

MODIFICATION OF POWER PLANTS FOR AUTOMATIC CONTROL AND REGULATION OF MOTOR-GENERATOR SETS AND REGULATED RECTIFIERS EQUIPMENT DESIGN REQUIREMENTS POWER SYSTEMS

1. GENERAL

SCOPE

1.01 This specification, together with the supplementary information listed herein, covers the equipment design requirements for the equipment and circuits to be used in the applique of automatic control equipment to existing power plants. This consists of the addition of the necessary control for converting existing commercial and M-type motor-generator sets for automatic voltage regulation with automatic start control. It also provides for the addition of 30-, 100-, and 200-ampere, 24- and 48-volt regulated rectifiers.

1.02 This specification is reissued:

- (a) To remove the KS-5651-01 rectifier which is "Mfr. Disc." and to add the KS-15689 200-ampere, 48-volt rectifier.
- (b) To remove manual start control, with automatic regulation, from the list of recommended circuit arrangements. Automatic start control of at least two charging units provides recharge capability after power failures during light-load periods when unattended operation is most likely.
- (c) To revise equipment information to specify J86260 or J86261 for generator control bays with automatic start and automatic regulation. For additions of manual start manual regulation units, J86234 or J86236 still apply.
- (d) To no longer recommend generator control equipment in the power board line-up.

DESCRIPTION

1.03 The circuit and equipment arrangements covered herein are for modifying existing 320- and similar type power plants



Fig. 1 - Addition of 30-ampere Regulated Rectifiers

for automatic control so that they may be operated on a full or part time unattended basis. They are also for use in ampere-hour meter or manually controlled power plants where it is desired to convert from a charge-discharge battery routine to the full-floating routine. Rectifiers referred to in this specification are as follows:

Rectifiers	Amperes	Volts
J86263B	30	24
J86263A	30	48
J86249B	100	24
J86249C	200	24
J86249A	100	48
KS-15689	200	48

1.04 The circuit arrangements which are covered herein provide for the following:

- (a) Thirty-ampere, 24- and 48-volt regulated rectifiers arranged for automatic voltage regulation with automatic start control.
- (b) Motor-generator sets and/or 100- or 200-ampere rectifiers arranged for automatic voltage regulation and automatic starting and stopping under control of the charge circuit load and the battery voltage.
- (c) Thirty-ampere rectifiers with motor-generators and/or 100- or 200-ampere rectifiers arranged for automatic voltage regulation and automatic starting and stopping under control of the charge circuit load and the battery voltage.

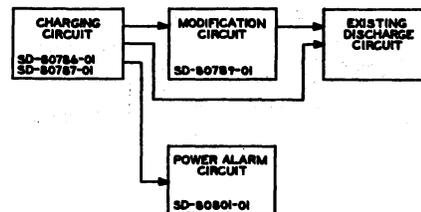


Fig. 2 - Ampere-hour Meter Controlled Plants

Thirty-ampere Regulated Rectifiers Arranged for Automatic Operation

1.05 This arrangement consists of one to four 30-ampere, 24- or 48-volt rectifiers arranged for automatic regulation. In plants using more than one rectifier, the first rectifier is operated continuously to maintain the battery within its floating limits. Additional rectifiers are started automatically under control of the charge circuit load and the battery voltage, as required, to carry the office load and maintain the battery voltage. The circuit arrangement for these rectifiers is also suitable for use as light-load charging equipment where motor-generator sets arranged for manual control are used during the heavy-load periods of the day. Fig. 1 covers the various circuits which are required for plants which are to be modified for this type of operation. Where ampere-hour meter controlled plants are to be arranged for full-float operation, facilities are available for applying a single 30-ampere rectifier so arranged that when the load on this rectifier increases to its full-ampere output, one or two 12-ampere tungar rectifiers can be started automatically to supplement the regulated rectifier. Fig. 2 covers the various circuits required for modifying the ampere-hour meter controlled power plants.

1.06 Where the ampere-hour meter control plants are modified to use the 30-ampere regulated rectifier, it will also be necessary to modify the existing CEMF cell control circuit to cut the CEMF cells into and out of the discharge circuit one cell at a time. It will also be necessary to readjust the voltage relay to operate on voltage limits of 47.75-50.75 volts.

