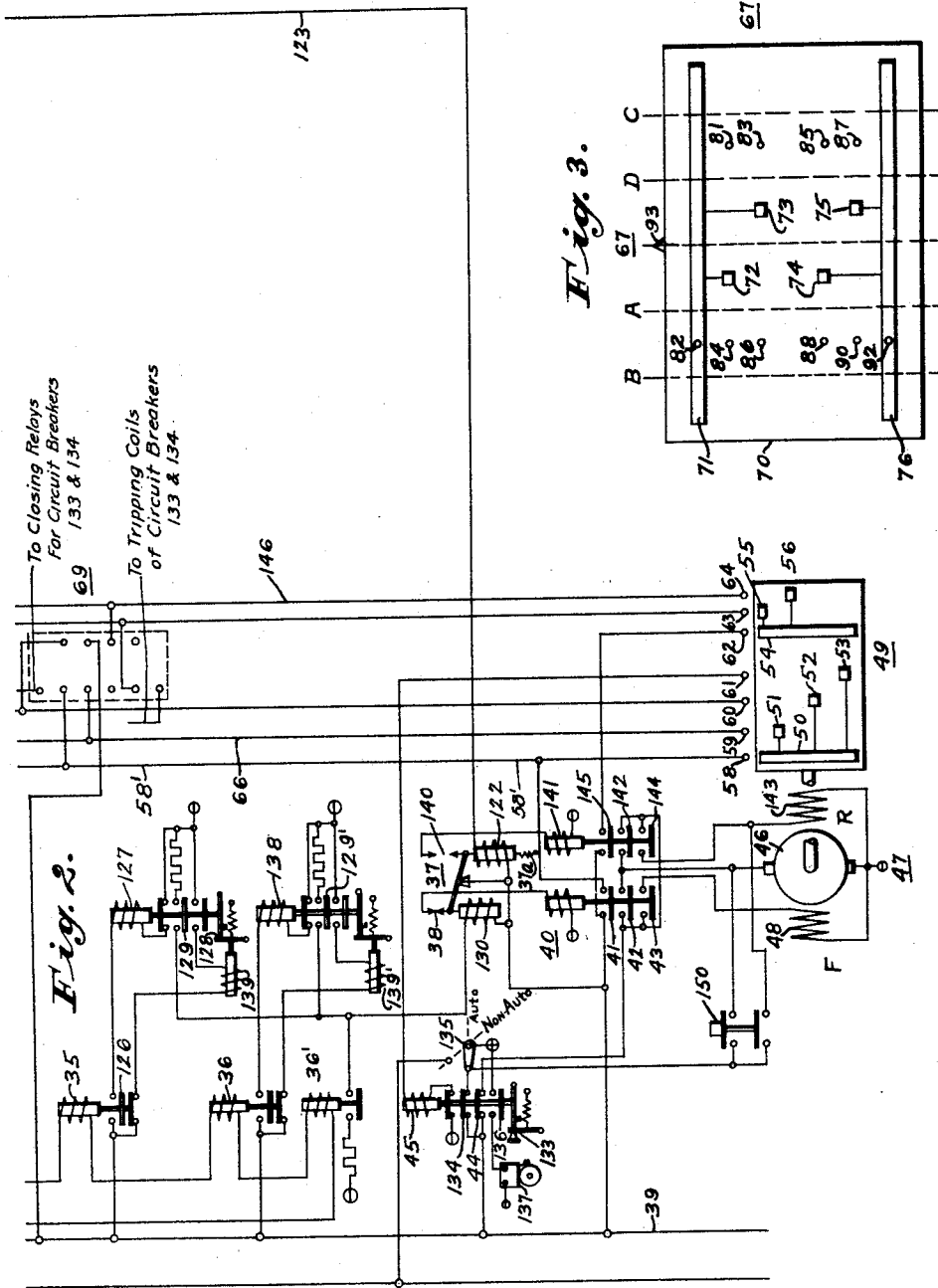
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AUTOMATIC STATION CONTROL

Filed May 27, 1929

2 Sheets-Sheet 2



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AUTOMATIC STATION CONTROL

Application filed May 27, 1929. Serial No. 366,263.

