RECTIFIERS
MISCELLANEOUS ELECTRON TUBE TYPE
(FORMERLY TUNGAR)
OPERATING METHODS

1. GENERAL

1.01 This section describes the method of operating 2-element electron tube-type rectifier units which are unregulated or manually regulated and are coded as follows:

KS-5191	KS-5194	KS-5364
KS-5191-01	KS-5197	KS-5395
KS-5192	KS-5280	KS-5420
KS-5193	KS-5281	KS-5443
	KS-5282	J86214A

1.02 This section is reissued to add the J86214A rectifier.

> Caution: Voltages inside the rectifier case are in some units higher than those usually encountered in telephone power plants. 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. Disconnect the a-c connections before opening a door or cover to work inside of a rectifier unit.

1.03 Routine checks should be made during a period when they will cause the least service reaction.

1.04 In this section, the term capacitor is used for all apparatus coded as either a capacitor or a condenser, and the term resistor is used for all apparatus coded as either a resistor or a resistance.

1.05 As this section covers a number of rectifier units, all the items do not necessarily apply to any one unit.

1.06 Information in this section is arranged under the following headings:

1. GENERAL

2. OPERATION
2.01 Description
2.05 Preparing to Start Initially
2.06 Initial Adjustments
2.13 Routine Adjustments (Normal Operation)

3. ROUTINE CHECKS

4. TROUBLES

2. OPERATION

Description

2.01 These rectifier units use half-wave, one anode and a filament cathode, or full-wave, two anodes and a filament cathode-type electron tubes to rectify the alternating current into direct current. The tubes, of course, act as valves allowing the current to flow in only one direction, from anode to cathode. Some units are unregulated, that is, there is no means of adjusting the output. The other units are manually regulated and in general have primary transformer taps, so that the proper one may be selected to match the power service voltage, as well as secondary transformer taps which can be chosen to give the desired output. The secondary taps are commonly terminated on some form of rotary or plug switch which permits ready adjustment of the output. In some cases, a series adjustable rheostat is provided to control the output.

2.02 A resistor, rheostat, or reactor is always furnished to limit the output current. A reactance coil, when furnished, may be provided to limit the peak of the rectified current or to provide substantial filtering action to reduce the ripple or noise of the output current and voltage.

2.03 In some rectifier units, particularly those with higher output voltages, there is the possibility of flashover of the tubes. Flashover is a condition in which the tube conducts current in the reverse direction and occurs when the inverse peak voltage applied to the tube exceeds its critical or inverse breakdown voltage. This can be produced by some surge on the power service which momentarily increases the inverse voltage applied to the tube. Flashover is liable to destroy the tube unless some device opens both the a-c and d-c circuits. For this purpose a flashover relay is frequently provided. If opening the circuits depends upon fuses, the tubes may become damaged before the fuses blow.

2.04 To avoid the possibility of a surge causing a flashover when a rectifier unit is shut down, it is desirable to open the d-c output circuit before or at the same time as the a-c supply circuit. In some rectifiers a switch is provided for starting and stopping which simultaneously makes or breaks both the a-c and d-c connections.

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Preparing to Start Initially

2.05 When putting a rectifier unit into service initially, check to see that:

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

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

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

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

(e) Rheostats are in the maximum resistance or low current position.

(f) The correct tube is in each socket.

Initial Adjustments

2.06 Connect the rectifier unit to the power supply in the following sequence.

(a) If an attachment plug is provided, insert it in the receptacle.

(b) See that the switch in the rectifier supply line is closed.

(c) Turn the switch on the rectifier to the ON position.

2.07 Where a polarized plug connected to the DC output leads is provided, insert it in its receptacle. Close the charge switch. (The switches on the rectifier units are 3-pole switches, two poles controlling the a-c power service and one pole the d-c output.)

Note: The battery and the power service should be disconnected from the rectifier unit when changing the setting of plug, dial, or toggle switches to prevent flashover of the tubes. This can be done by opening the 3-pole snap switch, where provided, or by pulling out the plug connections, where necessary, the battery plug first.

