RECTIFIERS
KS-19216 L1 AND L2
130 VOLTS, 300 AMPERES
OPERATING METHODS

CONTENTS PAGE

1. GENERAL 1
2. LIST OF TOOL AND TEST APPARATUS . 2
3. OPERATION 2
4. ROUTINE CHECKS 4
5. TROUBLES 7

1. GENERAL

1.01 The KS-19216 L1 and L2 semiconductor-type rectifiers, using saturable reactor control, are intended for use in the 700-type power plants to provide regulated dc power for floating and charging central office 130-volt storage batteries.

1.02 This section is reissued to add an output filter capacitor charging procedure, to revise the starting procedure, and to add a requirement for switch cleaning of the S6 dc output switch. This issue does affect the Equipment Test List.

1.03 The KS-19216 L1 and L2 rectifiers are rated at 130-volts, 300-amperes dc. The input power requirement is 3-phase, 3-wire, 60-Hz (±2 percent) alternating current applied to the input transformer through an input contactor. Taps are provided on the input transformer to match the ***nominal*** ac line voltage. The KS-19216 L1 rectifier operates on a range within the absolute limits of 400- and 500-volts ac. Either rectifier will operate with a permissible change from the ***nominal*** input voltage of −10 percent to +5 percent. The rectifiers are automatic in the regulation of float voltage when under control of the plant control circuit.

1.04 ▶This issue of the section is based on drawing SD-81633-01, Issue 4. For a detailed description of the operation, see the corresponding circuit description. If this section is to be used with equipment or apparatus that is associated with an earlier or later issue of the schematic drawing, reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.◀

1.05 The following changes have been incorporated in the rectifier circuit (see SD-81633-01):

(a) Rectifiers with Serial No. 6 and higher are ▶equipped with Q option◀ to improve the current regulating circuit (FS2).

(b) Rectifiers with Serial No. 25 and higher are equipped with M option which rearranges K8, K9, and K11 contacts to correct drift (FS1 and FS2).

(c) ▶Rectifiers with Serial No. 25, 39, 40, 41 and higher are equipped with a revised anti-hunt circuit which prevents instability when operating in parallel (J option).◀

(d) Rectifiers with Serial No. 81 and higher are equipped with H option to limit initial loading following a power failure (FS1 and FS2).

(e) Rectifiers with Serial No. 81, 83, and higher are modified to prevent dropout of relay K6 during operation of the NOR-TST (S5) key (FS3).

Warning: Voltages inside the rectifier cabinets exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test probe to touch two metal parts at the same time as destructive or dangerous short circuits may occur.

1.06 ▶A solid state controller is available to replace the mechanical contact type AR1 ammeter

relay. The solid state unit is designated KS-20522 Controller. The controller contains no moving parts or heated filaments and should provide more reliable service than the mechanical contact type ammeter relay. The KS-20522 Controller is available as part of a modification kit which includes mounting hardware, wire, installation and wiring information, and, when required, some minor external components. The KS-20522 Controller is available for several rectifier and plant applications. For additional information on the KS-20522 Controller, refer to CD- and SD-82023-01 and Section 024-360-201. ◀

1.07 The rectifier may be connected to charge 61-, 65-, or 69-cell battery with the S6 dc output switch set in BAT, GR1, or GR1 and GR2 positions, respectively.

1.08 Routine checks and adjustments, other than those required by trouble conditions, should be made during a period when they will cause the least unfavorable reaction to service.

1.09 For more detailed information on operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practices.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-Inch C Screwdriver
—	▶Resistor (10 ohm, 50 watt)
—	Fuse (6 ampere, 125 volt dc)
—	Switch (15 ampere, 125 volt dc)◀
TEST APPARATUS	
—	A.B. DuMont Lab Inc, Type 304 Oscilloscope. This scope is not required for normal maintenance (see 5.06).
KS-3008	Stopwatch
KS-8039	DC Volt-Milliammeter
KS-14510	Volt-Ohm-Milliammeter ▶(or an approved Digital Multimeter)◀

3. OPERATION

3.01 ***Preparing to Start:*** When preparing to place the rectifier in service, check the following.

