RECTIFIERS

MISCELLANEOUS SEMICONDUCTOR TYPE

OPERATING METHODS

1. GENERAL

1.01 This section covers unregulated and manually regulated rectifiers containing semiconductor-type rectifying elements used in power plant applications.

1.02 This section is reissued to add reference to the J86254B and the J86254C rectifiers which have been incorporated into one unit, the J86254C with four options. This reissue does not affect the Equipment Test List.

1.03 The following list is given as typical of the rectifiers covered. It is not planned to revise the section for the sole purpose of keeping the list up to date.

J86205	KS-5156	KS-5386
J86220	KS-5172	KS-5444
J86230	KS-5250	KS-5454
J86248	KS-5251	KS-5460
J86254 (See Note 1)	KS-5257	KS-5653
J86255	KS-5300	KS-5663 (See Note 2)
J86256	KS-5338 or KS-5338 L2, L2A, L3, or L4	KS-5703
J86257	KS-5363	KS-5739
J86258	KS-5363-01	KS-5740
J86259	KS-5368	KS-15687
J86264		
J86265		

Raytheon Cat. 1044-FR and 1044-HR
Westinghouse Style 1228746
Power Equipment Corp 594

Note 1: The J86254B (230 VAC input, 190 VDC output) and the J86254C (115 VAC input, 200 VDC output, with or without bobble suppressor) have been incorporated into one unit; the J86254C, with four options.

Note 2: Only L1 through L7 of KS-5663 are covered in this section. L8 through L10 of the KS-5663 are covered in Section 169-445-301.

It is also applicable to other semiconductor-type rectifiers as, for example, the rectifiers furnished with engine starting batteries.

Warning: Voltages inside the rectifier case are in some units higher than 150 volts to ground. Avoid all contact with terminals as high voltages may be present. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. The door switch, when open, disconnects only one side of the power supply so that some terminals may be alive or at service voltage to ground. The door switch is provided for the protection of personnel and should not be made inoperative. Disconnect ac supply before opening door or cover to work inside of a rectifier unit.

1.04 For more detailed information on the operation and maintenenace of individual equipment or apparatus in the rectifiers, refer to the appropriate Bell System Practice.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
R-1032, Detail 1	Thermometer

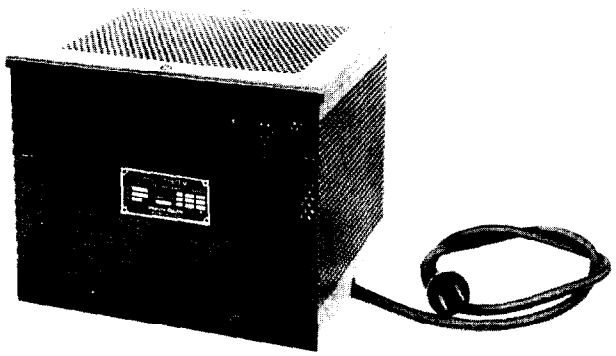

Fig. 1—J86205 Rectifier—Unregulated—Front View

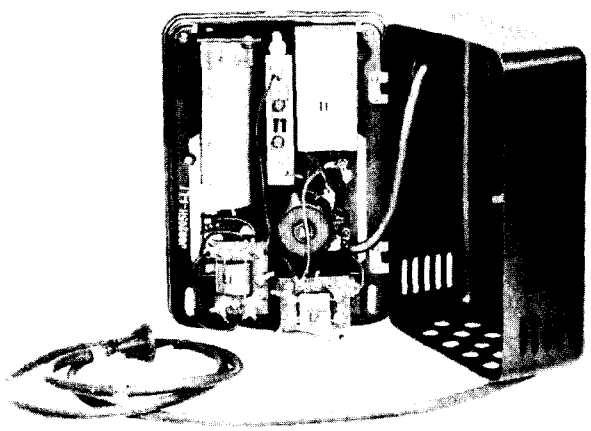

Fig. 2—J86205H, List 1 Rectifier—Cover Open

3. OPERATION

Description

3.01 These rectifiers, in general, consist of a transformer, semiconductor rectifying element, and, in some cases, a filter, all packaged in a case for relay-rack shelf-type mounting.