This invention relates to automatic stations and, in particular, to automatic stations including a plurality of translating devices, such as transformers, motor-generators, converters or the like. In automatic stations of this type, it is desirable that sufficient translating capacity shall be connected in circuit to supply the load on the station and it is equally desirable that, when the station load decreases, any unneeded translating apparatus shall be disconnected.

It is the principal object of this invention to improve upon the systems for operating multi-unit stations shown in the Moss Patent No. 1,564,303, the Field and Ross application, Serial No. 199,172 filed June 16, 1927, and the Moss and Peterson application, Serial No. 287,758, filed June 23, 1928.

A specific object of this invention is to provide improved means for comparing the station load and the number of the connected translating devices.

Another object of my invention is to provide load-measuring means which shall not be affected by changes in the voltage of the usual auxiliary supply source.

A further object of my invention is to provide means for varying the order in which the several units of a multi-unit automatic station are connected in service.

In accordance with my invention, I make use of a plurality of standard over-current relays which are adapted to be energized in accordance with the station load. These relays are set to operate at different values of station-load current and serve to initiate the operation of connecting an additional translating unit in service when the station load increases, and to disconnect surplus translating units when the station load decreases.

For a complete understanding of my invention, reference should be had to the accompanying drawings in which:

Figures 1 and 2 illustrate diagrammatically a multi-unit automatic station embodying the novel features of my invention.

Fig. 3 illustrates, diagrammatically, an element necessary in connection with the system shown in Figs. 1 and 2.

Referring particularly to Figs. 1 and 2, a

high-voltage supply circuit 25 is adapted to supply energy to a relatively low-voltage load circuit 26 through translating devices, such as transformers 27, 28 and 29.

The connection of the transformer 27 between the circuits 25 and 26 is controlled by suitable circuit breakers 30 and 31, in a manner which will become apparent hereinafter. It is to be understood at this point that, although I have illustrated my invention in connection with a transformer station, any other translating devices, such as rotary converters, motor-generators, vapor converters, or the like may be controlled by means similar to that shown and described herein. It is possible, furthermore, to control nonelectrical processes by the same means.

As hereinbefore indicated, the operation of the system of my invention is initiated in response to an increase in the load on the station in which the transformers 27, 28 and 29 are located. The station load is measured by the current transformers 32, 33 and 34 connected in corresponding leads of the transformers, in connection with standard over-current relays 35, 36 and 36'. Although I have illustrated my invention in connection with a single-phase system, it is obvious that it may be applied to any polyphase system. In such case, a relay corresponding to relays 35 and 36 will be provided for each phase, and the front and back contacts thereof will be connected in parallel and in series, respectively, as taught by the Edmonds Patent No. 1,675,336.

The remaining equipment necessary in the embodiment of my invention herein shown will be described in the course of the following explanation of the operation thereof.

It is desirable, in multi-unit automatic stations, that at least one translating device shall be connected between the supply and load circuits at all times. In order to insure this condition, I provide a balance relay 37. This relay is arranged to control the operations required to connect an additional translating device between said circuits under the influence of relays 35 and 36, upon the occurrence of an increase in station load. The pivoted lever of the relay is biased by a spring 37a, or other suitable means, so that, when both the

windings of the relay are deenergized, as when the apparatus is in the condition illustrated in Figs. 1 and 2, the contact 38 of the relay will be closed to complete a circuit from a source of auxiliary control current, such as the automatic bus 39, through the relay arm and the contacts 38, to the winding of an auxiliary relay 40 and the negative side of the control circuit (represented by a minus sign within a circle). Current is supplied to the automatic bus from any convenient source, as will be explained more fully later. Instead of biasing spring, one of the windings of the relay 37 may be permanently energized, in series with a resistor of appropriate value, to exert a biasing torque on the contact lever of the relay.