(a) The controls are positioned as follows:

RECT OFF-NOR (S1) switch to OFF

CONT (CB1) NOR-OFF circuit breaker to NOR

TST-NOR (S5) key to TST

AUTO-MAN (S2) key to AUTO

MAN ADJ (R42) potentiometer fully ccw

LOWER-NOR (S3) switch to NOR

RAISE-NOR (S4) switch to NOR

S6 dc output switch to OFF

Associated switch and fuse unit in bus duct or power service cabinet to OFF.

(b) The taps on the T1 input transformer have been selected to match the ac input voltage in accordance with SD-81633-01.

(c) ▶All external connections are made in accordance with the schematic drawing covering the associated circuit of which the rectifier is a part.◀

(d) The AR1 ammeter relay should be set as follows unless plant requirements differ (see 1.06):

(a) Low contact set to 15 amperes

(b) High contact set to 300 amperes.

3.02 ▶***Charging Output Filter Capacitors:*** This procedure charges the output filter capacitors, preventing arcing when closing the S6 dc output switch to the battery (For EC) position.

(1) Verify that the rectifier has been removed from service in accordance with the plant Bell System Practice, and the rectifier controls are positioned as listed in 3.01.

Note: The jumper used in this procedure is a series connection of a resistor (10 ohm, 50 watt), a fuse (6 ampere, 125 volt dc), and an ***on-off*** switch (15 ampere, 125 volt dc). Suitable clip leads are utilized to connect the jumper in the rectifier circuit.

(2) ***Caution: To prevent inadvertent shorting of a voltage-connected jumper with other parts of the rectifier, always make the battery connection last.***

Connect the jumper (jumper switch in ***off*** position) from the switch side of the CHG (F17) fuse to a convenient point on the battery connected F or EC terminal plate of the S6 dc output switch.

(3) Operate the jumper switch to the ***on*** position.

(4) When the rectifier voltmeter (VM1) indicates approximately battery or battery plus end-cell voltage, operate the S6 dc output switch to the required BAT, GR1 or GR1 and GR2 position.

(5) Operate the jumper switch to the ***off*** position.

(6) ***Caution: To prevent shorting with other parts of the rectifier, remove both clip leads simultaneously.***

Disconnect the jumper from the rectifier circuit.◀

3.03 ***Starting:*** To start the rectifier, proceed as follows.

Note: ▶With the controls in position for automatic operation, the rectifier will start, operate, and stop by signals from the plant.

(1) ***Caution: Do not operate the S6 dc output switch from the OFF position to either the BAT, GR1, or GR1 and GR2 position without first charging the output filter capacitors.***

Perform the capacitor charging procedure as outlined in 3.02 and operate the S6 dc output switch to the desired battery (BAT) or battery plus end-cell (GR1 or GR1 and GR2) position.

(2) Operate the associated switch and fuse unit in the bus duct or power service cabinet to the ON position.◀

(3) Verify that the AUTO-MAN (S2) key is in the AUTO position, and the CONT (CB1) NOR-OFF circuit breaker is in the NOR position.

(4) Operate the TST-NOR (S5) key to the NOR position.

(5) Operate the RECT OFF-NOR (S1) switch to the NOR position. ▶The rectifier is now connected to the plant control circuit and is placed in service in accordance with the plant Bell System Practice.

Note: If operational conditions require the rectifier to operate independently from signals from the charge control circuit, the AUTO-MAN (S2) key must be in the AUTO position and the TST-NOR (S5) key is operated to the TST position. The output of the rectifier can now be adjusted by means of the rectifiers RAISE-NOR (S4) switch and LOWER-NOR (S3) switch.◀

3.04 ***Stopping:*** To remove the rectifier from operation, proceed as follows.

(1) ▶Remove the rectifier from plant service in accordance with the plant Bell System Practice.◀

(2) Operate the RECT OFF-NOR (S1) switch to the OFF position.

