BELL SYSTEM PRACTICES
Teletypewriter Stations

SECTION P31.101
Issue 5, April, 1955
AT&T Co Standard

RECTIFIERS FOR TELETYPEWRITER STATION APPARATUS

Contents **Page**

Contents

List of Figures

List of Tables **Page**

1. GENERAL

1.01 This section covers the description and maintenance of various types of rectifiers specified for use with Telephone Company-owned teletypewriter station apparatus. Also covered are some common types of rectifiers associated with customer-owned teletypewriter station apparatus that may be maintained by Telephone Company personnel. Rectifiers are provided at locations where the customer's power is ac and when a dc supply is required for operation of the teletypewriter apparatus or to furnish line current.

1.02 This section is reissued to bring it up to date, to add the material in the addendum, Issue 1, and to include information for the following rectifiers:

KS-5536-L6 (Increased capacity of input fusetron)
KS-5663-L7
KS-5928-L4
KS-5988-L1
J86207U-L1
J86207U-L2
J86207W-L1

1.03 Due to the extent of the changes in this issue indicating arrows are omitted.

2. DESCRIPTION OF COMMON FEATURES

2.01 The rectifiers described herein consist essentially of a transformer, rectifying element (or varistor), output filter, fuses, terminal blocks, etc., suitably mounted in a metal case.

2.02 The rectifying element consists of either a copper oxide or a selenium rectifying unit, a rectifying tube or a varistor. On some types the unit is mounted in a separate metal case and connected to the main unit containing the transformers, etc., by means of a 4-conductor cord and plug.

2.03 The output filter circuit is provided to reduce the ac ripple, always present to some extent, in the dc output. Electrolytic capacitors are provided in rectifiers of more recent design for this purpose. The characteristics of these capacitors are such as to require periodic replacement or recharging.

2.04 The majority of the rectifiers are arranged for shelf mounting and can be used in space provided for this purpose in the teletypewriter tables and cabinets. The KS-5740, KS-15523, KS-15620 and J86207U rectifiers are arranged for relay-rack mounting. The J86207W rectifier is arranged for power board or relay-rack mounting.

2.05 Many of the rectifiers are equipped with a switch that opens the ungrounded side of the power supply whenever the cover is removed or the cover door is opened. However, as an added precaution with any of the rectifiers, whether equipped with a cover switch or not, the power supply should be disconnected whenever covers are removed for adjustment or maintenance purposes.

2.06 All rectifiers are equipped with either a tapped transformer or rheostat to adjust the output voltages and some types are also equipped with an automatic-voltage regulation feature as explained in more detail in Part 3.

2.07 The manufacturer's wiring diagram is pasted on the inside of the cover or cover door. Schematic drawings are included in this section.

3. DETAILED DESCRIPTION

(A) Rectifiers Not Equipped with Automatic Voltage Regulation—Table A

3.01 The output voltages on these rectifiers will vary with changes in the connected loads and also in direct proportion to ac input voltages. The design of teletypewriter station receiving apparatus is such that the load presented to the rectifier output remains fairly constant under all operating conditions.

(B) Rectifiers Equipped with Automatic Voltage Regulation—Table B

3.02 This feature maintains the output voltage of these rectifiers close to the adjusted value under conditions of varying connected loads and when ac input voltage varies approximately 10 per cent. This feature is necessary on rectifiers used with 19 teletypewriters as the load varies considerably with the intermittent operation of the perforator punch magnet, end-of-line indicator lamp and transmitter stop magnet.

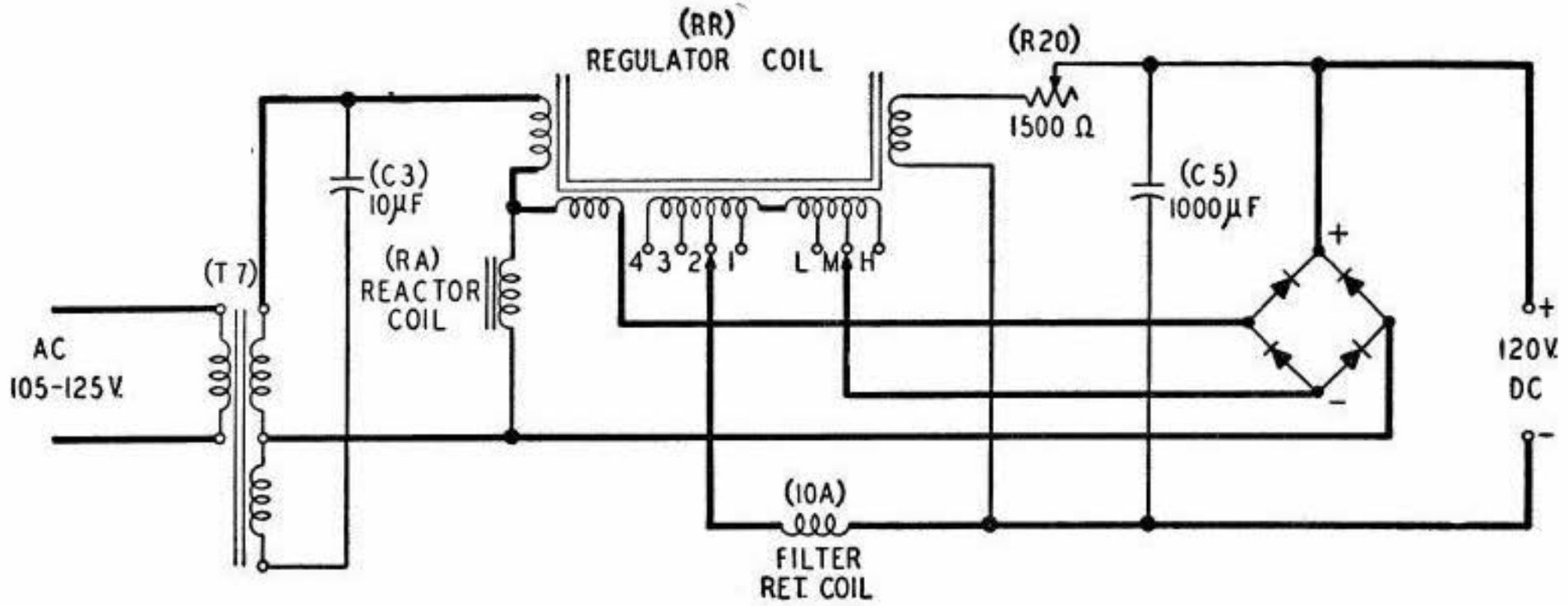


Fig. 1—Theory of Operation of KS-5928-L1, L2 and L3 Rectifiers

Description of KS-5928-L1, L2 and L3 Rectifiers (Fig. 1)

3.03 The regulation is obtained by the use of a regulator coil, RR. The dc load current is passed through two windings of this coil with adjustable taps. As the dc load increases the dc tends to saturate the magnetic core, thus reducing the impedance of the two ac windings, one in series with the reactor coil RA and the other in series with the rectifier elements. This tends to keep the dc output voltage constant with change of load. Rheostat R20 is for adjustment of the output voltage at the factory and should not be adjusted in the field. Capacitor C3 is for power-factor correction and aids regulation by resonating with reactor coil RA.

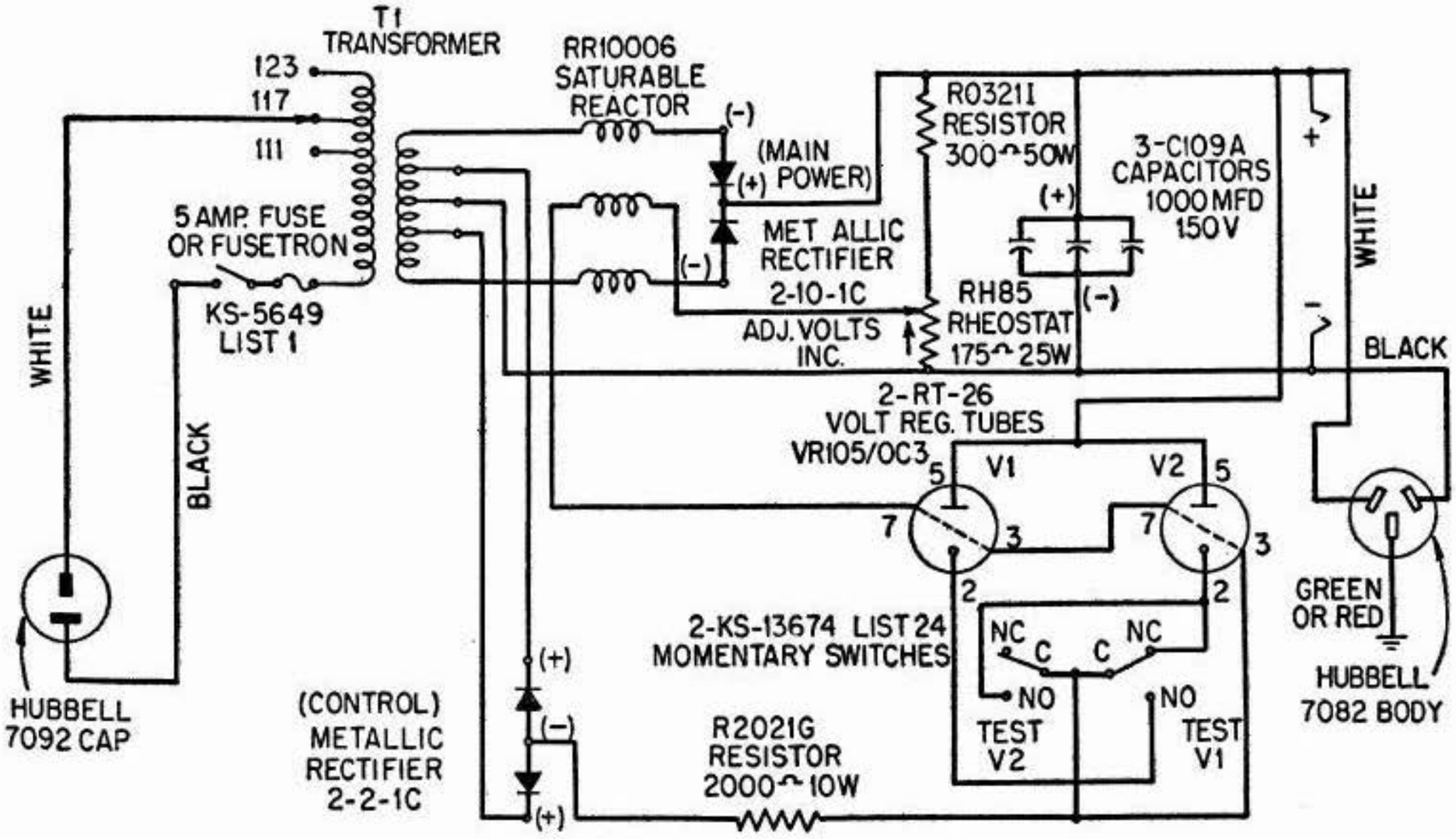


Fig. 2—KS-5928-L4—Circuit Schematic

Description of KS-5928-L4 Rectifier (Fig. 2)

3.04 The output voltage is regulated by a saturable reactor which, in effect, compares the output voltage to a constant reference voltage supplied by a gas tube VR105/OC3. A sample of the output voltage is fed from the ADJ VOLTS rheostat to the dc (center) winding of the saturable reactor. This sample voltage corresponds to the difference between the constant voltage of the VR tube and the output voltage. When the dc load increases there is a decrease in the saturation voltage which, in turn, decreases the impedance of the saturable reactor and raises the ac voltage applied to the main power rectifier elements. This in turn increases the output voltage. Conversely, when the dc load decreases there is an increase in the saturation voltage, which, in turn, decreases the output voltage.

3.05 Two tubes VR105/OC3 are provided. One tube supplies the reference voltage and the other serves as a stand-by. If the tube in service should fail, the stand-by tube would immediately ionize and maintain service. Nonlocking switches are provided on the control panel for checking the tubes. The test consists merely of operating the TEST V1 or TEST V2 switch on the control panel and observing that the corresponding tube ionizes. If the tube under test is faulty the tube will not ionize when the switch is operated and service will be interrupted during the period that the switch is operated. These switches should, therefore, not be operated unless the station involved is out of service.