The relay 40, when energized, closes its contacts 41, 42 and 43. The closing of the contact 42 of the relay 40 completes a circuit from the automatic bus 39, through a normally closed contact 44 of a master lockout relay 45, the operation of which will be described further hereinafter, the contact 42 of the relay 40 and the armature 46 of a reversible motor 47, to the negative bus. A circuit is likewise completed at the contact 43 of the relay 40 for the forward field winding 48 of motor 47.

The motor 47 serves to drive a drum switch 49 comprising conducting segments 50 to 56, inclusive, which are adapted to cooperate with contact fingers 58 to 64, inclusive. When the motor 47 is energized by the completion of the circuits hereinbefore mentioned, the motor starts to rotate in such direction as to cause the contact segments 50 to 56 to engage the fingers 58 to 64. Appropriate gearing may be interposed between the motor 47 and the drum 49 to reduce the speed of the latter. By the operation of the relay 40, a circuit is also completed from the automatic bus 39, through the contact 41 of the relay 40, conductor 58' to the corresponding contacts of a plurality of sequence switches 67, 68 and 69, which determine the order in which the transformers 27, 28 and 29 are connected between the circuits 25 and 26. An extension of the conductor 58' is connected to the contact finger 58 for a purpose to appear subsequently.

The sequence switch 67 is shown in detail in Fig. 3 and consists of a manually operable drum 70, preferably cylindrical, bearing segments 71 to 76, inclusive, which are adapted to engage stationary contact fingers 81 to 88, 90 and 92 when the drum is rotated through its various positions A, B, C and D. A pointer 93 indicates to the operator the position of the contact segments with respect to the contact fingers, and any suitable means (not shown) may be provided for rotating the drum 70 past the contact fingers 81 to 88, 90 and 92 which are fixed to the stationary portion of the switch structure.

When a sequence switch is actuated to position A, the translating device associated

therewith will be the first to be connected to the supply and load circuits. The unit having its sequence switch in position B will be connected second in the sequence, and so on. The disconnection of the units will be effected in the reverse order of their connection, as will be described hereinafter.

Assuming that the sequence switch 67 is in position A, the contact fingers 82 and 84 thereof will be connected through the segments 71 and 72 in engagement with said fingers, respectively. This being the case, the circuit to the conductor 58' is extended through the contact fingers 84 and 82 of the sequence switch 67, a current-limiting resistor 95' to the winding of a closing relay 95 associated with the circuit breaker 30 and through an auxiliary switch 96 on said breaker, a switch 97, the position of which is controlled by the manual closing and tripping switches 98 and 99 in such manner that the switch 97 will normally be closed until the manual-tripping switch 99 is actuated. The circuit extends to the negative bus through the normally closed contact 100 of a unit lockout relay 101, the function of which will be described later.

When the relay 95 is energized by the completion of the circuit which is traced above, it closes its contacts 102 and 103. The closing of the contact 102 completes a locking circuit for the relay 95 in parallel with the auxiliary switch 96. The contact 103 completes a circuit for the closing coil of the circuit breaker 30, which is thereupon actuated to its closed position, the source of current for the closing coil being indicated by a plus sign within a small circle. The consequent opening of the switch 96 does not affect the relay 95 but the closing of another auxiliary switch 104 on the circuit breaker 30 completes a circuit from contact 82 of the sequence switch 67 which is connected to the automatic bus, through the drum switch 49, as already described, to the winding of a cut-off relay 105. This circuit returns to the negative bus in the same manner as that described for the relay 95. The relay 105 closes its contacts 106 and 107, the former completing a locking circuit for the relay 105 in parallel with its original energizing circuit, and the latter serving to shunt the winding of the relay 95, which is thereupon deenergized. The relay 105 remains energized so long as positive battery is supplied to conductor 58'. When relay 40 is deenergized, however, as will be pointed out later, relay 105 is likewise deenergized but the circuit breaker 30 remains latched in the closed position.

