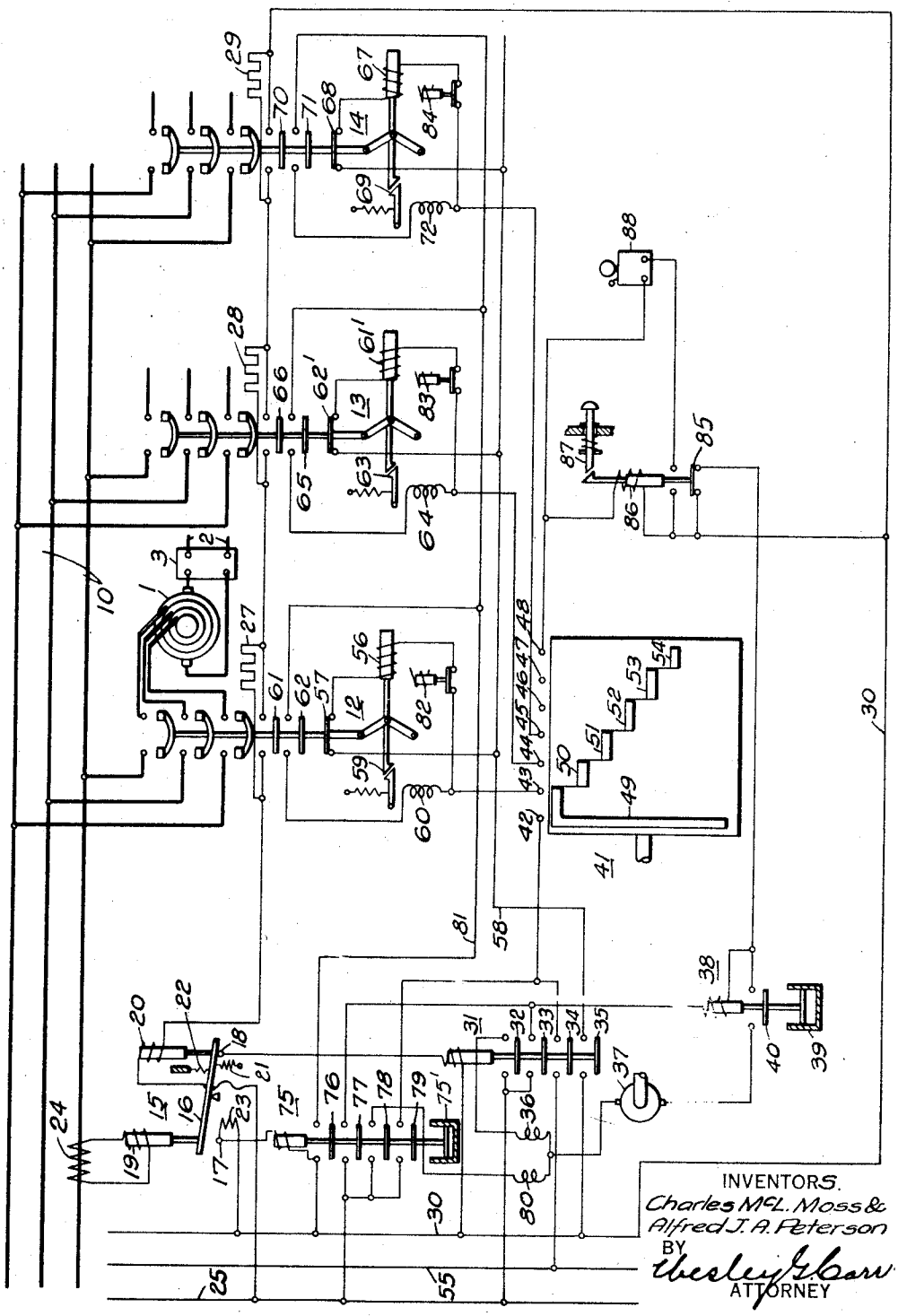
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AUTOMATIC STATION

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AUTOMATIC STATION

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This invention pertains to automatic translating stations and, more particularly, to stations of this type in which a plurality of translating devices are adapted to be connected to a source of energy for supplying a load circuit.

It is the principal object of this invention to provide an automatic translating station including means for causing additional translating devices to be connected to the supply circuit when the load on the station increases.

It is also an object of this invention to provide a system by which, upon a decrease of the load on the station, the translating devices will be successively disconnected until only sufficient translating capacity remains connected to the supply circuit to supply the load on the station.