3.06 The control rectifier serves as a source of dc supply for the VR tubes.

3.07 Maintenance of tubes—It is recommended that tubes be replaced regardless of condition, every two years.

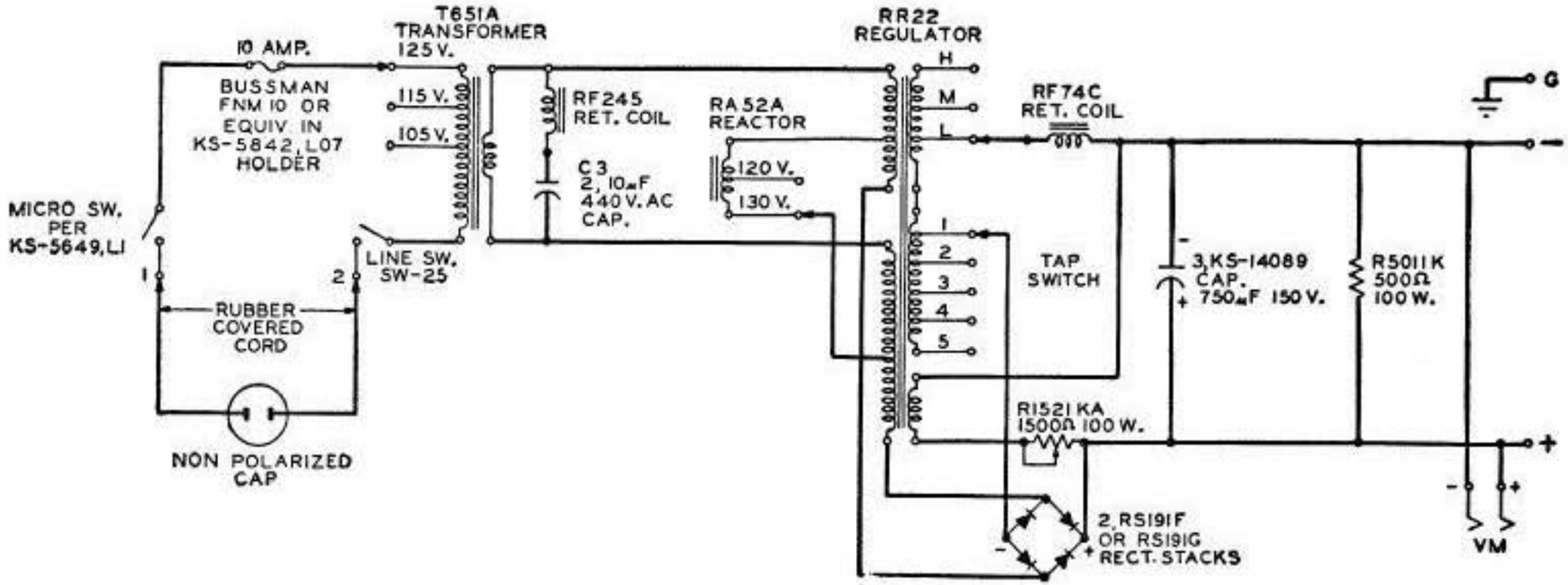


Fig. 3—KS-15523-L1—Circuit Schematic

Description of KS-15523-L1 Rectifier (Fig. 3)

3.08 Although the circuit details of this rectifier differ somewhat from those of the KS-5928-type rectifier shown in Fig. 1, the general method of obtaining regulation is the same. For example, the schematic of Fig. 3 indicates that capacitor C3 is for power factor correction as well as to aid in the regulation, that the regulator coil RR22 has reactive windings in series with the ac circuit to the rectifier elements and dc windings in series with the load. The 1500-ohm rheostat is for adjustment of the output voltage. These features are all identical with those of the KS-5928-type rectifier described in Paragraph 3.03.

3.09 KS-15523, List 2 is a special 19-inch relay rack for mounting the L1 rectifier. KS-15523, List 3 is a baffle plate which allows mounting the L1 rectifiers one above the other on the relay rack.

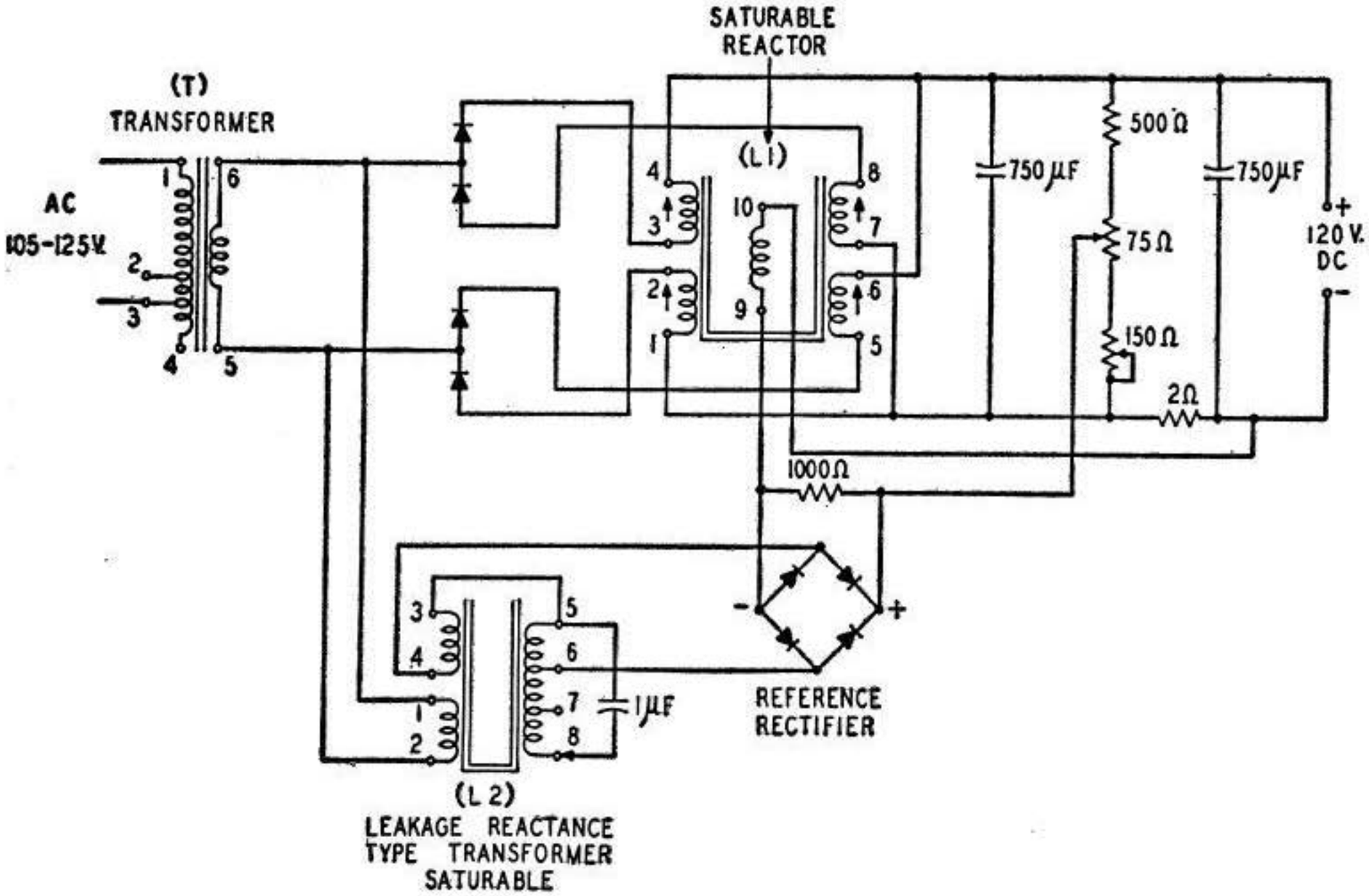


Fig. 4—Theory of Operation of KS-5769-type Rectifier

Description of KS-5769 Rectifier (Fig. 4)

3.10 The output voltage is regulated by a saturable reactor, L1, which is, in turn, controlled by the output of a reference rectifier. The reference rectifier uses a saturable leakage reactance transformer, L2 for its own regulation. The impedance of windings 1-2, 3-4, 5-6 and 7-8 of L1 limits the flow of current through the rectifier elements and thus limits the output voltage. As a result of the dc saturation of L1 the impedance, which is in series with the rectifier elements, decreases with increasing load. This provides relatively constant output voltage between no load and full load. In addition, winding 9-10 provides extra regulation capacity to compensate for the variation in input voltage and the aging of the rectifiers.

3.11 The output voltage of the rectifier is compared with the output voltage of a reference rectifier. When the voltage is higher than that of the reference, current flows through winding 9-10 in a direction to reduce the saturation and increase the impedance of L1 thereby reducing the output voltage. When the output voltage is lower than that of the reference, conditions are reversed and the output voltage is increased. Because the reference voltage (about 18) is lower than the output voltage it is possible to obtain a compounding effect by the use of the 2-ohm resistor connected in series with the load. The voltage drop through the resistor is a small fraction of the total output voltage but is a relatively larger fraction of the reference voltage so that with increasing load current, a rising output voltage characteristic may be obtained. The 1000-ohm resistor, bridged across the reference rectifier terminals, provides a path for the flow of reverse current through winding 9-10 of L1.

3.12 The core of the secondary side of L2 is maintained at saturation by the one mf capacitor (near resonance) and by virtue of the leakage reactance which exists between the primary and secondary sides of the transformer. The voltage which is fed to the reference rectifier elements consists of a component of secondary voltage at terminals 5 and 6 of L2 and subtracted from this is the voltage appearing across terminals 3 and 4. This combination provides a reverse voltage characteristic so that as the input voltage increases the voltage across the rectifier decreases.

3.13 The slider on the 75-ohm resistor which is part of the voltage divider is used to adjust the output voltage to the desired level. The 150-ohm rheostat is adjusted at the factory to center the range of voltage adjustment.