The circuit breaker 30 is provided with auxiliary contacts 108 and 109 which are closed when the circuit breaker is closed. The closing of the contact 108 extends the circuit previously traced to the contact finger 82, through said contact 108 and a current-limiting resistor 110', to the winding of a

closing relay 110 associated with the circuit breaker 31. This circuit returns to the negative bus through the auxiliary switch 111 of the circuit breaker 31, manual switch 97 and the lock-out contact 100. The relay 110 is thereby energized to close its contacts 112 and 113. The contact 112 closes a locking circuit for the relay 110 in parallel with that including the auxiliary switch 111. The contact 113 closes an energizing circuit for the closing coil of the circuit breaker 31 which is thereupon actuated to its closed position. The closing of the circuit breaker 31 does not affect the relay 110 since the contact 112 of the latter completes a locking circuit therefor, as described above, but the auxiliary switch 114 of the circuit breaker 31 completes an energizing circuit from the contact finger 82 of the sequence switch 67, through the auxiliary contact 108 of the circuit breaker 30 and the resistor 110', to the winding of a cut-off relay 115 and the negative bus through the auxiliary contact 114. The relay 115 is thus energized to close its contacts 116 and 117. The contact 116 shunts the winding of the closing relay 110, and the contact 117 locks the relay 115 in its energized position, so long as positive battery is connected to contact 82 through contact 41 of relay 40.

The circuit breakers 30 and 31 are now closed, and the high-voltage circuit 25 supplies energy to the low-voltage circuit 26 through the transformer 27. The high-voltage circuit breaker 31, obviously, may be closed first instead of the low-voltage breaker 30, if desired. The circuit breakers are latched in their closed positions by latches 118 and 119. These latches are adapted to be withdrawn by the tripping coils 120 and 121. The closing of the circuit breakers 30 and 31 also completes one of a plurality of parallel circuits from the automatic bus 39, through the winding 122 of the relay 37, to a "balancing" bus 123, through the auxiliary contacts 124 and 125 of the circuit breakers 31 and 30, to a resistor and the negative bus. Upon the completion of this circuit, the coil 122 of the relay 37 is energized, the latter is thereby restored to balance, and the circuit for the relay 40 is interrupted, so that further rotation of the motor 47 and the drum switch 49 is precluded, leaving the segment 50 in engagement with the finger 58 for the time being.

Conditions in the substation remain unchanged so long as the station load remains constant. Upon an increase in the station load, however, to a predetermined value, the relay 35 will operate by reason of the increased load current supplied by the station, to complete a circuit, at its contact 126, for a relay 127. The relay 127 operates and is latched in the operated position by the latch 128. The relay 127, through its contact 129, completes a circuit from the auto-

matic bus 39, through the winding 130 of the relay 37 and the contact 129 of the relay 127, to a resistor and the negative bus. When the winding 130 of the relay 37 is thus energized, the torque produced thereby counterbalances that exerted by coil 122, and the contacts 38 are again closed by the biasing spring, with the same results as before. The relay 40 is energized to start the motor 47, and the drum switch 49 is again rotated.

When the segment 51 of the drum switch engages its associated contact finger 59, a circuit is completed from the automatic bus 39 through the contact 41 of the relay 40, the contact finger 58, segments 50 and 51 and finger 59 of the drum switch 49, to the finger 86 of the sequence switches 67, 68 and 69. If it be assumed that the sequence switch 68 occupies the position B, as indicated in Fig. 3, the fingers 82 and 86 thereof will be bridged by the segments 71 and 73, with the result that current is supplied from the automatic bus to the closing relay (not shown) for the circuit breaker 131, which corresponds to the relay 95 shown in connection with the circuit breaker 30. The necessary control circuits for the circuit breakers associated with the transformer 28 are not shown in detail since they are duplicates of those shown in connection with circuit breakers 30 and 31. As described in connection with the latter, the closing of the circuit breakers 131 and 132 completes a parallel circuit from the balancing bus 123 to a resistor and the negative bus so that the coil 122 of the relay 37 is more strongly energized than before. The result of this operation is to restore the balance of the relay 37, deenergize relay 40 and stop the motor 47.