3.02 The KS-5338 L2, L2A, or L3 tube-replacement rectifier consists of a semiconductor rectifying element assembled in a cover and replaces the front cover and mercury arc rectifying tube (no longer available) of the KS-5338 mercury arc rectifier. The KS-5338 L2A and L3 are the same as the KS-5338 L2 except that they are made by different manufacturers. The KS-5338 L4 is a rectifying element replacing the rectifying element in the KS-5338 L2A tube replacement rectifier which is "Manufacture Discontinued."

3.03 Rectifiers may be provided with transformers having taps to adapt the rectifiers to various power service voltages. In addition, taps are usually provided to adjust the output voltage and charging current to the various loads and applications. Sometimes separate aging taps are provided to overcome the effects of aging of the rectifying element. In other cases, the load adjusting and aging taps are combined. All these taps may be connected to a terminal board to be accessible for changes. In some cases, rheostats are provided instead of, or to supplement, transformer taps in making a close adjustment. In other cases, the rectifier may be provided with a continuously tapped autotransformer for making adjustments of the output.

3.04 The semiconductor rectifying element may use copper-oxide or selenium cells or silicon diodes. Aging is the increase in the resistance of a cell. With some cells and on some applications, aging may develop quite slowly. With other cells, particularly during the first months of use, aging may develop more rapidly. It is anticipated that a silicon rectifying element has no forward aging characteristics. A rectifying element that is subject to aging is considered satisfactory until aging reaches the point where rated output cannot be obtained by changing taps or operating a rheostat. Aging is accelerated by current overload. Poor ventilation, operation near hot equipment, etc are undesirable. High voltages, long periods of current overload, high temperatures, or poor ventilation may even cause the rectifying element to break down electrically, rendering the element useless. In the case of a copper-oxide or selenium rectifying element, corrosive fumes, such as those from sulphuric acid or mercury vapor, may also cause rapid aging or breakdown of the element.