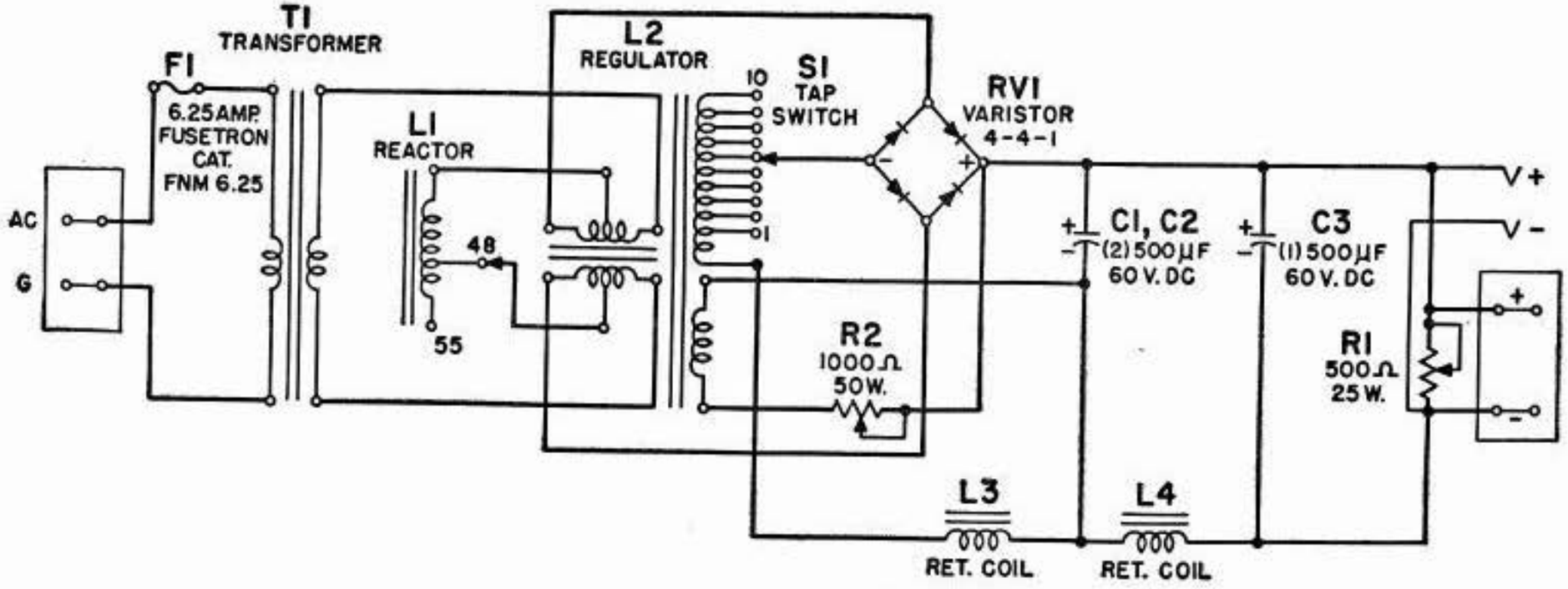


Fig. 5—KS-15620-L1 Circuit Schematic

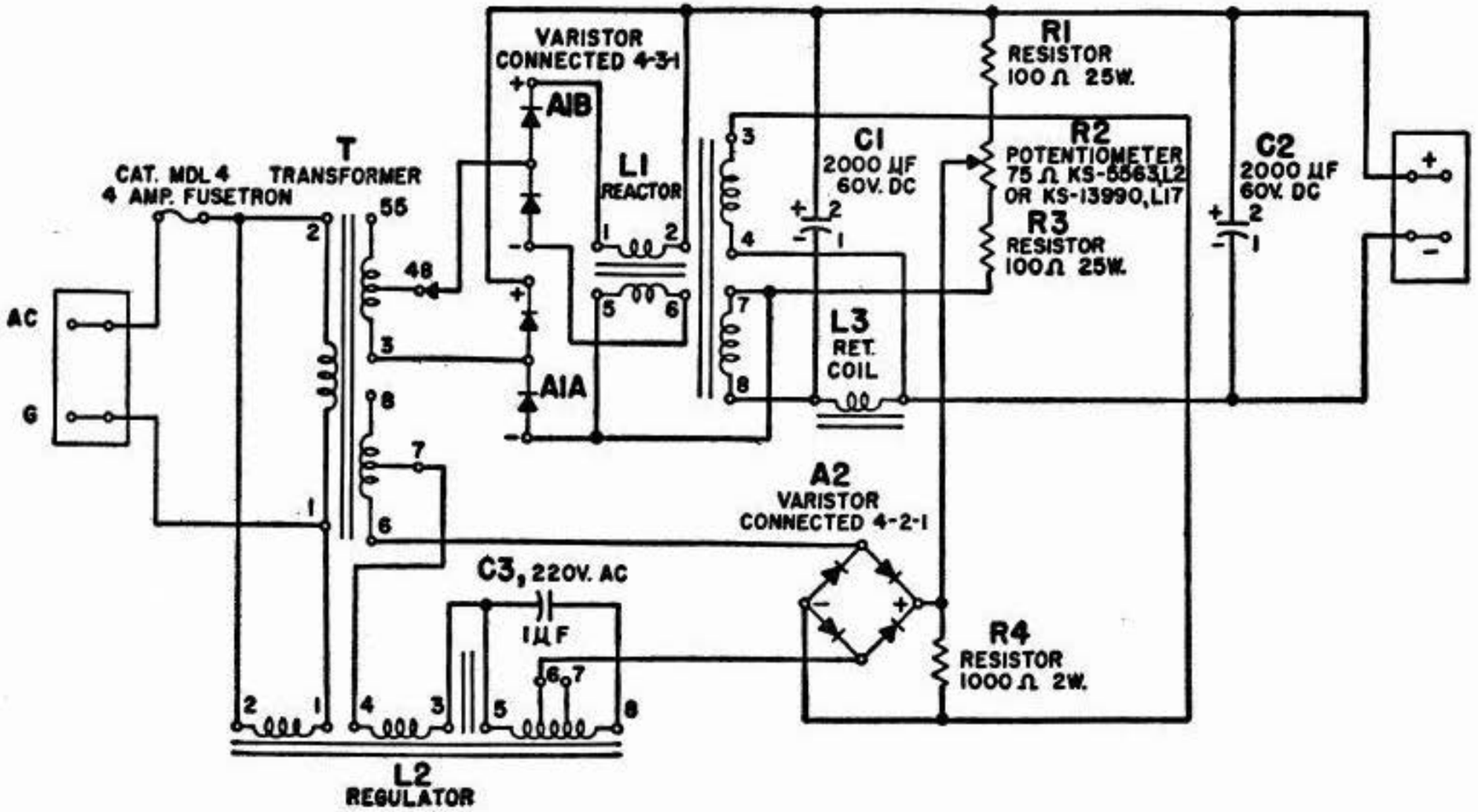


Fig. 6—KS-15620-L2 Circuit Schematic

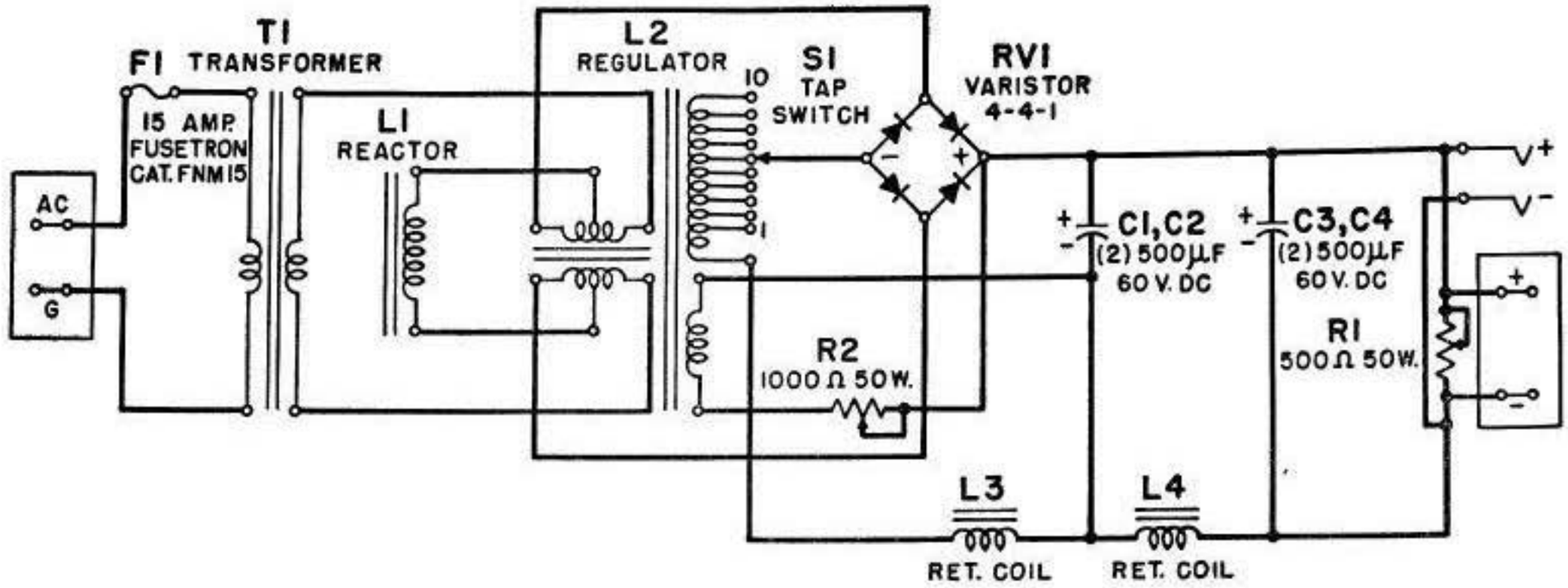


Fig. 7—KS-15620-L3 Circuit Schematic

Description of KS-15620-L1 and L3 Rectifiers (Figs. 5 and 7)

3.14 These rectifiers are similar in theory of operation to the KS-5928-L1, L2 and L3 shown in Fig. 1. The regulation is obtained by the use of a regulator coil L2 (Figs. 5 and 7). The dc load current is passed through a winding of this coil with adjustable taps (tap switch S1). As the dc load increases the dc tends to saturate the magnetic core, thus reducing the impedance of the two ac windings which are in series with the reactor coil L1. This tends to keep the dc output voltage constant with change of load. Rheostat R2 is for adjustment of the output voltage. Rheostat R1 is for the purpose of supplying a dummy load (approximately 15 ma) to stabilize the output voltage for cases where the real load might drop to a very small value.

Description of KS-15620-L2 Rectifier (Fig. 6)

3.15 This rectifier is similar in its general theory of operation to the KS-5769 shown in Fig. 4. There is a saturable reactor L1 (Fig. 6) and a reference rectifier A2. Other features may be easily recognized.

Description of J86207U Rectifier

3.16 This rectifier is used primarily with 805C power plants and is designed to operate, without batteries, into a resistance load. It is rated at a maximum of 3 amperes at 130 volts for continuous service and 4 amperes at the same voltage for intermittent loads. It will furnish combined plate and telegraph or telegraph supply of either polarity by means of apparatus and wiring options. A 24-volt signalling supply is available for operating the alarms in the 69A and 69B teletypewriter switchboards. If this rectifier is to be used for plate supply, additional filtering is required. List 4 provides the filter and wiring arrangements to permit combined plate and telegraph loads on the same polarity. Arrangements are available for positive or negative polarity and for internal grounding. Provision is made for bringing out of the rectifier case the negative regulating load. These rectifiers will normally not operate in parallel nor with batteries unless special provision is made in the plant with which they are used. Such applications should be referred to the Bell Telephone Laboratories, Inc. for analyzation.

It is a full-wave rectifier using magnitude control and is capable of regulating its output to within plus or minus 2 per cent for telegraph and 3 per cent for plate. A voltmeter and ammeter are provided as part of its equipment, together with a control to adjust its output voltage. This equipment is designed to mount on a 23 inch relay rack.

Description of J86207W Rectifier

3.17 This rectifier is designed to operate, without batteries, into a resistance load and is rated at a maximum of 8 amperes at 130 volts, for continuous or intermittent loads. It can be used for telegraph loads of either polarity by means of wiring options. The ripple on the d-c output is about 2- to 3-volt rms. This is a full-wave rectifier using phase shift control and is capable of regulating its output to within plus or minus 2 per cent. This rectifier shall be started with the external load disconnected. A voltmeter and an ammeter are provided as part of the rectifier together with a control to adjust its output voltage. These rectifiers will normally not operate in parallel nor with batteries.

4. INSTALLATION PROCEDURES

(A) Power Supply

4.01 The customer's power should be checked to insure that it is of the same voltage and frequency as given on the nameplate associated with the rectifier being installed. The ac voltage should be between the limits of 105 to 125 volts (except in the case of the KS-5988, J86207U-L2 and J86207W-L1 rectifiers) for satisfactory operation. Rectifiers equipped with transformer taps for different line voltages should be adjusted to the tap setting nearest to the actual ac line voltage.

(B) Protective Fusing

4.02 If the rectifier being installed is provided with protective fusing, check to insure that such fuses or fusetrons are of the proper type and capacity as detailed on Table E. If rectifier is equipped with fuse clip for storing spare fuses, check and, if necessary, provide spare fuses or fusetrons.

(C) Electrolytic Capacitors

4.03 If the rectifier is equipped with electrolytic capacitors (see Table E), check the requirement for recharging as covered in Part 5(B).

(D) Initial DC Voltage Checks

4.04 The initial dc voltage check should be made with the rectifier warmed up approximately 30 minutes or more after connection to the ac power supply. Check the dc voltage and adjust as outlined in Paragraph 5.02.

(E) Subsequent Voltage Checks

4.05 The output dc voltages will change as a result of the initial forming and aging of the copper oxide or selenium cell units. This is somewhat more pronounced during the first month or two of service. Following this initial forming period the voltage usually remains fairly stable, provided there are no wide variations in the terminal loads or in the ac power supply. Therefore, checks of the output voltage should be scheduled during the first few months of service and subsequent checks made as outlined in the instructions covering the particular type of apparatus.

5. MAINTENANCE REQUIREMENTS AND PROCEDURES

5.01 Maintenance of rectifiers will, in general, be limited to adjustment of dc output voltages, replacement or recharging of electrolytic capacitors, replacement of tubes or blown fuses and other minor items. In the event of total failure, or inability to adjust output voltages within specified limits, and if the procedures specified herein do not correct the trouble the rectifier should be replaced and returned for repairs.

(A) Output Voltage Requirements and Adjustments—Table D

Caution: Voltage measurements should be made with the rectifier hot, i.e., after being connected to power and operated for at least 30 minutes with normal load connected. Do not attempt to check or adjust voltages without connecting output to the normal load.

5.02 The voltage requirements, method of measuring and adjusting procedures are covered in Table D. These requirements should be used in all cases unless specified otherwise in the instructions covering the particular types of station apparatus. The voltohmmeter as specified in the tool section or an equivalent voltmeter with a 150-volt dc scale should be used for all measurements of the output voltages.

(B) Electrolytic Capacitors—Replacement and Recharging

5.03 The electrolytic capacitors (see Table E for rectifiers so equipped) will eventually deteriorate or the electrolyte will dry out and reduce the capacity and the efficiency of the output filter circuit. If the rectifiers are removed from service, the electrolytic film, which is the dielectric, tends to deteriorate progressively. This has the effect of decreasing the internal resistance and if this progresses far enough, it may result in overloading of the rectifier output when reconnected to power.

Replacement of Capacitors

Caution: When replacing use extreme care to insure that the positive terminal stamped on the capacitor case is connected to the positive terminal of the rectifier output circuit.

5.04 Electrolytic capacitors should be replaced when they are found to be causing trouble in the rectifier unit.

Recharging Capacitors

5.05 Whenever rectifiers are not connected to an ac supply for a period in excess of 24 months, the electrolytic capacitors should be recharged prior to reconnection to the power supply. On new rectifiers this interval may be determined by checking the date stamped on the capacitor. On reused rectifiers the service history records should be reviewed to determine this interval. If records are not available on this out-of-service time interval, or if there is some doubt, the capacitors should be recharged. The capacitors may be recharged as desired in connection with trouble investigation procedures.

5.06 The recharging of electrolytic capacitors should be in accordance with Section A438.961.

(C) Common Troubles and Corrective Procedures

Caution: The power supply to the rectifier should be opened whenever the cover is removed, cover door is opened or while making circuit checks on the connected load.

No DC Output Voltage

5.07 Check ac power supply, rectifier wiring, cover switches and for other defective parts.

5.08 Check protective fusing. If fuse or fusetrons are blown, check for use of proper size and type (see Table E), defective wiring in rectifiers and defective equipment such as electrolytic capacitors. If failures are experienced upon replacement of the fuse, check the possibility of shorts or low resistance in the connected load.

Varying or Low DC Output Voltages

5.09 Check ac power supply and if outside the limits of 105 to 125 volts check source of the power supply. Refer to Paragraph 4.01.

5.10 If dc output voltage is low and can not be adjusted within requirements check rectifier and connected load for troubles which would overload the rectifier output.

Low Voltage with Transformer Adjusted to Top Step

5.11 When the voltage requirements are not met and the procedures outlined in Paragraphs 5.09 and 5.10 are not effective the transformer should be adjusted to a higher step. If the requirements are not met after adjustment to the top step, it is usually an indication of deterioration of the rectifying element beyond the operating capacity of the unit.

6. REPLACEMENT PARTS

6.01 Spare or replacement parts will usually be limited to tubes, electrolytic capacitors, cover switches, fuses and power cords. Table E provides the manufacturer's code number and description of fuses as well as the capacity and code number of electrolytic capacitors, on those types of rectifiers so equipped. The code number and description of some other parts may be obtained from the schematic drawings.

6.02 On some rectifiers of older manufacture the fuse or fusetron numbers (such as 9012, etc.) were stamped on the control panel. These refer to obsolete code numbers which should be disregarded.

6.03 All rectifiers except the J86205J-L1 are furnished by suppliers other than the Western Electric Company and uniform coding for parts has not been established. Parts for the J86205J-L1 rectifier and other parts identified by a KS prefix may be obtained by ordering in the usual manner. Orders for all other parts should include the following information:

(a) Supplier's name, type of rectifier, and serial number obtained from the nameplate data attached to the rectifier.

(b) Complete description of the part and supplier's code number (when given) as indicated on the schematic drawings included in this section.

7. SPECIAL PROCEDURES ON CUSTOMER-OWNED RECTIFIERS

7.01 In some cases the Telephone Company may be called upon to maintain on a recurring basis or to assist in the maintenance of rectifiers owned by the customer and of a type other than those standard for Bell System use. In such cases the same procedures outlined herein should be followed.

7.02 Such rectifiers may not be provided with the automatic power disconnect switch associated with the cover. In such cases special care should be exercised to insure that the power input cord is disconnected whenever it is necessary to remove the cover.

7.03 At locations where such TTY stations are maintained by the Telephone Company on a recurring basis and the rectifier is not provided with the cover disconnect switch, it is suggested that the rectifier be equipped with a nameplate Form E-3244 (Fig. 8). The nameplate should be firmly attached to the rectifier case and in a position where it can be seen by any one who may have occasion to work on the rectifier.