It is obvious that another translating unit, such as the transformer 29, may be connected to the load and supply circuits through suitable circuit breakers 133 and 134, by the relay 36, which is set to operate at a higher value of load current than the relay 35, and the contact segments 52 on the drum switch 49 similar to the segment 51. The sequence switch 69 may be at its C position to connect its fingers 81 and 82 through segments 72 and 71, whereby the unit 29 is caused to take third place in the operation sequence.

After all available translating units have been connected in service, it is desirable that a further increase in load be indicated to an attendant. I make provision for such indication in the following manner. If all the transformers 27, 28 and 29 have been connected, in the manner hereinbefore described, and a further increase in the station load occurs, the resulting operation of a relay 36', which is set at the maximum permissible load, will cause the drum switch 49 to be actuated again, as explained above.

When the segment 53 engages the finger 61, however, a circuit will be completed for the master lockout relay 45. The relay 45 operates, and is latched in its operated position by a latch 133. At the contact 134 of the relay 45, the circuit from positive battery through the manual switch 135, the contact 134 to the automatic bus 39 is interrupted, and all devices drawing current therefrom are deenergized. The driving circuit for the motor 47 is interrupted at the contact 44 of the relay 45 and, at contact 136, a circuit is closed for an alarm, such as the gong 137. This indicates to an attendant that the station is overloaded and that steps should be taken to reduce the load. The signal device 137 may be located in the station if there are attendants present or it may be placed in any suitable position, such as the office of the system operator, which may be located at a considerable distance from the station.

After the operation of the master lockout relay 45, it is necessary that an attendant visit the station to reset the lock-out relay by withdrawing the manual latch 133. Until this is done, all automatic operation of the station is, of course, suspended, the translating units remaining connected, so that no interruption in service occurs. Obviously, the relay 36' may control the relay 45 directly instead of through the medium of the drum switch, as shown. The time required for the operation of the latter, however, prevents the operation of the master lockout relay 45 upon the occurrence of a temporary overload on the station.

It will be understood from statements above made that the current relays 35, 36 and 36' are set to operate at different values of current so that they operate successively, as the station load increases, to cause the second and third units to be connected and the station to be finally locked out as described hereinabove.

Assuming now that the station load has increased to such value that the transformers 27, 28 and 29 are connected in service but the master lockout relay is not operated, if the station load decreases, the relay 36 will be so actuated that its back contact will be closed to energize the tripping coil 139' of the relay 138. The latter is thereupon reset and the balance relay 37 operates, because of the opening of one of the plurality of circuits for the left-hand coil 130 thereof at the contact 129' of the relay 138, to close its right-hand contacts 140. This result follows because, after the opening of contact 129', the coil 122 is energized more strongly than the coil 130.

The closing of the right-hand contacts 140 of the relay 37 completes an obvious energizing circuit for a relay 141 which, in turn, completes a circuit from the automatic bus

39 through the contact 44 of the relay 45 which, it was assumed, has been reset manually after locking out, as previously described, a contact 142 of the relay 141 to the armature 46 of the motor 47. The reverse field winding 143 of the motor is simultaneously energized by the closing of contact 144. The contact 145 of relay 141 sets up a circuit from the automatic bus 39 to the contact finger 62 of the drum relay 49.