A further object of our invention is the provision of a relay for controlling the connection of the translating devices such that, upon a decrease in the station load, the translating device last connected to the supply source will not be disconnected therefrom until the load has decreased to such an extent that it may be supplied by the remaining translating devices.

Another object of our invention is the provision of a relay of the type described which shall be operable, when a single unit carrying the station load is tripped out for any reason, to substitute another translating unit to supply the station load.

In accordance with our invention we arrange to control the connection of a plurality of translating devices to a supply circuit by means of a relay responsive to the difference between the load on the station and the aggregate capacity of the translating devices connected to the supply circuit and supplying energy to the load. By utilizing a relay responsive to the conditions mentioned, we are enabled to cause additional translating units to be connected to a supply circuit whenever the station load exceeds the combined capacity of the devices already connected to the supply circuit and supplying energy to the load.

To accomplish this result we make use of auxiliary relays and a motor-driven contact-making device so connected and arranged that, when the relay operates in response to a station load exceeding the combined capacity of the connected translating devices, the contact-making device is actuated to cause the closing of the circuit-breakers associated with other translating devices, so that they are connected to receive energy from the supply circuit and deliver it to the load.

The closing of the circuit-breakers is effective, by means to be described later, to reset the control relay so that when the combined capacity of the translating devices connected to the supply circuit is equal to or greater than the load on the station, the operation of the contact-making device will be arrested and no further changes will occur in the station until the station load varies from its previous value.

Upon a decrease in the station load, the operation of the contact-making device is reversed and the tripping circuits of the circuit-breakers will be successively energized so that the surplus translating capacity is disconnected from the supply circuit.

We also provide means for preventing the disconnection of any translating device until the load upon the station has decreased to such value that it may be supplied by the translating devices remaining connected to the supply circuit.

Our invention may be more completely comprehended by consideration of the accompanying drawing which is a diagram illustrating the circuits and apparatus necessary for the accomplishment of the above-mentioned objects.

Referring to the drawing, a supply circuit is illustrated at 10. This circuit may be connected to any suitable source of energy, not shown. Ordinarily, it will be connected to a distribution circuit which may be supplied with energy from one or more points.

The automatic station of our invention comprises a plurality of translating devices, of which only one is shown, at 1, which are adapted to be connected to the distribution circuit 10 through the circuit-breakers 12, 13 and 14. Although we have assumed the

circuit 10 to be connected to an alternating-current system, our invention is also applicable to a direct-current system as well. The translating devices may be of any type or character desired, for example, they may be synchronous rotary converters, motor-generator sets, transformers, mercury arc rectifiers, or the like. For the sake of simplicity, the details of the translating devices are not illustrated since they constitute no part of the present invention.

The circuit-breakers 12, 13 and 14, inclusive, are the main circuit-breakers controlling the connection of the translating devices to the supply circuit, and the circuit breaker for connecting the translating units to the load circuit 2 is indicated schematically at 3. It will be obvious that, in the case of an automatic station employing rotary converters or motor-generators as the translating devices, it will be necessary to provide auxiliary starting means of a well-known type. The circuit breakers on the two sides of any translating device may be operated in any desired sequence, by known means.

To control the connection of the translating units in response to the load on the translating station, we make use of a relay indicated generally at 15. This relay comprises a pivoted contact arm 16 which is adapted to engage either one of two fixed contacts 17 and 18. The contact arm 16 is actuated by solenoids 19 and 20 which cooperate with suitable core members attached to the ends of the arm 16. A spring 21 is provided to urge the arm 16 into engagement with the contact 18 when both of the relay solenoids are deenergized. A second spring 22 is so disposed that, when the arm 16 moves into engagement with the contact 17, the spring 22 will resist such movement with a definite force for a purpose to be later described. The relay 15 is also provided with a small electromagnet 23 which serves as a sticking magnet to maintain the arm 16 in engagement with the contact 17 when such engagement has once been effected.

The solenoid 19 of the relay 15 is connected to a current transformer 24 in the supply circuit and the solenoid 19, therefore, is energized in proportion to the total load current drawn from the supply circuit by the translating station, but this solenoid may be energized in accordance with the magnitude of any other quantity which varies in proportion to the total station load. The solenoid 20 is shown connected to a direct current control bus 25 in a circuit including the control bus 25, contact arm 16, the solenoid 20, resistors 27, 28 and 29 and the negative bus 30. The current traversing the solenoid under this condition is insufficient to withdraw the arm 16 from engagement with the contact member 18.