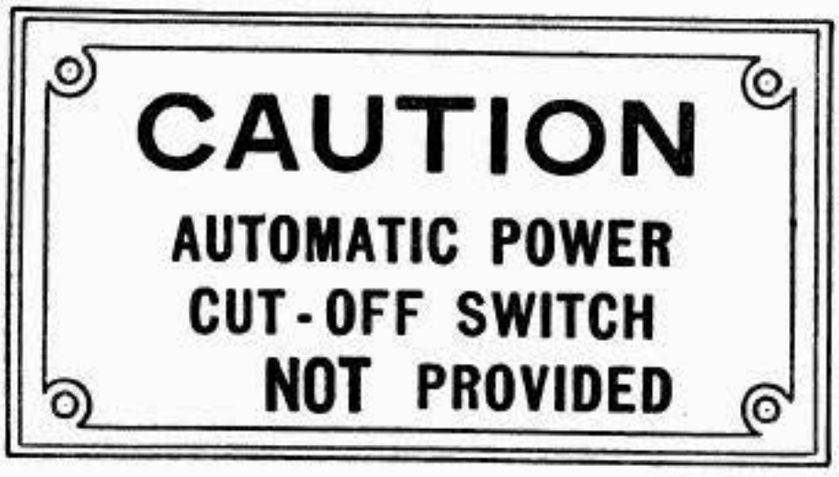


Fig. 8—Caution Label

TABLE A

Rectifiers Not Equipped with Automatic Voltage Regulation

Rectifier	Tel. Co. Status	Notes	Fig. No.	AC Input			DC Output		Rectifying Unit	Approx. Dimensions			Cord Length		Notes
				Volts	Freq.	Watts	Volts	Amps.		Width	Height	Depth	Input	Output	
KS-5300-L1 and L3	Mfr. Disc.	1	9	105 to 125	L1 50 to 60 L3 25 to 40	40	120	.125	Copper Oxide	6"	L1 10" L3 7"	12"	24"	24"	1. Suitable for re-use and included to cover information on those now in use.
J86205J-L1	Mfr. Disc.	1	10	105 to 125	50-60	40	120	.125	Copper Oxide	7"	7"	10"	24"	24"	2. The selenium rectifying units provide for somewhat better output voltage regulation than the copper oxide units.
KS-5579-L1	Mfr. Disc.	1,2	11	105 to 125	50-60	50	120	.200	Selenium	7"	8"	12"	24"	24"	3. The transformer is equipped with taps to adjust output voltages to 75 and 120 volts.
KS-5663-L1	Mfr. Disc.	1,2,3	12	105 to 125	50-60	50	75 and 120	.200	Selenium	7"	7"	12"	24"	24"	
KS-5663-L2 and L3	Mfr. Disc.	1,2,3	13	105 to 125	50-60	50	75 and 120	.200	Selenium	7"	7"	10"	24"	24"	4. Arranged for 19" relay rack mtg. and plate is 3-1/2" wide.
KS-5663-L4	Mfr. Disc.	1,2,3,7	14	105 to 125	50-60	35	75 and 120	.200	Selenium	7"	7"	10"	27"	27"	5. Similar to the KS-5663-L1.
KS-5663-L5	Present Standard	2,3,7	14	105 to 125	25-60	35	75 and 120	.200	Selenium	7"	7"	10"	27"	27"	6. Additional 20-volt ac output at .7 amp for tube heaters. If this is not used, dc output may be increased to .200 amps.
KS-5663-L6	Present Standard	2,3,6	15	105 to 125	50-60	45	75 and 130	.150	Selenium	7"	7"	10"	27"	27"	

(Contd on next page)

TABLE A - Continued

Rectifiers Not Equipped with Automatic Voltage Regulation

Rectifier	Tel. Co. Status	Notes	Fig. No.	AC Input			DC Output		Recti-fying Unit	Approx. Dimensions			Cord Length		Notes
				Volts	Freq.	Watts	Volts	Amps.		Width	Height	Depth	Input	Output	
KS-5663-L7	Present Standard	2,3,7	14	105 to 125	50-60	35	75 and 120	.200	Selenium	7"	7"	10"	27"	27"	7. Can be operated at 130 volts dc output for 128B2 sets.
KS-5740-L1	Present Standard	2,4	16	105 to 125	50-60	100	130	.400	Selenium	19"	3-1/2"	10"	None	None	8. Arranged for 23" relay rack mtg. and plate is 6" wide.
KS-5740-L2	Present Standard	2,8	16	105 to 125	50-60	140	120	.800	Selenium	23"	6"	10"	None	None	9. Similar to KS-5740-L2.
REC-36	Customer owned TTY equipment	2,3,5	17	105 to 125	50-60	.....	75 and 120	.200	Selenium	7"	7"	10"	27"	27"	10. Similar to KS-5740-L1.
J86256A-L1	Present Standard	2,9	18	105 to 125	50-60	140	120	.800	Selenium	23"	6"	10"	None	None	11. The dimensions shown in parenthesis represent the rectifying elements which are mounted separately.
J86256B-L1	Present Standard	2,10	19	105 to 125	60	100	130	.420	Selenium	19"	3-1/2"	10"	None	None	12. 25-, 40-, 50-, and 60-cycle motor supply leads on terminal board.
KS-5988-L1	Present Standard	2,11,12	26	95-125 and 190-250	25-60	140	120	.800	Selenium	19" (21")	10" (4")	8" (8")	24" (Rect.	24" 24")	

TABLE B

Rectifiers Equipped with Automatic Voltage Regulation

Rectifier	Tel. Co. Status	Notes	Fig. No.	AC Input			DC Output		Recti-fying Unit	Approx. Dimensions			Cord Lengths		Notes
				Volts	Freq.	Watts	Volts	Amps.		Width	Height	Depth	Input	Output	
KS-15523-L1 (For L2-L3 see Par. 3.08)	Present Standard	2	3	105 to 125	60	750	120 to 130	3.0	Selenium	17"	21"	11-1/2"	36"	None	1. Suitable for re-use and included to cover information on those now in use. 2. Equipped with transformers with 105, 115 and 125 AC voltage adjustment taps. 3. The Rect. element is mounted in a separate unit. The dimensions enclosed in parentheses are for the separate unit. 4. Similar to KS-5536-01. 5. Same as L1 except that all apparatus is mounted in a single housing.
KS-5536-L1	Mfr. Disc.	1,2,3	20	105 to 125	60	240	120	.640	Copper Oxide	8" (8")	9" (6")	21" (23")	24" (Rect.	24" 24")	
KS-5536-01	Mfr. Disc.	1,2,3	21	105 to 125	60	240	120	.800	Selenium	8" (4")	10" (4")	20" (21")	30" (Rect.	30" 24")	
KS-5928-L1 and L2	Mfr. Disc.	1,2,3	22	105 to 125	L1 60 L2 50	240	120	.800	Selenium	8" (4")	10" (4")	20" (21")	30" (Rect.	24" 24")	
KS-5928-L3	Mfr. Disc.	1,2,5,6	23	105 to 125	60	240	120	.800	Selenium	8"	10"	20"	42"	24"	
KS-5928-L4	Present Standard	6,7	2	105 to 125	60	240	120	.800	Selenium	8"	10"	20"	42"	24"	
REC-13 and 14	Customer owned TTY equipment	2,4	24	105 to 125	R13 60 R14 25	200	120	.600	Selenium	9"	11"	23"	30"	24"	(Contd on next page)
KS-5769-L1	Present Tel. Co. Standard		25	105 to 125	60	200	120	.800	Selenium	8"	10"	20"	42"	24"	

TABLE B - Continued

Rectifiers Equipped with Automatic Voltage Regulation

Rectifier	Tel. Co. Status	Notes	Fig. No.	AC Input			DC Output		Recti-fying Unit	Approx. Dimensions			Cord Lengths		Notes
				Volts	Freq.	Watts	Volts	Amps.		Width	Height	Depth	Input	Output	
KS-15620-L1	Present Standard	8,9	5	105 to 125	60	210	48 or 55	1.75	Selenium	19"	8-3/4"	12"	-	-	6. May be furnished as an alternate for KS-5769-L1.
KS-15620-L2	Present Standard	8,9	6	105 to 125	60	175	48 or 55	1.75	Selenium	19"	8-3/4"	7-1/2"	-	-	7. Equipped with 111-, 117-, and 123-volt AC adjusting taps.
KS-15620-L3	Present Standard	8,10	7	105 to 125	60	350	48	3.5	Selenium	19"	10-1/2"	12"	-	-	8. Arranged for 19" relay rack mounting.
J86207U-L1	Present Standard	12	-	115	50 to 60	460	130	3.0	Tube	23"	15-3/4"	11-1/4"	-	-	9. Mtg. plate 8-3/4" wide.
J86207U-L2	Present Standard	12	-	230	50 to 60	460	130	3.0	Tube	23"	15-3/4"	11-1/4"	-	-	10. Mtg. plate 10-1/2" wide.
J86207W-L1	Present Standard	11	-	210 to 250	50 to 60	1400	120 to 130	8.0	Tube		22-3/4"	13-15/16"	-	-	11. Width for power board mtg. 24"; for relay rack 23"
															12. Arranged for 23" relay rack mounting.

Table C

Field of Application - Station Rectifiers

TELETYPEWRITERS		SUBSCRIBER SETS				SWITCHBOARDS			
14,15,20,26 and Miscellaneous Apparatus (120V)**	19 TTY (120V)**	128B2 (130V)**	128C1, C2 and C3 (75V)**	130H1 (130V)**	131B2 (120V)**	69A	69B	65H1 (48V)**	67A2 (48/55V)**
KS-5300-L1 -L3 KS-5579-L1 KS-5663-L1 -L2 -L3 REC-36 J86205J-L1	KS-5536-L1 -01 KS-5769-L1 KS-5928-L3 -L4 KS-15523-L1 -L2* -L3* REC 13-14	KS-5663-L4 -L5 -L7	KS-5663-L1 -L2 -L3 -L4 -L5 -L7 REC-36	KS-5663-L6 (Inc. 20V A-C Fil. Supply)	KS-5988-L1	J86207U-L1 J86207U-L2	J86207U-L1 J86207U-L2 J86207W-L1	KS-15620-L3	KS-15620-L1 -L2

* KS-15523-L2 is a special 19 inch relay rack for mounting L-1 rectifiers
KS-15523-L3 is a baffle plate which allows mounting the L-1 rectifiers one above the other on the relay rack

** Make voltage adjustments in accordance with Table D

Table C - Continued

Field of Application - Station Rectifiers

81 Type Station Control Circuit (120V)**	81D1 Auto Address Cabinet (48/55V)**
KS-5740-L1 -L2 J86256A-L1 J86256B-L1	KS-15620-L1 -L2

Table D

Voltage Requirements and Methods of Adjusting - Station Rectifiers

Type of Rectifier	Correct Voltmeter (Notes)	Voltage Requirements			Method of Adjustment (Note 1)	Operating Conditions of Associated Apparatus
		Test	Readj.	Noted		
J86207D-11,12	1)	130	± 2		Adj. screwdriver control	Power ON and normal load connected; that is, with the associated TTY, Sub-Set or other apparatus in the normal closed circuit operating condition
KS-5300-11,13	2,4	120± 5	± 2	5	Adj. flexible leads in pin jacks	
KS-5579-11	2,4	120± 5	± 2	5		
J86205J-11	2,4	120± 5	± 2	5	Adj. flexible leads on screw terminals	
KS-5663-11,12,13	2,4	120± 5	± 2	5,6,7		
REC - 36	2,4	120± 5	± 2	5,6,7		
KS-5663-14,15,17	2	130± 5	± 2	7		
KS-5663-16	2	130± 5	± 2	7,10		
KS-5938-11	2	120± 5	± 2	11		
KS-19620-11,12,13	2	48/55	± 2	8,9	Adj. dial (tap) switches or knob control	
KS-5740-11,12	3	120	± 2	8		
J86256A-11	3	120	± 2	8		
J86256B-11	3	120	± 2	8		
KS-15583-11	2	120± 5	± 2			Power ON, LINE-TEST Key to TEST, SEND-REC Key to SEND, Trans Dist Operating
KS-5530-11,01	2	120± 5	± 2		Adj. flexible leads on screw terminals	
KS-5996-11,12	2	120± 5	± 2			
REC 13-14	2	120± 5	± 2			
KS-5928-13,14	2 or 3	120± 5	± 2	12	Adj. screwdriver control	
KS-5769-11	2	120± 5	± 2			
J86207K-11	13	120-130	± 2		Adj. screwdriver control	Start rectifier with external load disconnected

CAUTION

Open A-C power supply whenever covers or cover doors are removed or opened

NOTES

1. When top step of transformer or limiting position of rheostat is reached, check as outlined in Paragraph 5.12
2. At A-C Terminals on TTY, Base, Sub-Set or other apparatus
3. At jacks or terminals on Rectifier Control Panel or Terminal Board
4. Use 4721 Tool when Rectifier Terminals on TTY apparatus are not accessible. Remove Output Rect. Cord, place 1714 Tool over prongs of Outlet. Replace Rect. Cord and measure with load connected
5. Use this requirement for all types of Rectifiers when used for local battery supply and other misc. purposes and when requirements are not covered in separate instructions covering the apparatus
6. 75V required when used with 1280-Type Sub-Sets. Test & Readj. 75 ±2V.
7. To adjust KS5663-Type and REC 36 Rect. to 75V use L (75V) tap.
8. Test & Readj. requirements the same
9. L3 is arranged for 48V only. L1 and L2 may be set for 48V or 55V by selecting the 48V or 55V tap on the reactor
10. Additional 25V A-C outlet provided for tube heaters. Adj. to 25 ±0.5V
11. 25,40,50 and 60 cycle motor supply leads on terminal board.
12. KS-5928-L4 Test Tubes (Out of Service) failure of V1 or V2 to ionize (glow) with the corresponding TEST switch operated indicates a defective tube.
13. Has built-in voltmeter and ammeter.