2.08 Aging is not required where flashover protection is provided. In the absence of flashover protection equipment, General Electric Catalog No. 189048, 189049, 12X825, and 217283 tubes should be aged before being placed in service for the first time. Aging of tubes, when required, should be by operating at about one-quarter rated current for approximately ten minutes, (see 2.08 to 2.10) then raising the current gradually to full-load output of the rectifier unit (or as nearly full load as possible, if circuit voltage limits prohibit full load even during heavy load periods of the day) and operating for 2 hours at this load. The tubes should then be tested five times for flashover by turning the rectifier unit on and off at the switch. Flashover will be evidenced by a blown fuse or by a sudden increase in light intensity, a fluttering effect and a change in color from yellow to blue. If there is a flashover, the tubes should be further aged for 2 hours at quarter load followed by 6 hours at full load and then rechecked for flashover. If flashover is still experienced, replace the tube.

2.09 Adjust the output of a rectifier unit with plug-type or dial and toggle switches by moving the plug or dial switches consecutively from the low current position toward the high current position until the current is the nearest possible to that desired. With rectifier units equipped with both coarse and fine adjustments, the fine adjustment range is approximately equal to one step of the coarse adjustment. To avoid the danger of overloading the rectifier unit, the fine adjustment shall be carried to its maximum current position and returned to the low current position before the next coarse adjustment step is taken. With full wave rectifier units having duplicate dial and toggle switches, the toggle switch coarse adjustments shall be the same and the dial switch fine adjustments shall be not more than one step apart. This is to keep the output of the two tubes balanced. In these rectifier units, the adjustment of only one dial switch or the failure of one side of the rectifier unit will affect the output of both sides if a choke coil is supplied since such a coil tends to equalize the currents supplied by both tubes.

2.10 Adjust the output of a rectifier unit with plug or dial switches and rheostat by moving the rheostat to the minimum resistance position and then move the plug or dial switch as covered under 2.09. The current value obtained with the switches should be equal to or greater than that desired and if greater, the rheostat shall be moved towards the low current setting until the required current flows.

2.11 Adjust the output of a rectifier unit with rheostat only by moving the rheostat toward the high current position until the desired current flows.

2.12 It should always be possible with the above adjustments to secure the rated

output current and, if the particular plant application permits, the rated output voltage.

Routine Adjustments (Normal Operation)

2.13 Unless it is necessary to adjust the output to avoid overloads, starting of the rectifier unit is done by connecting the a-c supply and the d-c output circuit. Stopping the unit is done by disconnecting the d-c output circuit and then the a-c supply circuit unless a 3-pole switch is provided which opens or closes the a-c and d-c connections simultaneously.

3. ROUTINE CHECKS

3.01 The tubes should be checked periodically, while the rectifier is stopped, to make sure they are screwed tightly into their sockets, particularly where rectifier units are started and stopped frequently. Occassionally remove each tube, clean the contacts on both the bulb and the socket with fine sandpaper, wipe clean with a dry cloth, and screw the bulb tightly into the socket.

3.02 To avoid excessive oxidization of switch and plug contacts, it is desirable to periodically operate or remove and insert those switches or plugs which are not otherwise used in normal operation over long periods of time.

4. TROUBLES

4.01 Before doing any work inside the rectifier case, disconnect first the d-c and then the a-c circuit by means external to the rectifier, such as removal of plugs from receptacles or removal of fuses.

Trouble Chart

4.02 Should any of the following troubles develop, it is suggested that the possible causes be checked. If the trouble is not found, look for open or loose connections.

Trouble	Possible Cause
A-c fuses blown	Overload Flashover in tube Grounded lead Transformer short-circuited Capacitor short-circuited
D-c fuses blown	Overload Flashover in tube Grounded lead Capacitor short-circuited
Filament does not light	Tube loose in socket Filament burned out Failure of a-c supply Voltage at socket terminals not within the limits of 2.0 to 2.5 volts Dirty socket Center contact not making contact
No output current	D-c or a-c fuses blown Control switch open Voltage adjustment too low One tube only operating Tube loose in socket
Low output current	Voltage adjustment too low Low power supply voltage Wrong transformer primary tap connected Aged tube One d-c fuse blown One tube only operating