3.05 ▶***Removing from Service:*** If the rectifier is to be out of service for an extended period of time proceed as follows.

(1) Perform the rectifier stopping procedure in 3.04.

(2) Operate the CONT (CB1) NOR-OFF circuit breaker to the OFF position.

(3) Operate the S6 dc output switch to the OFF position.

(4) Operate the associated switch and fuse unit located in bus duct or power service cabinet to the OFF position.

(5) ***Caution: Connect the electrolytic capacitors of the output filter to a source of direct current of suitable voltage and polarity in accordance with 032-110-701.***◀

4. ROUTINE CHECKS

4.01 It is suggested that the following routine checks be made ▶in accordance with the Equipment Test List, or after the rectifier has been out of service for an extended period of time and is to be returned to service, or if maintenance is performed which may affect the settings of the rectifier controls.◀

4.02 ***Contactor and Relays:*** The contactor and relays should be inspected for adjustment and condition of contacts as often as local experience demands to make sure that they are in accordance with the circuit requirements table and the applicable Bell System Practices.

Note: ▶For information on the solid state KS-20522 Controller used to replace the mechanical contact type AR1 ammeter relay, refer to 1.06.

4.03 ***Clean S6 DC Output Switch:*** Test, inspect, clean, and adjust the S6 dc output switch in accordance with Section 169-724-701.◀

4.04 ***Voltage Limiting Circuit Check:*** Check the voltage limiting circuit as follows.

(1) ▶Remove the rectifier from plant service in accordance with the plant Bell System Practice.◀

(2) Position the controls as follows:

RECT OFF-NOR (S1) switch to OFF

CONT (CB1) NOR-OFF circuit breaker to NOR

TST-NOR (S5) key to TST

AUTO-MAN (S2) key to AUTO

S6 dc output switch to OFF

(3) Disconnect the lead at terminal 1 of terminal strip TS6 from the fuse side.

(4) Connect a temporary jumper from terminal 1 of terminal strip TS6 to either side of the CHG (F17) fuse.

(5) Connect the KS-8039 meter between the (+) and (−) test jacks (J1 and J2).

(6) Operate the RECT OFF-NOR (S1) switch to the NOR position.

(7) Operate the RAISE-NOR (S4) switch to the RAISE position and hold operated until the output voltage no longer increases. Release the RAISE-NOR (S4) switch.

Requirement: The KS-8039 meter should indicate between 137.5 and 138.5 volts or as specified in the plant Bell System Practice.

Note 1: If the requirement is met, proceed to (13). If the voltage indication is below 137.5 volts, continue with (8). If the voltage indication is greater than 138.5 volts, proceed to (9).

Note 2: ▶The rectifier voltmeter (VM1) should indicate the same voltage as the KS-8039 meter. If necessary, set the zero adjust on the rectifier voltmeter (VM1) so that the indication agrees with the indication on the KS-8039 meter.

(8) With the RAISE-NOR (S4) switch operated to the RAISE position,◀ slowly rotate the MAX VOLT LIM (R45) potentiometer cw until the KS-8039 meter indicates the required voltage. Release the RAISE-NOR (S4) switch.

Note: When the requirement is met, proceed to (13). If the voltage limit setting in (8) is exceeded, continue with (9).

(9) Connect a dummy load (a 300-watt bulb minimum) between terminal 2 of the S6 dc output switch and ground.

(10) Rotate the MAX VOLT LIM (R45) potentiometer ccw until the KS-8093 meter indicates the required voltage.

(11) ▶Operate the LOWER-NOR (S3) switch to the LOWER position until the output voltage decreases to float value. Release the LOWER-NOR (S3) switch.

(12) Repeat (7) to check the voltage limit setting.◀

(13) Operate the LOWER-NOR (S3) switch to the LOWER position and hold operated until the voltage cannot be reduced further. Release the LOWER-NOR (S3) switch.

(14) Operate the RECT OFF-NOR (S1) switch to the OFF position.