Table D

Voltage Requirements and Methods of Adjusting - Station Rectifiers

Type of Rectifier	Connect Voltmeter (Notes)	Voltage Requirements			Method of Adjustment (Note 1)	Operating Conditions of Associated Apparatus	
		Test	Readj.	Notes			
J86207U-L1,L2	13	130	± 2		Adj. screw-driver control	Power ON and normal load connected; that is, with the associated TTY, Sub-Set or other apparatus in the normal closed circuit operating condition	Open A-C … or cover …
KS-5300-L1,L3	2,4	120± 5	± 2	5	Adj. flexible leads in pin jacks		1. When to … position … has outli…
KS-5579-L1	2,4	120± 5	± 2	5			2. At D-C T… or other…
J86205J-L1	2,4	120± 5	± 2	5	Adj. flexible leads on screw terminals		3. At jacks … Control …
KS-5663-L1,L2,L3	2,4	120± 5	± 2	5,6,7			4. Use 47A… TTY appa… Output … prongs … measure…
REC - 36	2,4	120± 5	± 2	5,6,7			
KS-5663-L4,L5,L7	2	130± 5	± 2	7			5. Use this … Rectifie… supply … require… instruct…
KS-5663-L6	2	130± 5	± 2	7,10			
KS-5988-L1	2	120± 5	± 2	11			6. 75V requ… Sub-Sets…
KS-15620-L1,L2,L3	2	48/55	± 2	8,9	Adj. dial (tap) switches or knob control		7. To adjus… to 75V …
KS-5740-L1,L2	3	120	± 2	8			8. Test & …
J86256A-L1	3	120	± 2	8			9. L3 is a… may be … the 48V …
J86256B-L1	3	120	± 2	8			10. Additio… tube hea…
KS-15523-L1	2	120± 5	± 2			Power ON, LINE-TEST Key to TEST, SEND-REC Key to SEND, Trans Dist Operating	11. 25,40,… leads …
KS-5536-L1,01	2	120± 5	± 3		Adj. flexible leads on screw terminals		12. KS-592… Failur… with t… operat…
KS-5928-L1,L2	2	120± 5	± 2				
REC 13-L4	2	120± 5	± 2				13. Has bu…
KS-5928-L3,L4	2 or 3	120± 5	± 2	12	Adj. screw-driver control		
KS-5769-L1	2	120± 5	± 2				
J86207W-L1	13	120-130	± 2		Adj. screw-driver control	Start rectifier with external load disconnected	

	Operating Conditions of Associated Apparatus	
	Power ON and normal load connected; that is, with the associated TTY, Sub-Set or other apparatus in the normal closed circuit operating condition	CAUTION Open A-C power supply whenever covers or cover doors are removed or opened NOTES 1. When top step of transformer or limiting position of rheostat is reached, check as outlined in Paragraph 5.11 2. At D-C Terminals on TTY, Base, Sub-Set or other apparatus 3. At jacks or terminals on Rectifier Control Panel or Terminal Board 4. Use 471A Tool when Rectifier Terminals on TTY apparatus are not accessible. Remove Output Rect. Cord, place 471A Tool over prongs of Outlet. Replace Rect. Cord and measure with load connected 5. Use this requirement for all types of Rectifiers when used for local battery supply and other misc. purposes and when requirements are not covered in separate instructions covering the apparatus 6. 75V required when used with 128C-Type Sub-Sets. Test & Readj. 75 ±3V. 7. To adjust KS5663-Type and REC 36 Rect. to 75V use L (75V) tap. 8. Test & Readj. requirements the same 9. L3 is arranged for 48V only. L1 and L2 may be set for 48V or 55V by selecting the 48V or 55V tap on the reactor 10. Additional 20V A-C outlet provided for tube heaters. Adj. to 20 ±0.5V 11. 25,40,50 and 60 cycle motor supply leads on terminal board. 12. KS-5928-L4 Test Tubes (Out of Service) Failure of V1 or V2 to ionize (glow) with the corresponding TEST switch operated indicates a defective tube. 13. Has built-in voltmeter and ammeter.
	Power ON, LINE-TEST Key to TEST, SEND-REC Key to SEND, Trans Dist Operating	
	Start rectifier with external load disconnected	

TABLE F

Protective Fusing and Electrolytic Capacitors

Rectifier	Fig. No.	PROTECTIVE FUSING				ELECTROLYTIC CAPACITORS		
		Type	Capacity	Russell Co. Code No.	Notes	Capacitance	Part or Code No.	Notes
KS-15523-L1	3	Input Fuse	15 amp	ABC-15	1	2250 mf	Three KS-14069	9
KS-5579-L1	11	Output Fusetron	0.5 amp	MDL-1/2	2	200 mf	070	8
KS-5663-L1, L2, L3	12,13	Output Fusetron	0.5 amp	MDL-1/2	4,5	200 mf	KS-13751	9
KS-5663-L4, L5, L7	14	Input Fusetron	0.5 amp	MDL-1/2	4,5	750 mf	KS-14069	9
KS-5663-L6	15	Input Fusetron Output Fusetron	1.0 amp	MTH-1	4,5	750 mf	KS-14069	9
KS-5760-L1	16	Output Fusetron	1.0 amp	MDL-1	4	400 mf	Two KS-13761	9
KS-5760-L2	16	Output Fusetron	2.0 amp	MDL-2	4	600 mf	Three KS-13761	9
282-36	17	Output Fusetron	0.3 amp	MTE-3/10	4	200 mf	-	7
#662564-L1	19	Input Fusetron	2.0 amp	MTE-2	4	600 mf	Three KS-13761	9
#662563-L1	19	Input Fusetron	1.25amp	MTE-1-1/4	4	400 mf	Two KS-13761	9
KS-5988-L1	26	Input Fusetron	10.0 amp	MDL-10		Minimum 450 mf for each amp	Two C-36	9
		Output Fusetron	1.6 amp	FRN-1-6/10	2			
KS-6836-L1	20	Input Fuse	6.0 amp	3AG-6	1	900 mf	-	7
		Output Fusetron	1.25amp	FRN-1-1/4	2			
KS-5536-01	21	Input Fuse	6.0 amp	AGC-6	2	800 mf	C1	8
		Output Fusetron	1.6 amp	FRN-1-6/10				
KS-5928-L1, L2	22	Input Fuse	6.0 amp	AGC-6	2	1000 mf	C5-1	8
		Output Fusetron	1.6 amp	FRN-1-6/10				
KS-6908-L3	23	Input Fuse	5.0 amp	MTH-5L	3,5	750 mf	KS-14069	9
KS-5926-L1	2	Input Fuse or Fusetron	5.0 amp	MTH-5	3,5	1000 mf	3-0109A	9
KS-5769-L1	25	Output Fuse	5.0 amp	MTH-5	3,5	1500 mf	Two KS-14069	9
KS-14620-L1	5	Input Fusetron	6.25amp	MDL-6.25	6	500 mf	Three KS-14136	9
KS-15620-L2	6	Input Fusetron	4.0 amp	MDL-4	3	2000 mf	Two KS-14136	9
KS-15620-L3	7	Input Fusetron	15.0 amp	FNM-15	6	500 mf	Four KS-14136	9
J86207D L1,L2	-	Input Fuse - 115V	10.0 amp			See Drawing SD-80871-01		
		Input Fuse - 230V	6.0 amp					
J86207B-L1	-	Input Fuse - 210V	20.0 amp			See Drawing SD-80917-01		
		Input Fuse - 230V	15.0 amp					
		Output Fuse	10.0 amp					

Note 1: Cartridge Fuse, 9/16" diameter, 2" long.

Note 2: Cartridge Fusetron, 9/16" diameter, 2" long.

Note 3: Tubular Glass Fuse, 1/4" diameter, 1-1/4" long.

Note 4: Tubular Glass Fusetron, 1/4" diameter, 1-1/2" long.

Note 5: Rectifiers of recent manufacture are equipped with spare fuse holders inside the cover.

Note 6: Fiber Tube, 13/32" diameter, 1-1/2" long.

Note 7: No okt. designation provided. Order by description.

Note 8: Manufacturer's Part No. Order by description and refer to this Part No.

Note 9: Order in usual manner using KS Part No.

TABLE E

Protective Fusing and Electrolytic Capacitors

Rectifier	Fig. No.	PROTECTIVE FUSING				
		Type	Capacity	Bussman Co. Code No.	Notes	Cap
KS-15523-L1	3	Input Fuse	15 amp	ABC-15	3	2
KS-5579-L1	11	Output Fusetron	0.5 amp	FRN-1/2	2	
KS-5663-L1, L2, L3	12,13	Output Fusetron	0.5 amp	MDL-1/2	4,5	
KS-5663-L4, L5, L7	14	Input Fustron	0.5 amp	MDL-1/2	4,5	
KS-5663-L6	15	Input Fusetron Output Fusetron	1.0 amp	MDL-1	4,5	
KS-5740-L1	16	Output Fusetron	1.0 amp	MDL-1	4	
KS-5740-L2	16	Output Fusetron	2.0 amp	MDL-2	4	6
REC-36	17	Output Fusetron	0.3 amp	MDL-3/10	4	
J86256A-L1	18	Input Fusetron	2.0 amp	MDL-2	4	6
J86256B-L1	19	Input Fusetron	1.25 amp	MDL-1-1/4	4	
KS-5988-L1	26	Input Fusetron	10.0 amp	REC-10		Mi 160 ea
		Output Fusetron	1.6 amp	FRN-1-6/10	2	
KS-5536-L1	20	Input Fuse	6.0 amp	Non-6	1	80
		Output Fusetron	1.25 amp	FRN-1-1/4	2	
KS-5536-01	21	Input Fuse	6.0 amp	Non-6	2	80
		Output Fusetron	1.6 amp	FRN-1-6/10		
KS-5928-L1, L2	22	Input Fuse	6.0 amp	Non-6	2	100
		Output Fusetron	1.6 amp	FRN-1-6/10		
KS-5928-L3	23	Input Fuse	5.0 amp	HKP-EL	3,5	75
KS-5928-L4	2	Input Fuse or Fusetron	5.0 amp	MTH-5	3,5	100
KS-5769-L1	25	Output Fuse	5.0 amp	MTH-5	3,5	150
KS-15620-L1	5	Input Fusetron	6.25 amp	FNM-6.25	6	50
KS-15620-L2	6	Input Fusetron	4.0 amp	MDL-4	3	200
KS-15620-L3	7	Input Fusetron	15.0 amp	FNM-15	6	50
J86207U-L1,L2	-	Input Fuse - 115V	10.0 amp			See
		Input Fuse - 230V	6.0 amp			
J86207W-L1	-	Input Fuse - 210V	20.0 amp			See
		Input Fuse - 230V	15.0 amp			
		Output Fuse	10.0 amp			

Note 1: Cartridge Fuse, 9/16" diameter, 2" long.

Note 2: Cartridge Fusetron, 9/16" diameter, 2" long.

Note 3: Tubular Glass Fuse, 1/4" diameter, 1-1/4" long.

Note 4: Tubular Glass Fusetron, 1/4" diameter, 1-1/2" long.

Note 5: Rectifiers of recent manufacture are equipped with spare fuse holders inside the cover.

Note 6: Fiber Tube, 13/32" diameter, 1-1/2"

Note 7: No ckt. designation provided. Orde

Note 8: Manufacturer's Part No. Order by d this Part No.

Note 9: Order in usual manner using KS Part

TABLE E

nd Electrolytic Capacitors

IVE FUSING			ELECTROLYTIC CAPACITORS		
	Bussman Co. Code No.	Notes	Capacitance	Part or Code No.	Notes
	ABC-15	3	2250 mf	Three KS-14089	9
	FRN-1/2	2	200 mf	C70	8
	MDL-1/2	4,5	200 mf	KS-13761	9
	MDL-1/2	4,5	750 mf	KS-14089	9
	MDL-1	4,5	750 mf	KS-14089	9
	MDL-1	4	400 mf	Two KS-13761	9
	MDL-2	4	600 mf	Three KS-13761	9
	MDL-3/10	4	200 mf	-	7
	MDL-2	4	600 mf	Three KS-13761	9
	MDL-1-1/4	4	400 mf	Two KS-13761	9
	NEC-10		Minimum 450 mf for each cap	Two C-36	9
	FRN-1-6/10	2			
	Non-6	1	800 mf	-	7
	FRN-1-1/4	2			
	Non-6	2	800 mf	C1	8
	FRN-1-6/10				
	Non-6	2	1000 mf	C5-1	8
	FRN-1-6/10				
	HKP-EL	3,5	750 mf	KS-14089	9
	MTH-5	3,5	1000 mf	3-C109A	9
	MTH-5	3,5	1500 mf	Two KS-14089	9
	FNM-6.25	6	500 mf	Three KS-14136	9
	MDL-4	3	2000 mf	Two KS-14136	9
	FNM-15	6	500 mf	Four KS-14136	9
			See Drawing SD-80871-01		
			See Drawing SD-80937-01		

Note 6: Fiber Tube, 13/32" diameter, 1-1/2" long.

Note 7: No ckt. designation provided. Order by description.

Note 8: Manufacturer's Part No. Order by description and refer to this Part No.

Note 9: Order in usual manner using KS Part No.