Since it was assumed that the units 27, 28 and 29, were in service, it is obvious that the drum switch 49 will be so positioned that segment 52 engages the finger 60. Such being the case nothing will happen until the reverse movement of the drum switch causes segment 56 to engage finger 64, whereupon the circuit to the finger 62 will be extended, through segments 54 and 56, to a tripping conductor 146 which is connected to a finger 85 of the sequence switches 67, 68 and 69. It will be assumed that the sequence switches 67, 68 and 69 are so adjusted, as before stated, that transformer 27 is the lead-off unit, and transformers 28 and 29 the second and third units. To arrange this sequence of operation, the sequence switch 67 should be placed in position A, sequence switch 68 in position B and switch 69 in position C. The circuit traced to the conductor 146 and contact fingers 85 of the sequence switches, therefore, extends from finger 85 of the sequence switch 69 to segment 74, segment 76 and finger 92 of said sequence switch.

Since the complete closing and tripping circuits for the circuit breakers 131—134 have not been shown, the tripping of the circuit breakers 133 and 134 will be described in connection with circuit breakers 30 and 31, it being remembered that circuit breakers 133 and 134 are tripped by the first decrease in the station load sufficient to cause the relay 36 to close its back contact. From the finger 92, the circuit extends to the tripping coils for the circuit breakers 133 and 134 corresponding to those illustrated at 120 and 121 for the circuit breakers 30 and 31. The tripping coils withdraw the latches which maintain the circuit breakers closed, and the breakers are tripped in the usual manner.

The tripping of the circuit breakers 133 and 134, at the auxiliary contacts thereof, opens one of the parallel circuits to the balancing bus 123. The energization of the coil 122 of the relay 37 is thereby diminished, and the relay 37 is restored to balance. The opening of the contacts 140 thereof deenergizes the relay 141 and stops the motor 47.

I desire to emphasize, at this point, the advantage resulting from the staggering of the segments 55 and 56 with respect to segments 51 and 52. This arrangement of contact segments requires that a definite move-

ment of the switch 49 be effected before any unit is tripped, and thus introduces a slight time delay between the decrease in the station load and the reduction in the member of translating units connected. If this time delay were not provided, a rapidly fluctuating load on the station might cause repeated closing and tripping of the circuit breakers 133 and 134. This repetition of needless operations is avoided by properly staggering the contact segments 51, 52 and 55, 56 so that no change in the number of connected translating devices will be effected until a substantial change in load conditions occurs, of sufficient duration to permit the required movement of the switch 49.

Further decrease in the station load will cause the relay 35 to close its back contact to repeat the tripping impulse through the relays 127 and 37. Segment 55 of the switch 49 subsequently engages finger 63 to extend a tripping circuit for the circuit breakers 131 and 132 through fingers 90 and 92 bridged by segments 75 and 76 of sequence switch 68 which is in position B. The translating units are thus disconnected from the load and supply circuits until the station load is balanced, with the capacity of the translating devices connected in circuit, or until only one unit remains in service.

In addition to the automatic operation described hereinbefore, I provide manual means for controlling the operation of the circuit breakers which connect the translating units between their load and supply circuits. Examples of these means are the closing and tripping switches illustrated at 98 and 99. The manual switch 98 is adapted to complete a circuit for relay 95 from the non-automatic bus 147, which may be connected to the auxiliary source of current by actuating the manual switch 135 to the "non-automatic" position. As a result of the operation of the relay 95, the circuit breakers are closed, as described above. The manual switch 99 is for the purpose of tripping the circuit breakers 30 and 31 and, when operated, completes an energizing circuit for the trip coils 120 and 121.

A particular feature of the manual switch is that, when the tripping switch 99 is actuated, the normally-closed back contact 97 associated therewith is opened and latched to prevent functioning of the automatic circuit-breaker-control equipment. The latch is released when the manual closing switch 98 is actuated. This feature provides for a suspension of the automatic operation during a period of manual operation which may be necessary for any reason. Duplicates of the manual switches 98 and 99 will, obviously, also be provided for each of the units 28 and 29. An alternative means for manually closing the various circuit breakers for connecting the translating units 27, 28 and 29

in service is afforded by the connection of the automatic bus 39 to contact fingers 83 of the sequence switches 67, 68 and 69. Thus, when the sequence switches are shifted to the D position, in which fingers 82 and 83 are engaged by segments 71 and 73, current is supplied to the relays corresponding to 95 for closing the circuit breakers. This manual operation, obviously, may be effected even when the switch 135 is in the "automatic" position. The tripping of the breakers might be similarly accomplished should this be desirable but, of course, both closing and tripping by the sequence switches could not be controlled except by adding other contacts to the sequence switches.