(15) Disconnect the KS-8093 meter from (+) and (−) test jacks.

(16) If the dummy load was connected in (9), disconnect the dummy load from the S6 dc output switch and ground.

(17) Disconnect the jumper from terminal 1 of terminal strip TS6 and the CHG (F17) fuse.

(18) Reconnect the lead at terminal strip TS6.

(19) To return the rectifier to service, perform 3.03 and refer to the plant Bell System Practice.

4.05 ***Current Limiting Circuit Check:*** Check the current limiting circuit ▶under plant load◀ as follows.

Note: This check is performed with the rectifier operating in normal mode of operation. If the rectifier is not operating in service, perform 3.03 and refer to the plant Bell System Practice. There must be sufficient plant load connected to the output terminals of the rectifier to increase the rectifier output current to 350 amperes.

(1) Verify that the controls are positioned as follows:

RECT OFF-NOR (S1) switch to NOR

S6 dc output switch to BAT

CONT (CB1) NOR-OFF circuit breaker to NOR

AUTO-MAN (S2) switch to AUTO

TST-NOR (S5) switch to TST

AR1 ammeter relay high contact set to 400 amperes.

(2) Operate the RAISE-NOR (S4) switch to the RAISE position and hold operated for at least 30 seconds. Observe the indication on the AR1 ammeter relay ▶and the rectifier voltmeter (VM1).◀ Release the RAISE-NOR (S4) switch.

Requirement: ▶The voltage indication on the rectifier voltmeter (VM1) will droop at current limit.◀ The indication on the AR1 ammeter relay should be between 320 and 340 amperes.

Note 1: If the requirement is met, proceed to (7). If the current limits below 320 amperes, continue with (3). If the current continues to increase above 340 amperes, proceed to (4).

Note 2: ▶The plant voltmeter and the rectifier voltmeter (VM1) will not indicate the same voltage value due to the loop voltage drop of the charge leads.◀

(3) While holding the RAISE-NOR (S4) switch in the RAISE position, slowly rotate the MAX CUR LIM (R23) potentiometer ▶cw for Q option [see 1.05(a)] or ccw for R option, until the AR1 ammeter relay indicates 330 amperes. Release the RAISE-NOR (S4) switch.◀

Note: When the requirement is met, proceed to (7).

(4) ▶Operate the LOWER-NOR (S3) switch to the LOWER position and hold operated until the AR1 ammeter relay indicates 200 amperes. Release the LOWER-NOR (S3) switch.

(5) Rotate the MAX CUR LIM (R23) potentiometer slightly ccw for Q option or cw for R option, to reduce the current limit setting.

(6) Repeat (2) to check the current limit setting.◀

(7) Operate the LOWER-NOR (S3) switch to the LOWER position and hold operated until the output current is reduced to a minimum. Release the LOWER-NOR (S3) switch.

(8) Operate the RECT OFF-NOR (S1) switch to the OFF position.

(9) Set the AR1 ammeter relay high contact to 300 amperes.

(10) To return the rectifier to service, perform 3.03 and refer to the plant Bell System Practice.

4.06 ***Raise and Lower Rate Check:*** Check the raise and lower rate ▸under plant load◂ as follows.

Note 1: ▸This check is performed with the rectifier operating in the normal mode of operation. If the rectifier is not operating in service, perform 3.03 and refer to the Plant Bell System Practice. There must be sufficient plant load connected to the output terminals of the rectifier to increase the rectifier output current to 300 amperes.

Note 2: The raise or lower rate can not be accurately determined if the rectifier has appreciable output voltage change during load change.◂

(1) Verify that the controls are positioned as follows:

RECT OFF-NOR (S1) switch to NOR

CONT (CB1) OFF-NOR circuit breaker to NOR

S6 dc output switch to BAT

AUTO-MAN (S2) switch to AUTO switch to TST

TST-NOR (S5)

Note: ▸The AR1 ammeter relay must indicate minimum current.◂

Raise Rate

(2) Operate the RAISE-NOR (S4) switch to the RAISE position and hold operated while using the KS-3008 stopwatch to check the time required for the rectifier current to increase from minimum current to 300 amperes. When the AR1 ammeter relay indicates 300 amperes, release the RAISE-NOR (S4) switch.