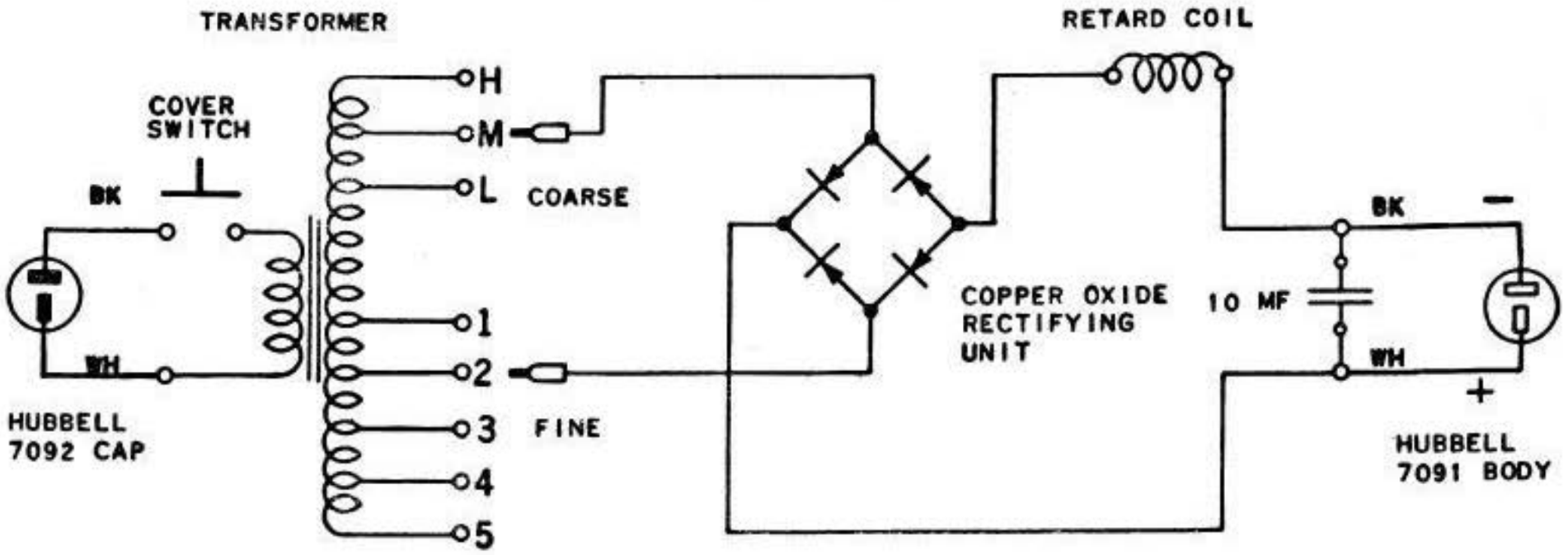
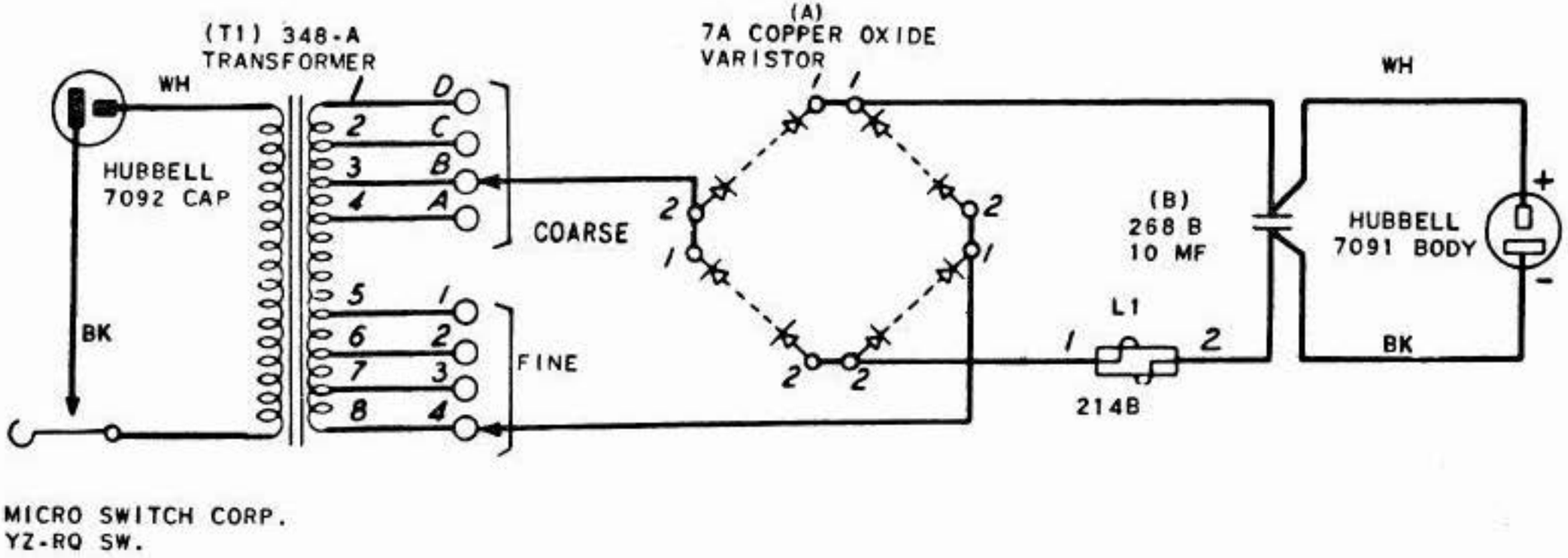


Fig. 9—KS-5300-L1 and L3—Circuit Schematic



MICRO SWITCH CORP.
YZ-RQ SW.

Fig. 10—J86205J-L1—Circuit Schematic

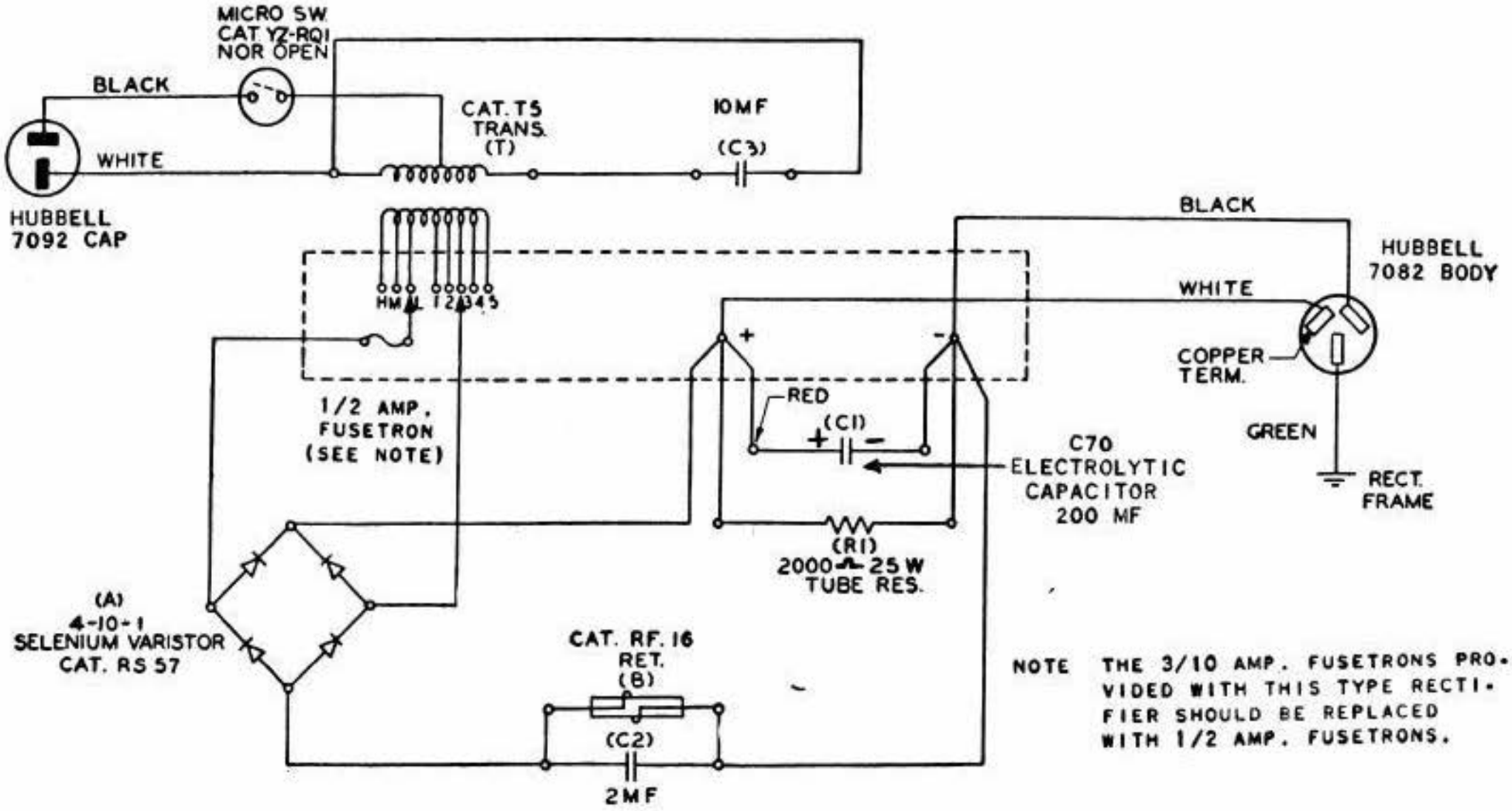
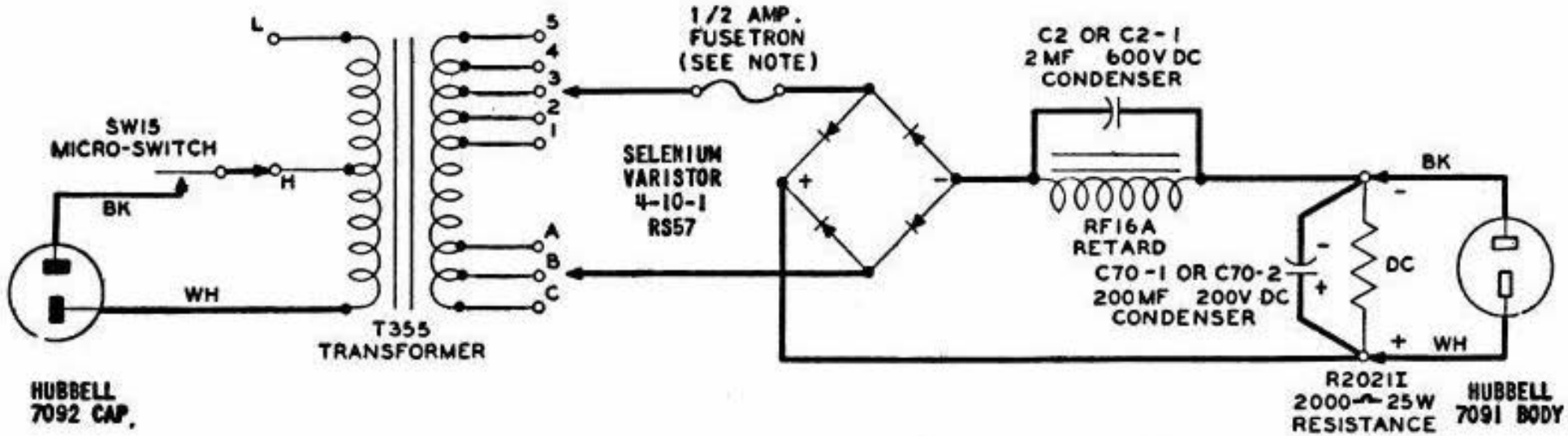


Fig. 11—KS-5579-L1—Circuit Schematic



NOTE: THE 1/3 AMP. FUSETRONS PROVIDED WITH THIS TYPE RECTIFIER SHOULD BE REPLACED WITH .5 AMP. FUSETRONS.