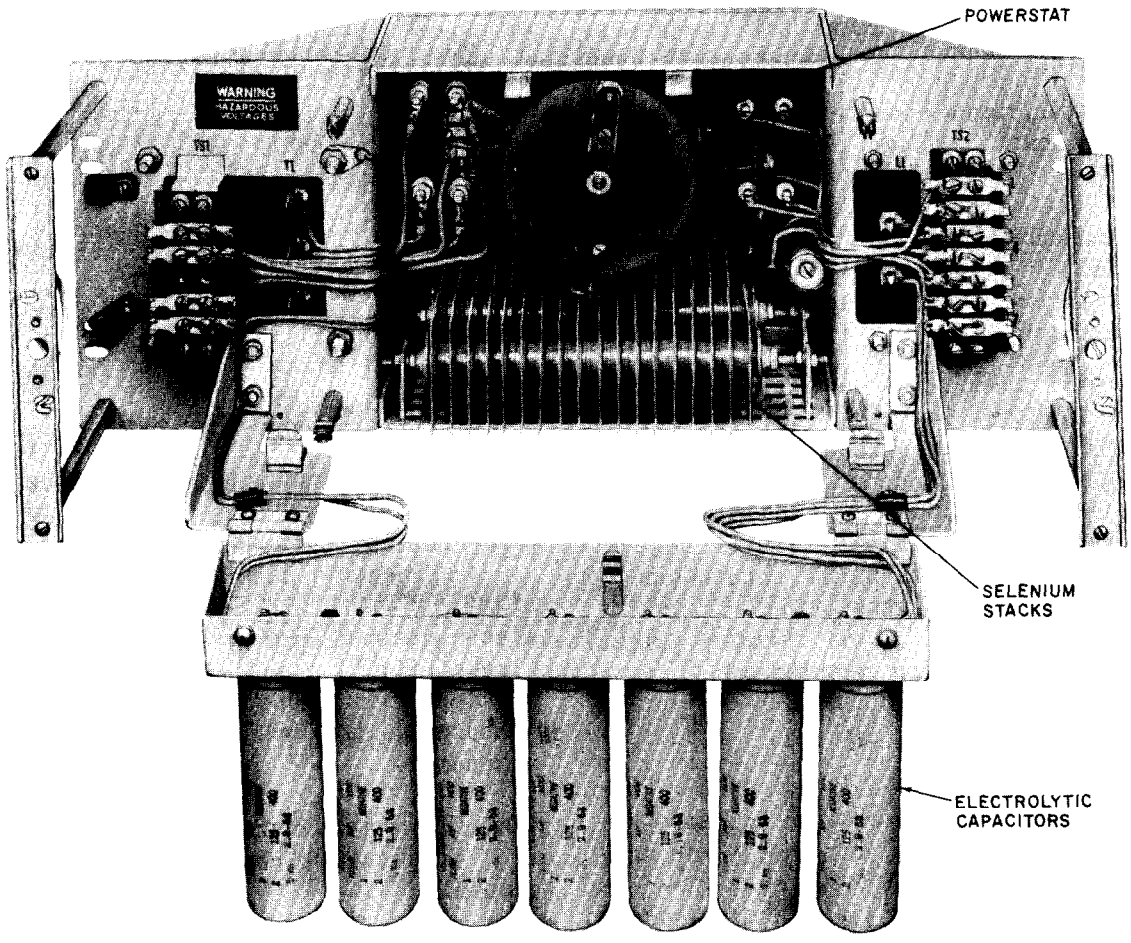

Fig. 3—J86254B, List 1 Rectifier—Rear View—Cover Off

3.05 A rectifier may be equipped with a filter consisting of one or more inductors (retardation coils), resistors, and capacitors, particularly if the output is to be used on talking or quiet circuits. These are not adjustable but are fixed by the design.

3.06 A relay is sometimes included to transfer the load to a reserve battery in case of power failure. This relay requires no special maintenance. It should release when ac power is disconnected and operate when it is connected.

Preparing to Start Initially

3.07 When putting a rectifier in service initially, check to see that:

(a) There is nothing in or on the rectifier to interfere with its operation or prevent free ventilation.

(b) Proper transformer primary taps are connected to the power service voltage to be used or, if no taps are provided, that the rectifier is rated for the power service to be used.

(c) Proper fuses are in place in the rectifier or the input and output circuits.

(d) The lowest secondary transformer taps are connected, unless previous experience has indicated a better choice.

Initial Adjustments

3.08 Transformer tap selection is nearly always necessary. Tap changes are made in various ways, such as by plugs, jacks, switches, links, connections on a terminal block, etc.

3.09 Primary taps, when provided, are usually for different line voltages. Where the proper

tap to use is not obvious from the marking, the circuit or circuit label notes give the necessary instructions.

3.10 Secondary taps are provided for the adjustment of the output voltage. Where both coarse and fine taps are provided, the output setting is made as close as possible with the coarse taps; final adjustment is made with the fine taps or, in some cases, a rheostat. In some cases, secondary taps are provided for different output voltages and in such cases the taps are identified.

3.11 In some cases, no-load and full-load current and full-load voltages of the rectifier may be appreciably different. In such cases, the final adjustment of secondary taps should be made to obtain at least minimum voltage requirements with the rectifier at full-load current. Where a rectifier has more than one set of output connections to supply different types of loads, output adjustments should be based on the battery charging output and the battery operating requirements, if any; otherwise the output adjustment should be based on the relay supply output.

> ***Note:*** Transmitter talking supplies of the J86205A and J86205H rectifiers are examples whose output voltages vary widely with load. Where there is also a relay supply on the same rectifier, the transmitter supply no-load voltage of the rectifier may be as high as the relay supply voltage. When loaded with transmitters, nominal 3.5 volts, the voltage may be from 3 to 8 volts depending on the transmitter characteristics and the loop resistance.