Caution: If cyclic hunting develops, adjust the ANTI-HUNT (R46) potentiometer (see 5.07) at once to prevent possible damage to the equipment.

Requirement: The raise rate must meet the requirement in the plant Bell System Practice. In the absence of a plant requirement, the raise rate should be approximately 20 seconds.

Note: If the requirement is met, proceed to (6). If the raise rate is too slow or fast, continue with (3).

(3) Operate the LOWER-NOR (S3) switch to the LOWER position and hold operated until the output current is reduced to a minimum.

(4) Adjust the RAISE ADJ (R38) potentiometer ▸1/8◂ turn ccw to decrease the raise rate or ▸1/8◂ turn cw to increase the raise rate.

(5) Repeat (2) to check the raise rate setting. Repeat (3) and (4) until a satisfactory raise rate is obtained.

Lower Rate

(6) Verify that the AR1 ammeter relay indicates 300 amperes.

(7) Operate the LOWER-NOR (S3) switch to the LOWER position and hold operated while using the KS-3008 stopwatch to check the time required for the current to decrease from 300 amperes to minimum current. When the ARI ammeter relay indicates minimum current, release the LOWER-NOR (S3) switch.

Requirement: The lower rate must meet the requirement in the plant Bell System Practice. In the absence of a plant requirement, the lower rate should be approximately 20 seconds.

Note: If the requirement is met, proceed to (11). If the lower rate is too slow or fast, continue with (8).

(8) Operate the RAISE-NOR (S4) switch to the RAISE position and hold operated until the AR1 ammeter relay indicates 300 amperes.

(9) Adjust the LOWER ADJ (R39) potentiometer ▸1/8◂ turn ccw to decrease the lower rate or ▸1/8◂ turn cw to increase the lower rate.

(10) Repeat (7) to check the lower rate setting. Repeat (8) and (9) until a satisfactory lower rate is obtained.

(11) ▶Verify that the AR1 ammeter relay indicates minimum load.◀

(12) Operate the RECT OFF-NOR (S1) switch to OFF position.

(13) To return the rectifier to service, perform 3.03 and refer to the plant Bell System Practice.

4.07 ***Fuse Alarm Check:*** Check the fuse alarm as follows.

Note: ▶This check is performed with the rectifier output connected to the battery (S6 dc output switch in BAT position). The rectifier must be in an unloaded condition.◀

Caution: Charge output filter capacitors in accordance with 3.02 before operating the S6 dc output switch from the OFF to the BAT position.

(1) Verify that the controls are positioned as follows:

RECT OFF-NOR (S1) switch to OFF

CONT (CB1) NOR-OFF circuit breaker to NOR

TST-NOR (S5) key to TST

AUTO-MAN (S2) key to AUTO

S6 dc output switch to BAT.

(2) Provide ground on the LP lead by connecting a temporary ground to terminal 9 of terminal strip TS1.

(3) Remove the CHG ALM (F18) fuse and substitute a blown fuse in its place.

(4) Operate the RECT OFF-NOR (S1) switch to the NOR position.

Requirement: The OVERLOAD (DS5) lamp and the RECT FAIL (DS4) lamp should light.

(5) Operate the RECT OFF-NOR (S1) switch to OFF.

Requirement: The OVERLOAD lamp and the RECT FAIL lamp should extinguish.

(6) Remove the blown fuse and replace the CHG ALM (F18) fuse.

(7) Remove the CONTR ALM (F16) fuse and substitute a blown fuse in its place.

(8) Operate the RECT OFF-NOR (S1) switch to the NOR position.

Requirement: The RECT FAIL lamp lights.

(9) Operate the RECT OFF-NOR (S1) switch to the OFF position.

Requirement: The RECT FAIL lamp extinguishes.