Fig. 12—KS-5663-L1—Circuit Schematic

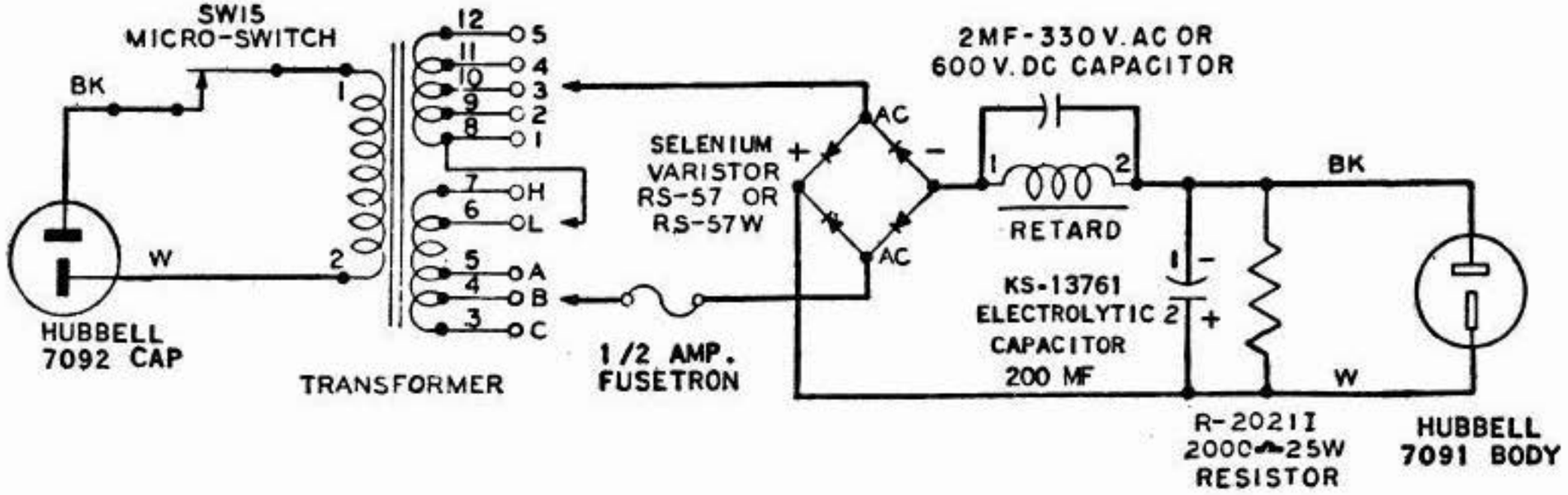


Fig. 13—KS-5663-L2 and L3—Circuit Schematic

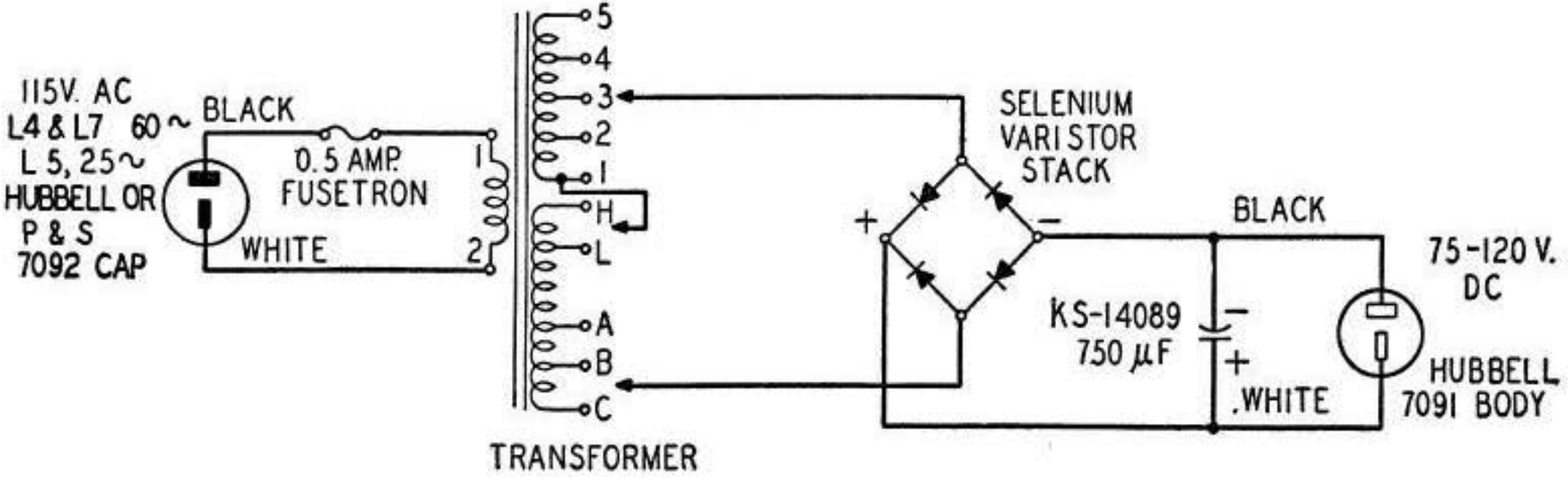


Fig. 14—KS-5663-L4, L5 and L7—Circuit Schematic

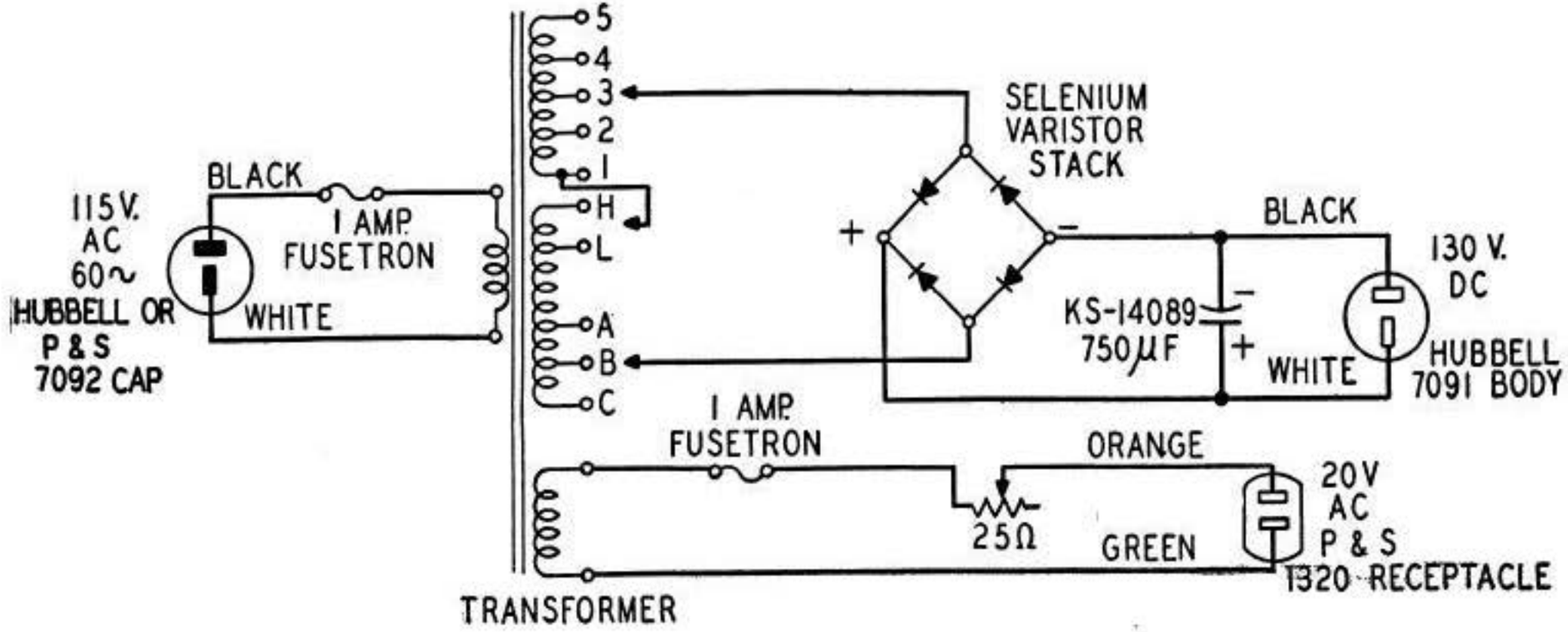
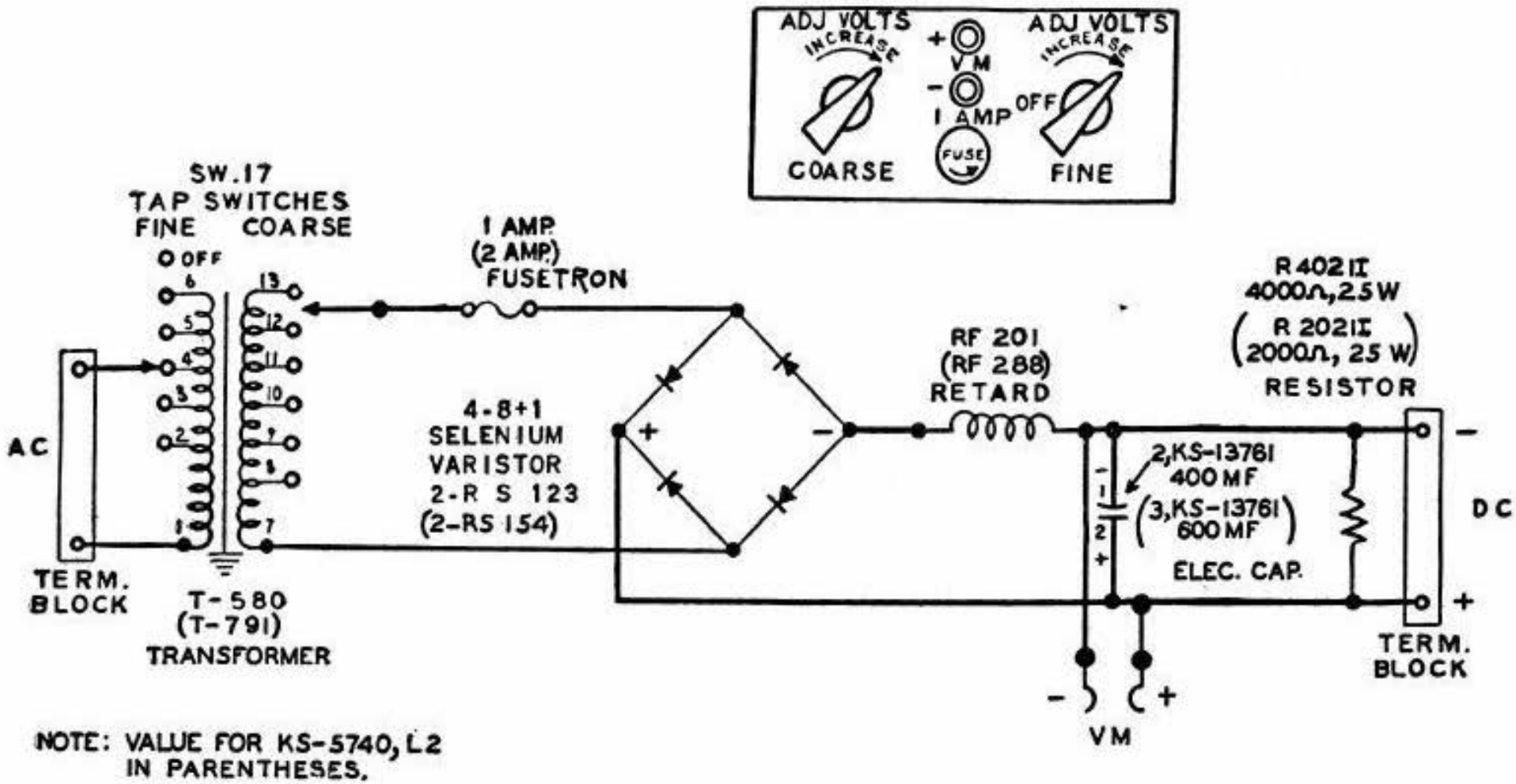


Fig. 15—KS-5663-L6—Circuit Schematic



NOTE: VALUE FOR KS-5740, L2 IN PARENTHESES.