1.07 On those plants having three steps of CEMF cell control with the first step being operated under control of the ac line contactor which connects and

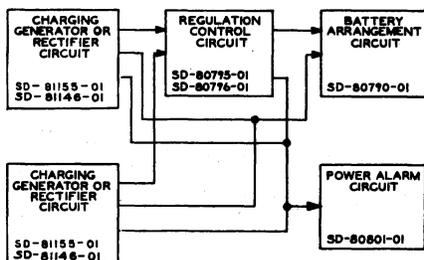


Fig. 3 - Motor-Generator Sets Arranged for Automatic Starting and Regulation

disconnects the rectifiers, the control circuit should be modified as shown on SD-80789-01, Fig. 5, to cut the counter-cells into and out of the circuit one cell at a time. The voltage relay will also require readjusting as outlined in 1.06.

Motor-Generator Sets and/or 100- or 200-ampere Rectifiers Arranged for Automatic Control and Regulation

1.08 This arrangement is for plants where two or more charging units are required to carry the load and it is desired to arrange the charging units for automatic starting and stopping under control of the office load. This arrangement provides for a maximum of six charging units.

1.09 With this method of operation, all motor-generator sets are equipped with motor-driven rheostats and automatic motor starters, and the 100- or 200-ampere rectifiers are equipped with relay regulation units for controlling their output. A voltage regulation circuit common to all charging units controls the operation of the motor-driven rheostats and the rectifier relay regulation units.

1.10 One charging unit is operating at all times with the voltage regulation circuit, by means of the control equipment associated with the charging unit, maintaining the output of this unit at the proper value to float the battery. As the office load increases, the battery voltage will decrease and the voltage regulation circuit will cause the control circuit to function and increase the output of the charging unit and thereby maintain the battery voltage within the floating limits.

1.11 When the load on the charging unit reaches its full-load ampere rating, its associated ammeter relay will cause the succeeding charging unit to be brought into service and to be controlled by the voltage regulation circuit.

1.12 In case the next unit is a motor-generator set, the set will be started and the voltage regulation control which is immediately transferred to govern the

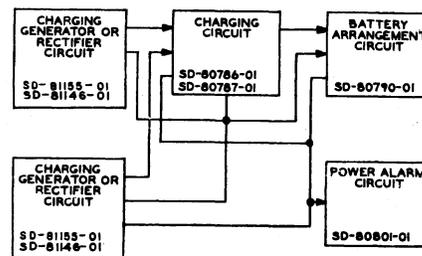


Fig. 4 - Combination of Rectifiers and Motor Generators with Automatic Starting and Regulation

added machine, will cause the voltage of this set to be raised and the circuit breaker to operate and connect the generator to the battery. This generator is then controlled by the voltage regulation circuit and its load adjusted as required. If the next charging unit is a 100- or 200-ampere rectifier, the voltage regulation or control will be connected to it, and will cause its output to increase as required to float the load. The output of the preceding charging units will remain unchanged. Succeeding charging units will be put into service in the same manner, as the load requires. Fig. 3 covers the various circuits required for this method of operation.

Thirty-ampere Rectifiers with Motor-Generator Sets and/or 100- or 200-ampere Rectifiers Arranged for Parallel Operation and Automatic Start Control and Regulation

- 1.13 The arrangement is a combination of those described in 1.05 and 1.10. It provides for one or two 30-ampere rectifiers and one or more motor-generator sets and/or 100- or 200-ampere rectifiers, with a maximum of six charging units.
- 1.14 One 30-ampere rectifier runs continuously and the second one is started as described in 1.05. When it reaches full-load ampere rating, one or more motor-generators or 100- or 200-ampere rectifiers are started one at a time as required by load, the charging units being maintained at their full-load ampere output and the regulation of battery voltage being maintained by the regulation circuit and the last operating generator or rectifier.
- 1.15 This arrangement is for use in plants where the load during the unattended or light-load period is too small to operate a motor-generator set or 100- or 200-ampere rectifier economically. Fig. 4 covers the various circuits required with this method of operation.