When all of the circuit-breakers 12, 13 and 14 are open, there will be no energy taken from the supply circuit 10 and, therefore, the solenoid 19 of the relay 15 will be deenergized. Similarly, the solenoid 20 will be energized to a slight extent only, since its circuit will include all the resistors 27, 28 and 29. As already stated, when the solenoids 19 and 20 are in this condition, the spring 21 serves to actuate the arm 16 into engagement with the contact 18.

This operation completes a circuit from the control bus 25 through the contact arm 16, contact 18, the operating coil of a circuit-breaker-closing relay 31 and thence to the negative bus 30.

The relay 31 is operated by the completion of the circuit above traced and closes its contacts 32, 33, 34 and 35. The closing of the contact 32 sets up a circuit from the control bus 25 through the contact 32, the forward field 36 of a series motor, through the armature 37 thereof, to a fixed contact of a timing relay 38. The closing of the contact 33 of the relay 31 completes a circuit from the control bus 25 through the contact 33 to the operating coil of the timing relay 38 and thence, through a back contact member 85 of a lockout relay 86, to the negative bus 30.

The time delay in the operation of the relay 38 may be obtained by any convenient means, as an example of which we have illustrated a dash pot 39. The function of the time relay 38 is to prevent initiation of the operation about to be described, on the occurrence of temporary or transient overloads, and after a time delay, the relay 38 closes its contact 40 to extend the circuit above traced for the motor 37 through the contact member 85 of the lockout relay 86, to the negative bus 30.

The motor 37 is connected by any convenient means to a rotating contact device 41 which consists of a series of fixed contact fingers 42 to 48, inclusive, and a corresponding number of contact segments 49 to 54, inclusive, which are mounted on a rotating drum adapted to be driven by the motor 37. When the forward field 36 of the motor 37 is energized, the contact segments 49 to 54 are so actuated that they engage successively the fixed contacts 42 to 48. The contact segments 49 to 54 are electrically connected by means of suitable conductors.

The fixed contact finger 42 is connected through the contact 34 of the relay 31 to a source of energy 55 for operating the closing solenoids of the circuit-breakers 12, 13 and 14. The closing coils of these circuit-breakers are connected to the contact fingers 43, 44 and 45 of the contact-making device 41, through the normally engaged contact members of lockout relays 82, 83 and 84.

When the operations so far described have been effected, the contact-making device 41

will start to rotate, being driven by the motor 37. When the device 41 has operated sufficiently so that the contact segment 49 engages the contact fingers 42 and 43, a circuit will be completed from the closing bus 55 through contact 34 of relay 31, contact finger 42, segment 49, finger 43, and the contact of relay 82, to the closing coil 56 of the circuit breaker 12, through a back contact 57 on the circuit breaker to the negative closing bus 58 which is connected to the negative bus 30 through contact member 35 of the relay 31.

The circuit-breaker 12 is thereupon closed and, through its main contacts, the translating device 1, which is first in the operating sequence, is connected to the supply circuit 10 to supply energy to the load circuit 2 through the circuit-breaker 3 which may be automatically closed by any suitable means. When the circuit-breaker 12 is closed it is latched in by a latch 59 which is adapted to be withdrawn by the energization of a tripping coil 60 in a manner to be later described. The closing of the circuit-breaker 12 interrupts the circuit to the closing coil 56 by opening the switch 57 which is so designed that it will not be opened until the circuit-breaker has been closed and latched. Simultaneously, the auxiliary switches 61 and 62 are closed. The switch 62 sets up a tripping circuit for the trip coil 60 which may be completed in a manner to be described hereinafter. The switch 61 of the circuit-breaker 12 short-circuits the resistor 27 in circuit with the solenoid 20 of the relay 15. This operation results in an increase in the energization of the solenoid which thereupon moves the contact arm 16 out of engagement with the contact 18.

When the contact arm 16 is moved out of engagement with the contact 18 by the increased energization of the solenoid 20, the circuit-breaker-closing relay 31 is deenergized by the interruption of the circuit to its operating coil, and its contacts are immediately opened. The relay 38 and the motor 37 are thereby deenergized and the contact-making device 41 is left in a position in which the segment 49 engages the fingers 42 and 43.