(10) Remove the blown fuse and replace the CONTR ALM (F16) fuse.

(11) Repeat the test in (7) through (10) for ▶CONTR ALM (F20) fuse◀ and ALM fuses F4 through F7.

(12) To return the rectifier to service, perform 3.03 and refer to the plant Bell System Practice.

4.08 ***ARI Ammeter Relay Settings for Plant Signaling:*** Set the ARI ammeter relay high and low contacts as follows unless plant requirements differ (see 1.06).

(a) Set the low contact to 15 amperes.

(b) Set the high contact to 300 amperes.

5. TROUBLES

5.01 The rectifiers consist of a main power circuit controlled through an electronic regulating circuit. In addition, the output of the current sensing circuit is introduced into the regulating circuit for the purpose of current signaling and limitation. The output of the regulating circuit is introduced into the main power circuit to effect the desired corrections in the power output. In the maintenance of intricate equipment, trouble

must be localized in an orderly way. This is difficult in the case of a circuit having this feedback or loop arrangement because trouble anywhere in the loop will give faultly operation of other parts of the loop which may be trouble free. In these rectifiers, provision has been made for opening the loop by means of the AUTO-MAN (S2) key which, when operated to the MAN position, permits checking the performance of each major subdivision of equipment until the trouble is isolated. A MAN ADJ (R42) potentiometer is provided for use in conjunction with the AUTO-MAN (S2) key to manually control the control current when some of the more complex regulating circuits are temporarily disabled by operation of the AUTO-MAN (S2) key to the MAN position.

Caution: The MAN ADJ (R42) potentiometer should always be turned fully ccw before operation of AUTO-MAN (S2) key to MAN to avoid excessive voltage and current.

5.02 Although it may vary widely with extreme conditions, the control current, when observed in connection with daily routine and compared with operating experience, can serve as a guide to the causes of unusual operation or trouble conditions. The purpose of the CONTROL (AMI) ammeter is to give a continuous indication of the output of the regulating circuit. This output also controls the output of the rectifier. The control current supply circuit and main power circuit are generally performing satisfactorily if increasing the amount of control current increases the rectifier output and decreasing the control decreases the rectifier output.

5.03 When any kind of trouble is encountered, it is necessary to decide whether to locate the trouble with the equipment operating or de-energized. Trouble is easier to find if the equipment can be fully energized. However, if it is of a nature that causes excessive output from the equipment, it will be necessary to take the initial steps with the system de-energized, energizing it in subdivisions for short periods only while electrical measurements are made. Operation for more than a few minutes at a time while trouble exists, even though the output may not be excessive, may result in overheating of some components. Therefore, it is essential when testing to be on the alert for the need to quickly shut down the rectifier.

5.04 Jacks mounted on the front of the panel have been provided to enable the troublelocater to meter various portions of the circuit with the equipment fully energized. Consult Table A for values that should be read when the output voltage is 132.2 volts and the output current is 10.0 amperes. The control circuit should indicate 0.25 ampere. The values shown in the table are average. Specific values for individual rectifiers may vary from those given.

TABLE A – POINT-TO-POINT VOLTAGES

METER CONNECTIONS (TEST POINTS)	EQUIPMENT LOCATION	METER SCALE	METER READING (VOLTS)
T1 — T2	AC Contactor	300	205.4 ac
T1 — T3		300	205.4 ac
T2 — T3		300	205.4 ac
Term. 2, phase A — Term. 2, phase B	Transformer T1	300	205.4 ac
Term. 2, phase A — Term. 2, phase C		300	205.4 ac
Term. 2, phase B — Term. 2, phase C		300	205.4 ac
Term. 6, phase A — Term. 2, phase B		300	217.5 ac
Term. 6, phase B — Term. 2, phase C		300	217.5 ac
Term. 6, phase C — Term. 2, phase A		300	217.5 ac
Term. 5, phase X — Term. 1, phase X	Transformers T5 and T9	300	276 ac
Term. 5, phase Y — Term. 1, phase Y		300	276 ac
Term. 5, phase Z — Term. 1, phase Z		300	276 ac
J2(+) — J1(—)	Front Panel	300	132.2 dc
J4 — J3 Grd		300	60.0 dc*
J5 — J3 Grd		60	12.0 dc*
J6 — J3 Grd		60	11.8 dc*
J7 — J3 Grd		60	11.9 dc*
J8 — J3 Grd		60	12.0 dc*
J9 — J3 Grd		60	10.0 dc*
J10 — J3 Grd		60	10.0 dc*
J11 — J3 Grd		60	30.0 dc*
J12 — J3 Grd		60	30.0 dc*