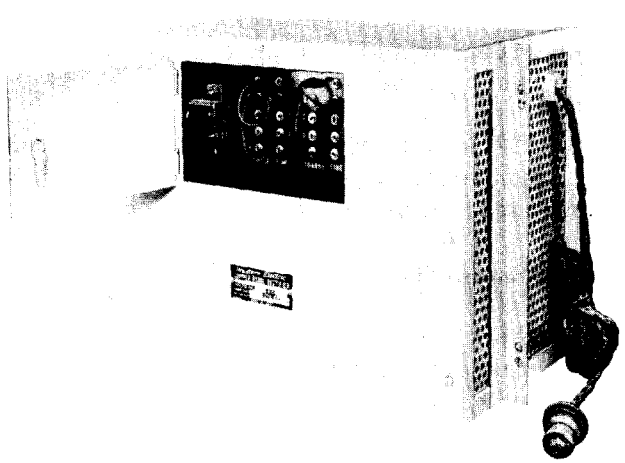

Fig. 4—KS-5444 Rectifier

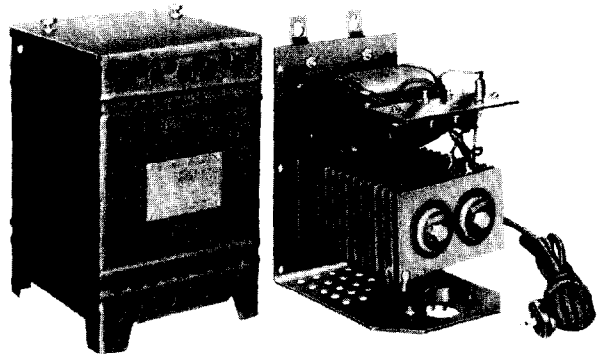

Fig. 5—KS-5454 Rectifier

4. ROUTINE CHECKS AND ADJUSTMENTS

4.01 Routine checks are intended to detect defects, particularly in infrequently operated parts of the equipment, and insofar as possible to guard against circuit failures which interfere with service. Checks and adjustments other than those required by trouble conditions should be made during a period when there will be a minimum interference with service.

4.02 For routine starting and stopping, it is only necessary to connect or disconnect the ac supply.

4.03 Local standards for cleanliness should apply to the rectifiers. It is especially important that ventilating passages and rectifying elements be clean to reduce heating. Cleaning of the cells of the rectifying element should be by air only.

4.04 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

4.05 The output voltage and load current should be measured periodically, if and as facility for the measurement is provided, to check that they are correct for the operating load.

5. TROUBLES

5.01 Semiconductor rectifying elements may fail due to the following reasons.

(a) Excessive aging (see 3.04).

(b) Operating the rectifier near heat producing equipment causing the air surrounding the rectifier to exceed the rated maximum temperature.

(c) Operating the rectifier at output currents above the rectifier rating.

(d) Operating with the ac supply above the rated voltage.

To avoid unbalance caused by replacing only part of a rectifying element, such as one rectifying stack or diode of a bridge, replace the complete rectifying element. In no case should any attempt be made to replace only some of the rectifying cells in a stack or bolt assembly, such as the cells in a copper-oxide or selenium rectifying stack. If the rectifying element consists of more than one rectifying stack, do not combine stacks of different list numbers or stacks made by different manufacturers.

5.02 Some rectifiers have internal fuses, usually on the terminal block. Such fuses should be made the first item to investigate in case of no output from the rectifier. If possible, the cause of the overload should be determined and corrected before replacing the fuse. A blown fuse may be due to trouble in a rectifying element. If a new fuse does not blow when the load is disconnected and does blow when the load is reconnected, the trouble is probably external to the rectifier.

5.03 Broken wires, particularly at terminals, may cause failure. Poor contact between plugs and associated jacks due to either dirt or bent parts is also a possible source of trouble.

5.04 On rectifyling elements made of stacks of selenium or copper-oxide cells, periodically check the temperature of the stacks with a thermometer. With the rectifier at rated load or as near rated load as possible and the cover on, insert the thermometer through a cover hole located near the middle of an upper stack. Place the thermometer bulb in contact with one of the cells about halfway between the edge of the plate and the center bolt. Remove the rectifier cover, if necessary, to gain the required access. If the temperature approaches 90°C (194°F), the stack is nearing the end of its useful life and replacement should be considered. If any selenium or copper-oxide stack is replaced, all stacks in the rectifier should be replaced.