The unit lockout relay 101 may be controlled by any number of suitable protective devices each of which is adapted to control contacts, such as those shown at 148. These contacts are connected in parallel and serve to energize the lockout relay upon the occurrence of any condition which it is desired to guard against, such as excess load on any unit, excess temperature thereof, or the like. Although only a single lockout relay is illustrated, it is desirable that one such relay be provided for each unit in the station. When any one of the contacts 148 is closed, the circuit for the relay 101 is completed and its operation closes a circuit at contact 149 for the tripping coils 120 and 121 of the circuit breakers 30 and 31. The unit lockout relay, furthermore, by opening the automatic control circuit at contact 100, prevents continued operation of the transformer 27 in the automatic sequence. Upon the occurrence of such condition, the balance relay 37 is so actuated as to cause another unit, if available, to be substituted for that disconnected by the protective equipment. The relay 101 is of the manually reset, latching type.

A push-button switch 150 or its equivalent is provided to enable an attendant to reset the motor relay 47—49 when the station has been locked out automatically. As above stated, after a station lockout, it is necessary for an attendant to reset the lockout relay 45. It is also necessary for the motor relay 47—49 to be reset and this is accomplished by actuating the switch 150 which completes a circuit for the reverse winding of the motor 47. When the relay 47—49 has been reset, the relay 37 operates automatically, as described above, to connect the first unit in service and additional units are required.

It will be apparent that the system of my invention provides means whereby the aggregate connected translating capacity of an automatic station may be made to correspond to the station load. This system obviates certain difficulties experienced in similar systems known heretofore. The principal of these is that, in the present case, the load-indicating relays respond only at a definite

value of station load. Exact balancing of the load-indicating relay, therefore, is easily possible, whereas, in previous systems, the load-indicating coil of the balance relay was continually subject to changes in its energization, in accordance with station load, so that maintenance of an exact balance of the relay was exceedingly difficult. In this system also, I am able to vary the sequence in which the units are connected by a simple adjustment of the sequence switch. Upon the lock-out of any unit, furthermore, another unit is automatically substituted. Excess translating capacity, also, is automatically disconnected as soon as the station load decreases to a predetermined value.

Various changes, modifications, substitutions, additions and omissions may be made in the apparatus illustrated without departing from the spirit and scope of my invention as set forth in the appended claims.

I claim as my invention:

1. An automatic station comprising a plurality of transformers, circuit breakers for connecting the windings of said transformers to load and supply circuits, closing and tripping means for said circuit-breakers, a drum switch adapted to successively energize said closing means when rotated in one direction and said tripping means when rotated in the other direction, a motor for driving said switch in both directions, and a balanced relay for controlling said motor, said relay having opposing windings, one of which is energized in proportion to the number of connected translating devices, and the other of which is energized by a plurality of over-current relays responsive to successively increasing values of the current in the supply circuit and relays controlled by said balance relay for causing either the closing or the tripping means to be energized by said drum switch.

2. The combination with a plurality of translating devices, circuit-breakers for connecting said devices to load and supply circuits, closing and tripping coils for said circuit breakers, of a controller load-responsive-relay means for energizing said closing coils when operated in one direction and said tripping coils when operated in the reverse direction, means for operating said controller in both directions, a relay for controlling said operating means, said relay having two opposing windings, one controlled by auxiliary switches on said circuit-breakers and the other controlled by over-current relays responsive to successively increasing values of current in said supply circuit.