Manual Operation of Supplementary Charging Units

- 1.16 The automatic operation described may be applied to only the first one or two charging units, if desired. Supplementary units may be operated on the existing manual start, manual regulation basis where the additional charging capacity is only required during attended periods. At least two automatic units are usually furnished so that regulation is maintained when one unit is removed from service.

Equipment Arrangements

- 1.17 Due to the various equipment arrangements of existing power plants, definite recommendation which will be applicable in all cases cannot be made. Where

possible, standard equipment units and assemblies should be provided as outlined herein.

Rectifiers

- 1.18 The 30-ampere, 24- and 48-volt regulated tube rectifiers per J86207P and J86207S have been replaced by regulated metallic rectifiers per J86263B and J86263A. The new rectifiers are essentially the same as the replaced rectifiers except for the substitution of rectifier stacks for the tubes. Applique units have been made available so that rectifier tubes of existing J8620P and J86207S rectifiers can be readily replaced by rectifier stacks. ED-81627-01 shows applique units consisting of rectifier stacks. Group 1 of this drawing covers an applique unit for a 48-volt rectifier and group 2 for a 24-volt rectifier. ED-81572-01 shows applique units with rectifying stacks and powerstat as an assembly. Groups 1 and 2 of this drawing show applique units for 48- and 24-volt rectifiers, respectively. Equipment producing a considerable amount of heat should not be mounted below the rectifier stacks which are on the rear of the rectifier. ED-81631-01 shows the method of assembling the conversion units on the rectifier.
- 1.19 J86249 or KS-15689 rectifiers are self-contained, floor-mounted units 3 feet 0 inch long, 2 feet 6 inches deep, and 7 feet 0 inch high. Location of these rectifiers should follow the practice for locating motor-generators. ED-81264-01 shows the cabling of the rectifiers in the machine line-up.

Charging Generator Equipment

- 1.20 Generator control bays with motor-driven rheostats and associated motor starters per J86260 or J86261 are used for control of the automatic start, automatic regulation charging units. The motor-driven and the manual rheostats, which form a part of these units, may not have a suitable value of resistance for the existing generators. In order to determine the amount of resistance required for use with the generator, the no-load, full-load field saturation data should be provided. In the event that the above information is not obtainable, the complete nameplate data should be furnished.
- 1.21 For additions of manual start, manual regulation charging units, J86234 and J86236 cover the required equipment.
- 1.22 On semiremote controlled plants where the generator circuit breaker and switch panels are mounted adjacent to the machine and the unit is to be equipped with an automatic circuit breaker, with manual or automatic starter, these panels

should be replaced with a J86260 or J86261 generator control bay assembly of suitable capacity.

- 1.23 When the generator control equipment is mounted in the power board line-up, it should be replaced by control bay assemblies located at the machine, as outlined in 1.22.

Regulation and Control Relay Equipment Units

1.24 ED-80997-01 covers the various relay and control units required for the circuits listed in this specification. The group numbers contained on this drawing include the local wiring and relays, resistances, etc., for the circuit specified. These units use 23-inch relay mounting plates which are to be located on a 2-foot 0-inch to 2-foot 6-inch wide power board bay by means of adapters in a similar manner to that shown on ED-80919-01. In those cases where sufficient alarm-type fuses are not available for supplying these circuits, one or more unit fuse panels per ED-90425-01, Group 2, should be provided and mounted with the relay equipment units.

Motor Starters

1.25 In those cases where the motors are equipped with starters of the contactor type using push-button control, such as KS-5236 starters, they can be converted for automatic control by removing the push-button switch and adding a KS-5483, List 21 or List 24, relay mounted inside of the starter case.

1.26 Motors equipped with manually controlled reduced voltage starters, such as KS-5140 and similar type starters, will require replacement with automatic starters.

Power Alarms

1.27 SD-80801-01 covers the various alarms required for the applique of the equipment contained in this specification.

1.28 On plants equipped with high-low and floating voltage alarms, the alarm circuits should be modified to agree with Fig. 4 and 15 of this drawing to provide the delayed alarm feature.