If the station load is now increased so that the engagement of the contact arm 16 with the fixed contact 18 is repeated, the above-described cycle of operations is duplicated. The relay 31 picks up its contacts, energizes the motor 37 when the relay 38 has closed its contact 40, and the contact-making device 41 is advanced so that the finger 44 is engaged by the segment 50. Simultaneously, the engagement between the contact finger 43 and the segment 49 is broken, but the contact finger 42 remains in engagement with the segment 49. The interruption of the circuit to the closing coil 56 of the circuit-breaker 12 resulting from the disengagement of the finger 43 and the segment 49 does not affect any portion of the apparatus since the circuit-breaker 12 is latched closed by the latch 59. When the finger 44 is engaged by the segment 50, a circuit is completed from the closing bus 55 through contact 34, contact 42, segment 49, segment 50, contact 44, the closing coil 61, and back contact 62′ of the circuit-breaker 13, and thence to the closing bus 58 and through contact 35 of relay 31 to the negative bus 30.

When this circuit is established, the circuit-breaker 13 is closed and by opening its contact 62′ deenergizes its closing coil 61′. The breaker is latched in by the latch 63 and the circuit to the tripping coil 64 is set up by the closing of the contact 65. The closing of the contact 66 short circuits the resistor 28 in circuit with the solenoid 20 of the relay 15. The energization of the solenoid 20 is again increased so that the arm 16 of the relay is moved out of engagement with the contact 18, whereby the relay 31 is deenergized and the motor 37 is stopped.

It will be obvious that, upon a further increase of the load on the station, the operations already described will be repeated. The coil 67 will be energized and the circuit breaker 14 closed and latched in by the latch 69 to connect additional translating capacity to the supply circuit. Simultaneously, the auxiliary switch 68 will be opened to deenergize the closing coil, and switches 70 and 71 closed to short circuit the resistor 29, and to set up a circuit for the trip coil 72, respectively. This cycle of operations may be repeated until all available translating capacity is connected between the supply and load circuits.

If it now be assumed that the circuit breakers 12, 13 and 14 are closed, the contact device 41, in accordance with the above explanation, will occupy a position such that the segment 51 engages the finger 45. If the load on the station now decreases, the energization of the solenoid 19 of the relay 15 becomes insufficient to maintain the contact arm 16 out of engagement with the contact 17, if the decrease in the load is sufficient to permit the solenoid 20 to compress the spring 22 which tends to oppose the engagement of the arm 16 and the contact 17. The function of the spring 22 is to prevent engagement of the contact members 16 and 17 upon small decreases in the station load. When the load has decreased to such an extent that a single translating device may safely be disconnected, the spring 22 is compressed by the solenoid 20 and the contact arm 16 engages the contact 17.

The engagement of the contact arm 16 and contact 17 completes a circuit from the control bus 25 through the contact arm 16, contact 17, the operating coil of a relay 75, and thence to the negative bus 30. At the same time, the solenoid 23 is energized to maintain the contact arm 16 in engagement with the

contact 17 until the relative energizations of the solenoids 19 and 20 are altered. When the operating coil of the relay 75 is energized, it operates after a time delay introduced, for example, by a dash pot 75', to close its contacts 76 to 79, inclusive. The dash pot 75' serves to prevent false operation of the device 41 as a result of transient changes in the station load. The closing of the contact 77 connects the operating coil of the timing relay 38 to the control bus 25. The closing of the contact 78 connects the reverse field 80 of the motor 37 to the control bus 25 and when the contact 40 is closed at the end of the time for which the relay 38 is set, the motor 37 operates to return the contact-making device toward its original position. Before the contact-making device is moved, however, a circuit is completed from the control bus 25 through the contact 79 of the relay 75, to the contact finger 42 of the device 41 and thence to the segment 49. The segment 51 being electrically connected to the segment 49, the circuit continues therethrough to the contact finger 45 and thence to the trip coil 72 of the circuit-breaker 14, which is connected through the auxiliary switch 71 to a tripping bus 81 which is in turn connected by the contact 76 of the relay 75 to the negative bus 30.

Thus a circuit is completed through the trip coil 72 of the circuit-breaker 14 before the contact-making device 41 is operated in the reverse direction by the motor 37. The tripping of the circuit-breaker 14 opens the auxiliary switches 70 and 71 and closes the auxiliary switch 68. When the switch 70 is opened, the short-circuit around the resistor 29 is removed and the current in the circuit including the solenoid 20 is thereby reduced. The opening of the switch 71 deenergizes the trip coil, and the closing of the switch 68 sets up a circuit to the closing coil 67.