3. In a multi-unit automatic translating station, a plurality of translating devices, switches for connecting said devices to load and supply circuits, operating and releasing means for said switches, a controller for successively energizing said means, a motor

for driving said controller and a two-winding differential relay for controlling said motor, auxiliary contacts on said switches for controlling the energization of one winding of said relay, and a plurality of relays responsive to the current in said supply circuit for controlling the energization of the other winding of said differential relay.

4. An automatic station comprising a plurality of translating units, means for connecting said units between load and supply circuits, and means for successively operating said connecting means, including a balance relay normally biased to effect the connection of one of said units between said circuits, means controlled by said connecting means for restoring said relay to neutral, and a plurality of over-current relays responsive to predetermined different values of current in said supply circuit for again biasing said balance relay to effect the connection of an additional unit when the station load exceeds the capacity of the unit previously connected.

5. An automatic station comprising a plurality of translating units, means for connecting said units to a supply circuit and to a load circuit, and means for successively operating said connecting means, including a balance relay effective in one position to cause the successive closing of said connecting means to connect said units to said load and supply circuits, and in the other position to cause the successive opening of said connecting means to disconnect said units, means normally biasing said relay to said first-mentioned position, a solenoid controlled by a plurality of relays responsive to the station load for assisting said biasing means and a solenoid controlled by said connecting means for opposing said biasing means, whereby an additional unit is connected between said circuits whenever the station load exceeds a certain relation to the number of connected units, and a unit is disconnected whenever the station load has a certain other relation to the capacity of the connected units by a predetermined amount.

6. In a multi-unit automatic station, supply and load circuits, a plurality of translating units, means for successively connecting said units therebetween and disconnecting said units therefrom in the reverse order of their connection, a relay for controlling said means and a plurality of over-current relays responsive to different predetermined values of current in said supply circuit for controlling said first-mentioned relay.

7. In an automatic station, a plurality of translating devices, means for connecting them between load and supply circuits for transferring energy therebetween, load relays responsive to the total station load, a balance relay having two opposing windings, means whereby said load relays control the ener-

gization of one of said windings, means controlled by said balance relay for controlling the operation of said connecting means and means for controlling the energization of the other winding of said balance relay in response to said operation.

tion of said devices, and control means comprising a balance relay for said first-mentioned means responsive only to definite, predetermined changes in the station load.

In testimony whereof, I have hereunto subscribed my name this 20th day of May, 1929.

ALFRED J. A. PETERSON.

8. In an automatic station having a plurality of translating units and means including a motor-operated switch for connecting them to load and supply circuits, a balance relay for controlling the operation of said connecting means, said relay having opposing windings adapted to be energized from a common source, and means responsive to the station load and to the number of said units connected to said circuits respectively, for controlling the energization of said windings.

9. An automatic station including a plurality of translating devices, means including a balance relay responsive to the station load and the number of translating devices in service for varying the number of said devices in service, and means for delaying the initiation of the operation of said devices for a predetermined time after the occurrence of a predetermined change in the station load comprising a drum switch having spaced contacts, adapted to be controlled by said load-responsive means.

10. In an automatic station, apparatus units, means for rendering said units effective including a balance relay adapted to be controlled in accordance with the station load and the number of said units connected in service, means for biasing said balance relay to maintain at least one of said units in service at all times, and means including a motor-operated timing device controlled by said relay for causing other units to become effective after a time delay, upon an increase in the station load.

11. In an automatic station, apparatus units, means for rendering said units effective including a balance relay adapted to be energized from a common source and controlled in accordance with the station load and the number of said units connected in service, and means for biasing said relay to maintain at least one of said units in service at all times.

12. In a control system for a plurality of apparatus units adapted to supply a common load, means for effecting the initiation and cessation of the operation of said units, a balance relay having opposing electro-magnetic operating means for controlling said first-mentioned means, and means for controlling the energization of said operating means from a single energy source in accordance with the common load and the number of units connected whereby the effects of variations in the voltage of said source are obviated.

13. An automatic station including a plurality of translating devices, means for effecting the initiation and cessation of the opera-

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