1.29 On plants not equipped with floating voltage alarms, the regulator failure alarms, in accordance with Fig. 12, should be provided. In the case of those plants which obtain the high-low voltage alarm from the voltage relay associated with the CEMF cell control circuit, the regulator failure alarm is not required.

1.30 The other alarms, in accordance with the various figures shown on SD-80801-01, should be provided, as required,

for the equipment specified. The alarm relay and lamp equipment shall be mounted in the same locations as existing alarm equipment for the particular installation.

Charge Lead Filters

1.31 When commercial-type generators are added to power plants which do not have a discharge lead filter, it will be necessary to add a charge lead filter in the new generator circuit. SD-80325-01 and ED-81417-01 are schematic and equipment modification drawings for this purpose.

2. SUPPLEMENTARY INFORMATION

802-000-000 - Power Systems Index
 AA128.002 - List of Equipment Design Requirements Sections
 AA128.006 - List of General Equipment Requirements Sections
 J86234 (802-152-150) - Charging Equipment for 301C Plant
 J86260 (Mfr Disc.) - Charging Equipment for 301C and 302A Plants
 J86261 (Mfr Disc.) - Charging Equipment for 301C and 302A Plants
 E-1378 - Checking and Classified Lists - KS-5000 Series Specifications
 Power Data Book

3. DRAWINGS

Circuits

SD-80325-01 - Modification Circuit for Charge Lead Filters
 SD-80786-01 - Charging Circuit Using 30-ampere, 48-volt Rectifiers With or Without Motor-Generator Sets or KS-5651-02 or J86249 Rectifiers
 SD-80787-01 - Charging Circuit Using 30-ampere, 24-volt Rectifiers With or Without Motor-Generator Sets or KS-5651-02 or J86249 Rectifiers
 SD-80789-01 - Modification of Ampere-hour Meter Controlled Plants for Applique of 30-ampere Rectifiers
 SD-80790-01 - Battery Arrangements of Existing Plants
 SD-80795-01 - Regulation and Control Circuit - Automatic Operation of Motor-Generator Sets and KS-5651-02 or J86249 Rectifiers - 45 to 50 Volts
 SD-80796-01 - Regulation and Control Circuit - Automatic Operation of Motor-Generator Sets and KS-5651-02 or J86249 Rectifiers - 22 to 26 Volts
 SD-80801-01 - Power Alarm Circuit
 SD-81129-01 - Regulated Disc Rectifier Circuit (J86249)
 SD-81146-01 - Rectifier Application Schematic J86249 and KS-15689 Rectifiers
 SD-81155-01 - Charging Generator Circuit
 SD-81178-01 - Motor Starter Circuit

- SD-81180-01 - Rectifier Circuit - Metallic Type - Automatic Regulation - 48 Volts, 30 Amperes
- SD-81181-01 - Rectifier Circuit - Metallic Type - Automatic Regulation - 24 Volts, 30 Amperes
- SD-81242-01 - Rectifier Circuit Metallic Type (KS-15689)
- Framework, Equipment, and Assemblies
- ED-80459-01 - Motor Starter Mounting Frameworks
- ED-80679-01 - Machine Mounting Framework
- ED-80729-01 - Motor Starter Mounting Frameworks
- ED-80919-01 - Main Control Board Relay Equipment
- ED-80997-01 - Rectifier, Regulation, and Control Applique Units
- ED-81264-01 - Bus Bar and Cabling of Rectifiers
- ED-81417-01 - Modification Drawing for Addition of Charge Lead Filter to Charging Generator Assembly
- ED-81523-01 - J86249 Rectifier Assembly
- ED-81571-01 - Rectifier Equipment - Metallic Type - Automatic Regulation - 48 and 24 Volts, 30 Amperes, DC (J86263)
- ED-81572-01 - Applique Equipment - Discs and Powerstat - J86207P and J86207S
- ED-81577-01 - Generator Bay Assemblies - 302A Plant
- ED-81627-01 - Applique Equipment - Discs Only - J86207P and J86207S
- ED-81631-01 - Applique Assembly - Metallic Type - Powerstat Control - J86207P and J86207S
- ED-90425-01 - Fuse Board Panels for Individual Mounted Fuses

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