If the load on the station is such that, even with the reduced current, the solenoid 20 maintains the contact arm 16 in engagement with the contact 17, the relay 75 is maintained energized and the motor 37 operates to move the contact segments of the device 51 in the reverse direction so that the segment 50 is brought into engagement with the contact 44. When this happens the tripping coil 64 is energized and the circuit-breaker 13 is opened.

The opening of the circuit-breaker 13 opens the switch 66 and inserts the resistor 28 in series with the solenoid 20, so that the energization thereof is again decreased. If the relative values of the station load and the combined capacity of the translating device connected to the supply circuit are such that the load may be supplied by the translating device controlled by the circuit-breaker 12, the solenoid 19 will cause the separation of the contact arm 16 from the contact 17, being aided by the springs 21 and 22 and opposed by the sticking magnet 23. The disengagement of contact members 16 and 17 deenergizes relay 75 and stops the controller 41 in a position such that finger 44 engages segment 50.

If the station load decreases further, the circuit-breaker 12 will automatically be opened and the translating device controlled thereby disconnected from the supply circuit 10, and the contact device 41 will be returned to its original position at which none of the fingers are engaged by any of the segments.

It will be obvious that the system of our invention may be employed to control the connection of any number of translating units between a load circuit and a supply circuit. We also make provision for giving an alarm and suspending further automatic operation of the station upon the occurrence of a load demand in excess of the aggregate capacity of all the units in the station.

To accomplish this result, the coil of the relay 86 is connected to the contact finger 48 which is adapted to engage the segment 54 when the drum 41 has moved into such position that all available translating units are connected and in operation. The relay 86 is provided with a mechanical latch so that when once actuated, it remains in the actuated position until released manually. The latch and releasing mechanism is illustrated at 87.

When the contact finger 48 engages the segment 54, a circuit is completed from the control bus 25 through the contact 34 of the relay 31, which is actuated in the manner already described when the load demand on the station increases, contact finger 42, segment 49 and segment 54 which is electrically connected to the segment 49, finger 48, coil of the relay 86 and thence to the negative bus 30. When the operating coil of the relay 86 is energized, its contact member 85 disengages the lower fixed contact members and bridges the upper fixed contact members. The lower fixed contact members of this relay are connected in series with the motor 37 which drives the drum 41, so that after the relay 86 has operated, further operation of the motor-driven drum-controller is precluded. At the same time, a circuit from the control bus 25 through the contact member 34 of relay 31, contact finger 42, drum controller, contact finger 48 to an alarm device such as a gong 88 and through the contact member 85 of the relay 86 to the negative bus 30 is completed.

As long as the excessive demand exists, the relay 15 will be actuated to engage the contact member 18 so that the circuit for the relay 31 is maintained. Thus the contact finger 42 is connected to the bus 25, and the energizing circuit of the alarm 88, which may be of any suitable type, remains closed.

After the automatic operation of the station has been suspended by the operation of the relay 86, it is necessary for an attendant to visit the station to reset the relay 86, although it is obvious that means may be provided for resetting this relay from a distance. After resetting, automatic operation of the station is resumed in the manner already described. It is apparent that the operation of the relay 86 may be employed to effect the disconnection of all the translating units from both the load and supply circuits upon the occurrence of a predetermined overload on the station.

It will thus be apparent that the automatic station of our invention operates in response to an increase in the load on the station to connect additional translating devices to the supply circuit to assume a portion of the load and that when the station load decreases, the unnecessary translating devices are disconnected from the supply circuit.

As previously set forth, the system of our invention may be utilized to control a connection of any type of translating devices to a supply circuit. If the station is an automatic transformer station, the circuit-breakers 12, 13 and 14 may be employed to connect the primaries of the transformers to the supply circuit. The secondaries of the transformers may be connected to the load circuit simultaneously with the operation of the primary circuit-breakers 12, 13 and 14 or a short time thereafter.

If any of the translating devices are out of service for any reason, the system of our invention will operate to pass over such defective devices and connect the next unit to the supply circuit, or if any unit is removed from service by any protective device, an additional unit will immediately be connected to the supply circuit. Obviously, the usual protective apparatus such as thermal relays, overload relays or any other form of protective apparatus desired, may be utilized in connection with my invention. We have shown lockout relays 82, 83 and 84, associated with the circuit-breakers 12, 13 and 14, to open the circuits of the closing coils of the circuit-breakers upon the occurrence of any predetermined abnormal condition.

Instead of employing the current in the supply circuit as a measure of the station load, any other suitable electrical quantity such as the power or the voltamperes may be used instead.