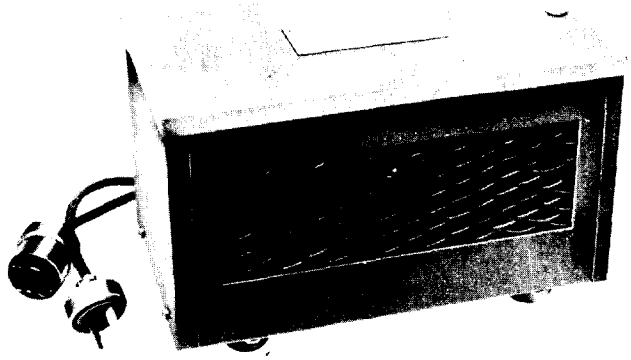

Fig. 6—KS-5663 Rectifier

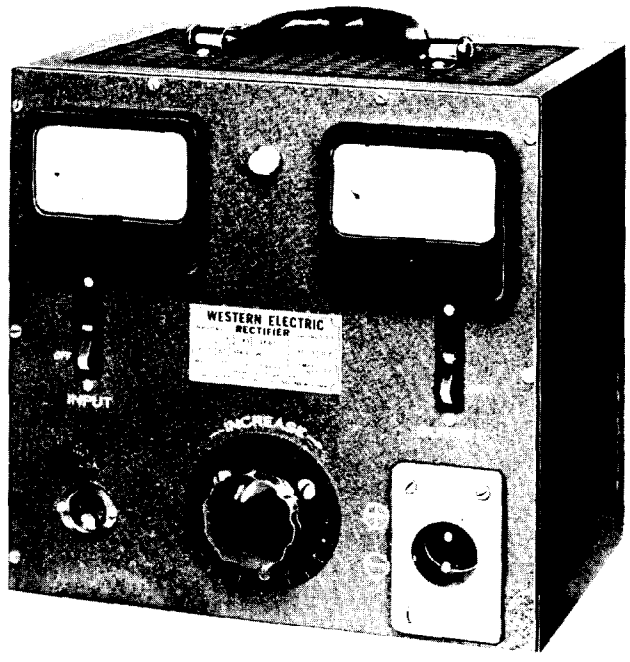

Fig. 7—KS-15687, List 1 Rectifier

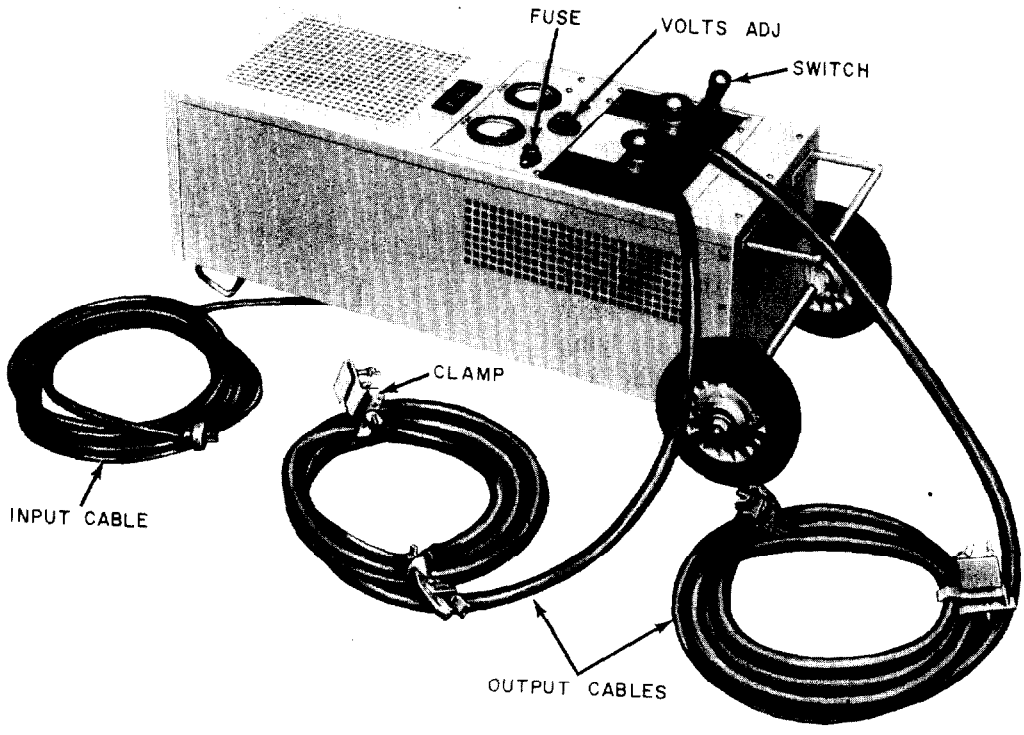

Fig. 8—J86264A Rectifier