* Voltage may be positive or negative, depending upon option installed.

TROUBLE CHART

5.05 Should any of the following troubles develop, it is suggested that the possible causes be checked in the order given. If the trouble is not found, look for loose or open connections or short circuits due to foreign matter lying across wiring terminals.

TROUBLE	POSSIBLE CAUSE
(a) No dc output current (no saturating current)	Blown ac supply or alarm fuse. CONT (CB1) circuit breaker in OFF position. K2, K6, or K7 relay failure. AC (K1) contactor not operated.

TROUBLE	POSSIBLE CAUSE
(b) No dc output current (high saturating current)	Blown ALM F4-F7 output fuse.
(c) Low dc output current (low control current)	Check RAISE circuit. Low line voltage or T1 transformer taps incorrect. Faulty transistor amplifier.
(d) Low dc output current (high saturating current)	Rectifier operating single phase.
(e) High dc output current (output voltage normal)	Defective transistor amplifier.
(f) Output current high (output voltage high)	RAISE circuit adjustment. Defective transistor amplifier. High line voltage or T1 transformer taps incorrect.
(g) High dc output voltage (output current less than full load)	Rectifier in manual condition [AUTO-MAN (S2) key in MAN position].
(h) Output excessively noisy	Defective output filter capacitors. Unbalanced ac input voltage. Defective rectifier stacks. R4-R6 potentiometers require adjustment.
(i) Hunting	ANTI-HUNT potentiometer requires adjustment.
(j) High ripple indication	Defective L4-L6 saturable reactors. Defective R4-R6 balancing potentiometers. Defective filter.

5.06 ***Defective Saturable Reactor:*** To check for a defective saturable reactor proceed as follows:

(a) Connect the oscilloscope between terminal 1 of L10 and the F21 (K4) fuse.

(b) Adjust the sweep frequency so as to have six complete cycles present on the oscilloscope. If all waves are approximately equal in height, the cores of L4, L5, and L6 saturable reactors are balanced and the trouble is elsewhere. If they are not of equal height, it is an indication of a defective saturable reactor, a shorted CR1 to CR6 diode, or a defective R1 to R6 resistor.

(c) Check the diodes for short circuit and the resistors for open circuit with the KS-14510 meter.

(d) Replace any defective components.

5.07 ***Cyclic Hunting:*** If cyclic hunting develops, proceed as follows.

Note: ANTI-HUNT (R29) potentiometer has been removed from KS-19216 rectifiers with Serial No. 25, 39, 40, 41 and higher. On these rectifiers, cyclic hunting is eliminated by adjustment of ANTI-HUNT (R46) potentiometer only.

(1) Rotate ANTI-HUNT (R29) potentiometer, if applicable, and ANTI-HUNT (R46) potentiometer fully cw.

(2) Slowly rotate ANTI-HUNT (R29) potentiometer ccw until hunting is eliminated.

(3) If hunting continues or if hunting increases, rotate ANTI-HUNT (R29) potentiometer to maximum cw position, then rotate ANTI-HUNT (R46) potentiometer ccw ◗1/8 turn◖ and again rotate ANTI-HUNT (R29) potentiometer ccw until hunting is eliminated.

(4) Repeat (3) if hunting continues. Advance ANTI-HUNT (R46) potentiometer by ◗1/8-turn◖ each time.

Caution: Hunting should be corrected as soon as possible to prevent damage to the rectifier.