An especially advantageous feature of our invention is the combination of the restrained tripping action of the relay 15 and the timing action of the relay 38. The latter prevents the connection of any additional translating capacity to the supply circuit unless the overload on those already connected is sustained for a predetermined period. The relay 15 is so designed and the spring 22 is so adjusted that when the station load decreases, no translating equipment will be disconnected from the supply circuit until the load has decreased so that it may be safely carried by the remaining translating devices. By this arrangement, successive connection and disconnection of any translating unit is prevented but at the same time an additional unit is placed in service whenever the excess loads remain for a predetermined time.

Our invention is not limited to stations utilizing translating devices of the type mentioned, or to electrical systems, since it is easily adaptable to stations in which the translating devices are water-wheel generators or similar devices and to pneumatic or hydraulic systems as well as electrical systems. Since our invention is obviously susceptible of changes and modifications such as will be apparent to those skilled in the art, we do not intend to be limited to the system or apparatus herein shown and described, but desire to cover all such changes and modifications as fall within the scope of the appended claims.

We claim as our invention:

1. In an automatic translating station, a load circuit, a supply circuit and a plurality of translating devices adapted to be connected to the supply circuit through circuit-breakers, means for successively closing said circuit-breakers in response to an increase in the load on the station, including a motor-driven drum switch, a balance relay having two opposing coils, one of which is energized in proportion to the load on the station and the other in proportion to the number of translating devices connected to the supply circuit, and means whereby the relay controls said switch.

2. An automatic station comprising a plurality of translating devices adapted to be connected through circuit-breakers to a supply circuit, means for causing the successive closing of said circuit-breakers in response to an increase in the load on the station including a reversible drum controller and a motor for driving said controller in either direction, and means energized respectively in proportion to the station load and the number of translating devices connected to the supply circuit, for controlling said motor.

3. In an automatic translating station, a plurality of translating devices for supplying energy to a load circuit, circuit-breakers for connecting said devices to a supply circuit, means for causing said circuit-breakers to be closed successively upon an increase in the load on the station, and means for causing the successive opening of said breakers in the reverse order of their closing, upon a decrease in the station load, said means including a motor-driven switch and a relay responsive to the station load and the number

of devices connected, for controlling said switch.

4. The combination, in an automatic translating station, with a plurality of translating devices, means for successively connecting said devices to a supply circuit to transfer energy to a load circuit when the station load increases, of means for automatically disconnecting said devices in the inverse order of their connection upon a decrease in the station load, and means for preventing the disconnection of any of said devices until the station load has decreased so that it may be supplied by the devices remaining in service, said means including a sequence switch and a load-responsive relay for controlling said switch.

5. In an automatic translating station the combination with a plurality of translating devices for supplying energy to a load circuit, circuit-breakers for connecting said devices to a supply circuit, closing and tripping coils for said circuit-breakers, of a relay for setting up circuits to said closing and tripping coils, and a contact-making device controlled by said relay for successively completing the circuits to said circuit-breaker closing coils, whereby when the station load increases additional translating devices are connected to the supply circuit and when the station load decreases, the translating devices are successively disconnected from the supply circuit, in the inverse order of their connection thereto.

6. An automatic translating station comprising a plurality of translating devices for supplying energy to a load circuit, circuit-breakers for connecting said devices to a supply circuit, closing and tripping coils for said circuit-breakers, a relay for setting up circuits to said closing coils or to said tripping coils depending on the relative values of the station load and the aggregate capacity of the connected devices, and a contact-making device controlled by said relay for completing successively the circuits to the said closing coils if the station load is greater than the aggregate of the capacities of the connected devices, or to said tripping coils if the station load is less than the combined capacities of the translating devices operating.

7. In an automatic station, the combination with a plurality of translating units, a supply circuit and a load circuit, and means for connecting said units to said circuits, of means responsive to the difference between the load on the station and the number of translating units connected, for causing the connection of said units to said circuits.

8. In an automatic station, a load circuit, a supply circuit and a plurality of translating units, means for connecting said units to said circuits, and means for controlling said connecting means including a relay having opposing actuating elements and a movable contact-making member, means for biasing said movable contact-making member to maintain the connection of one of said units to said circuits at all times, and means whereby said actuating elements are energized to render said movable contact-making member ineffective as long as the station load is less than the capacity of the connected unit.

In testimony whereof, we have hereunto subscribed our names this 18th day of June, 1928.

CHARLES McL. MOSS.
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