Fig. 16—KS-5740-L1 and L2—Circuit Schematic

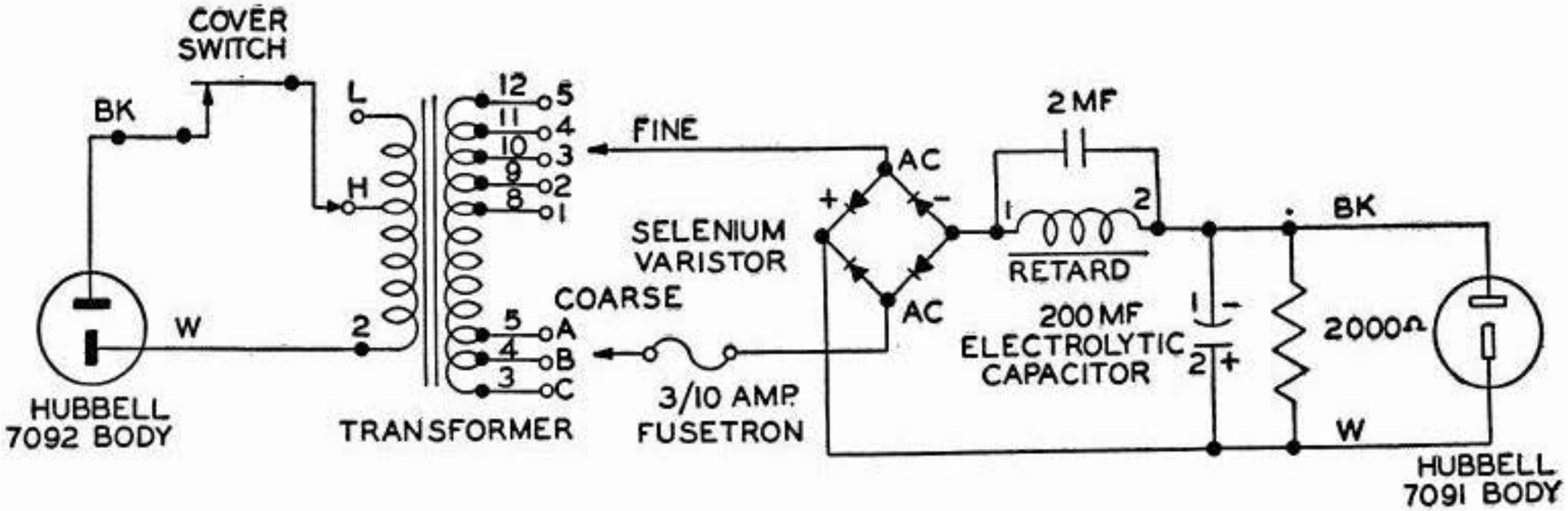


Fig. 17—REC 36—Circuit Schematic

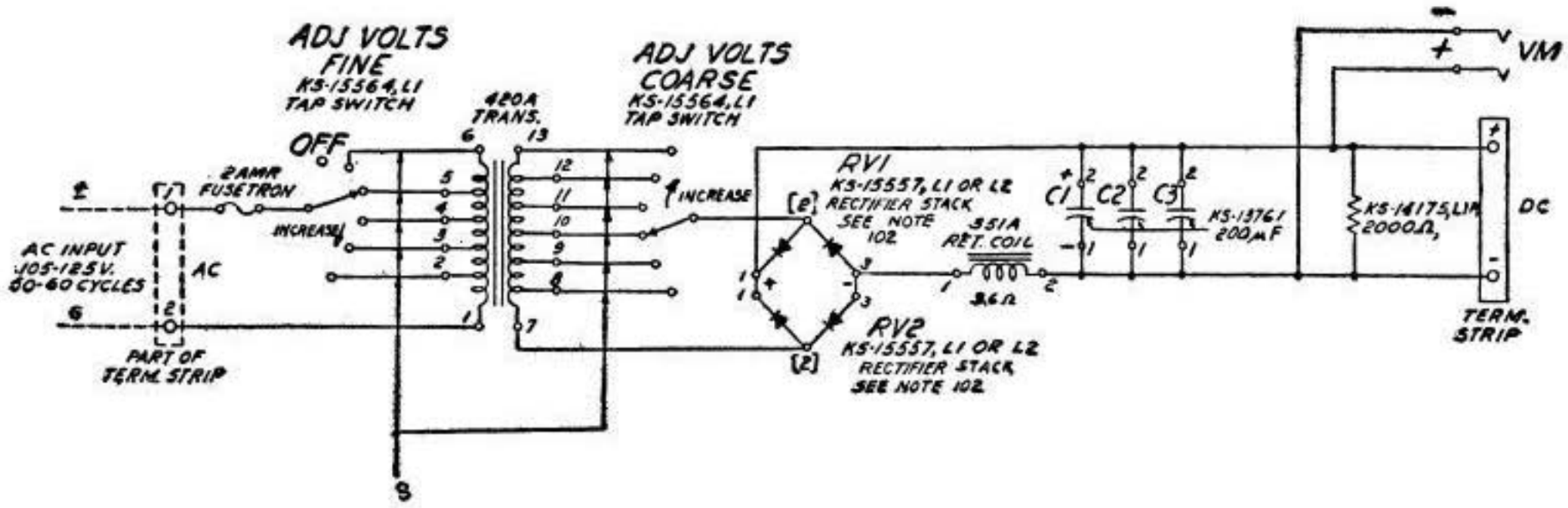


Fig. 18—J86256A-L1—Circuit Schematic

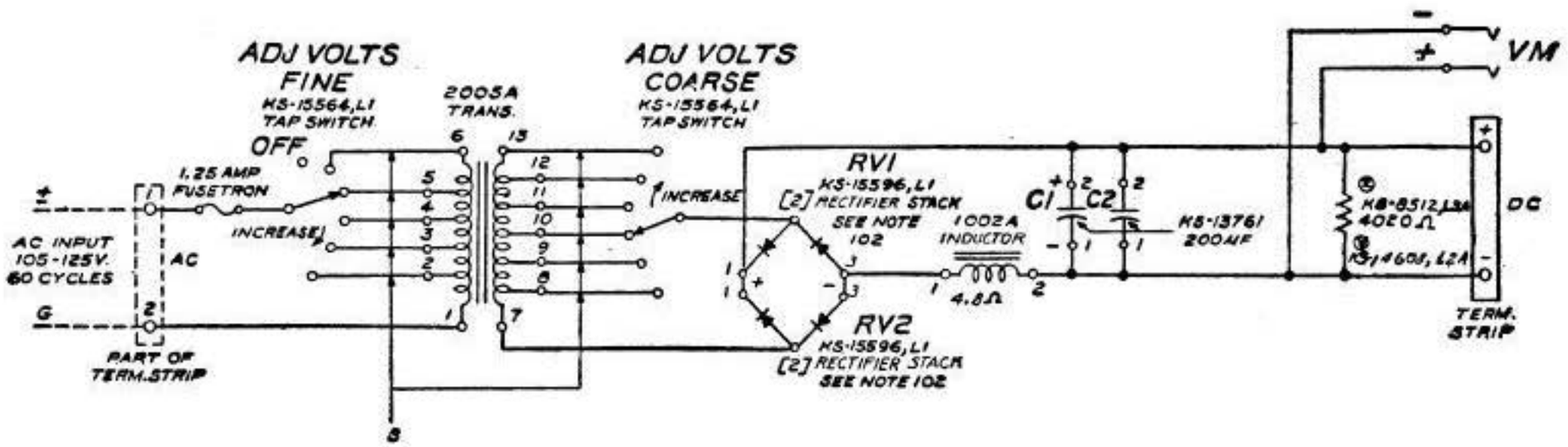


Fig. 19—J86256B-L1—Circuit Schematic

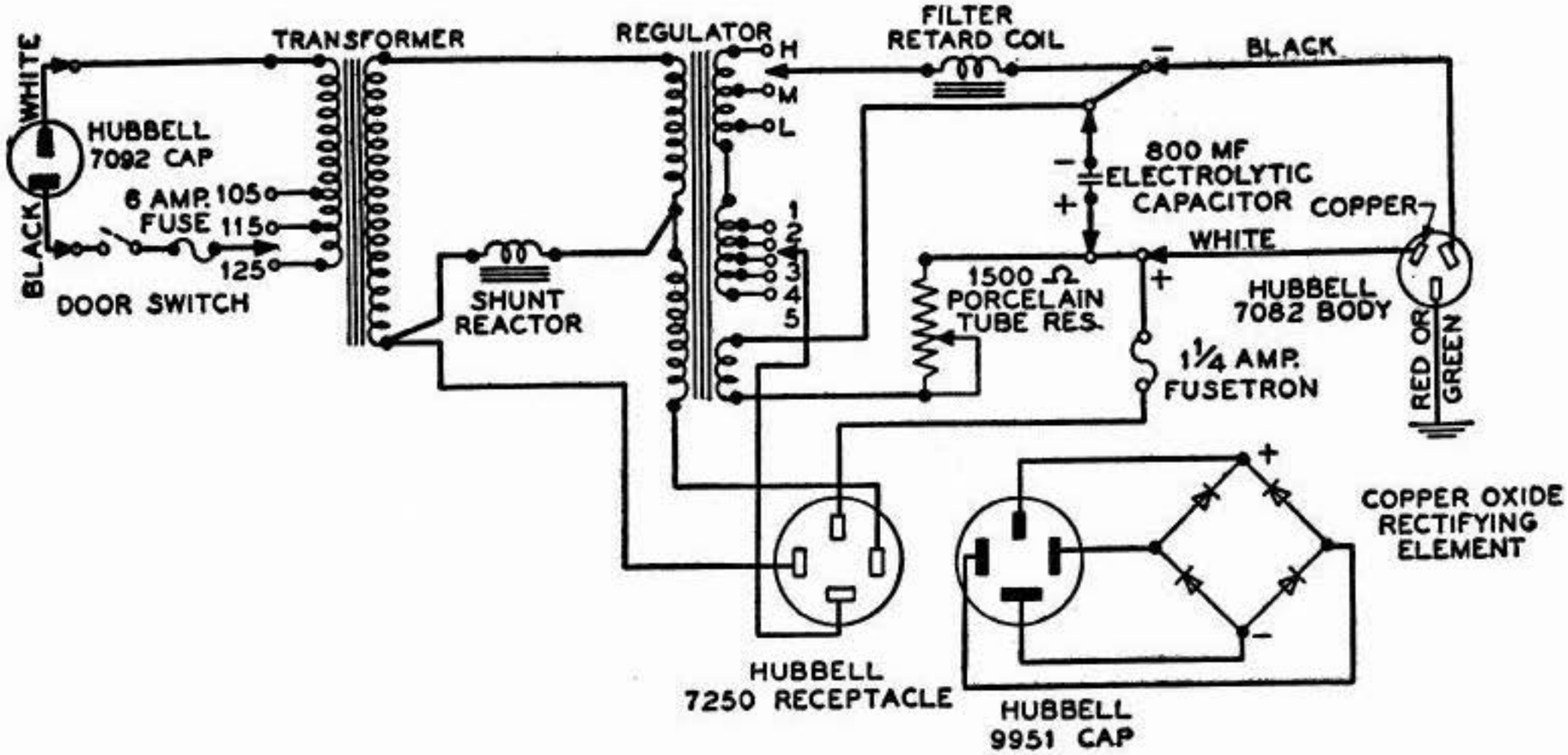


Fig. 20—KS-5536-L1—Circuit Schematic

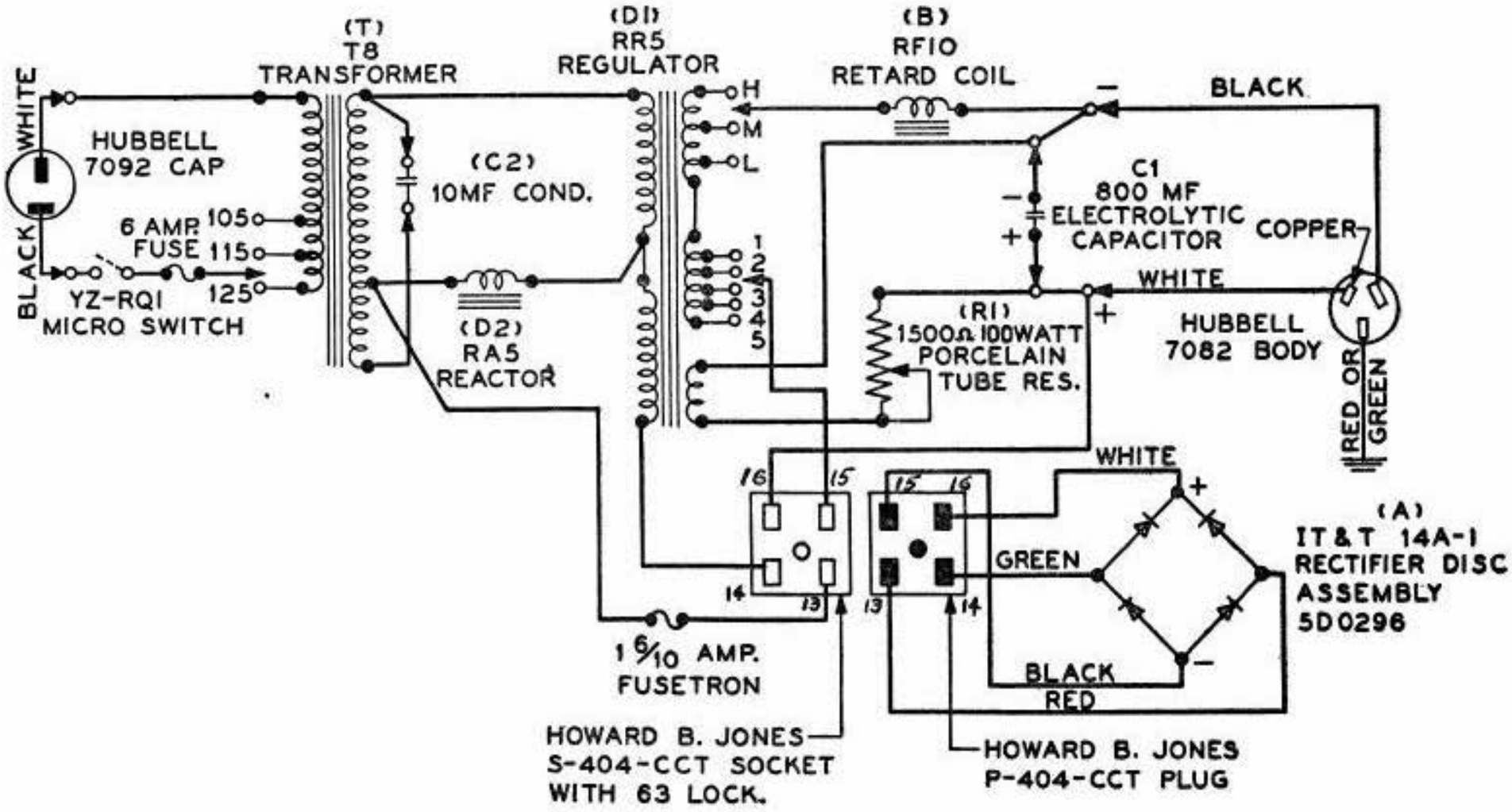


Fig. 21—KS-5536-01—Circuit Schematic

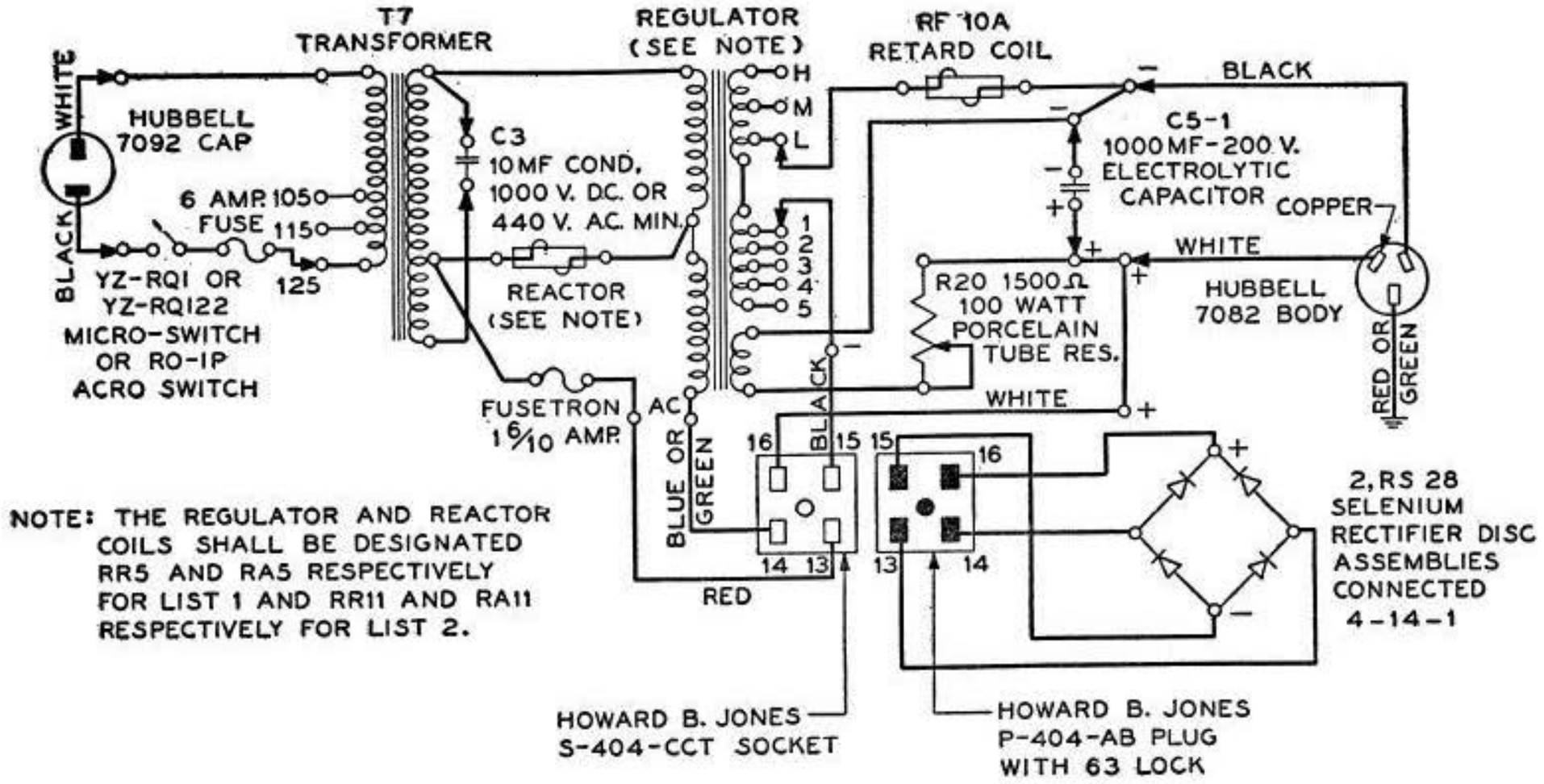


Fig. 22—KS-5928-L1 and L2—Circuit Schematic

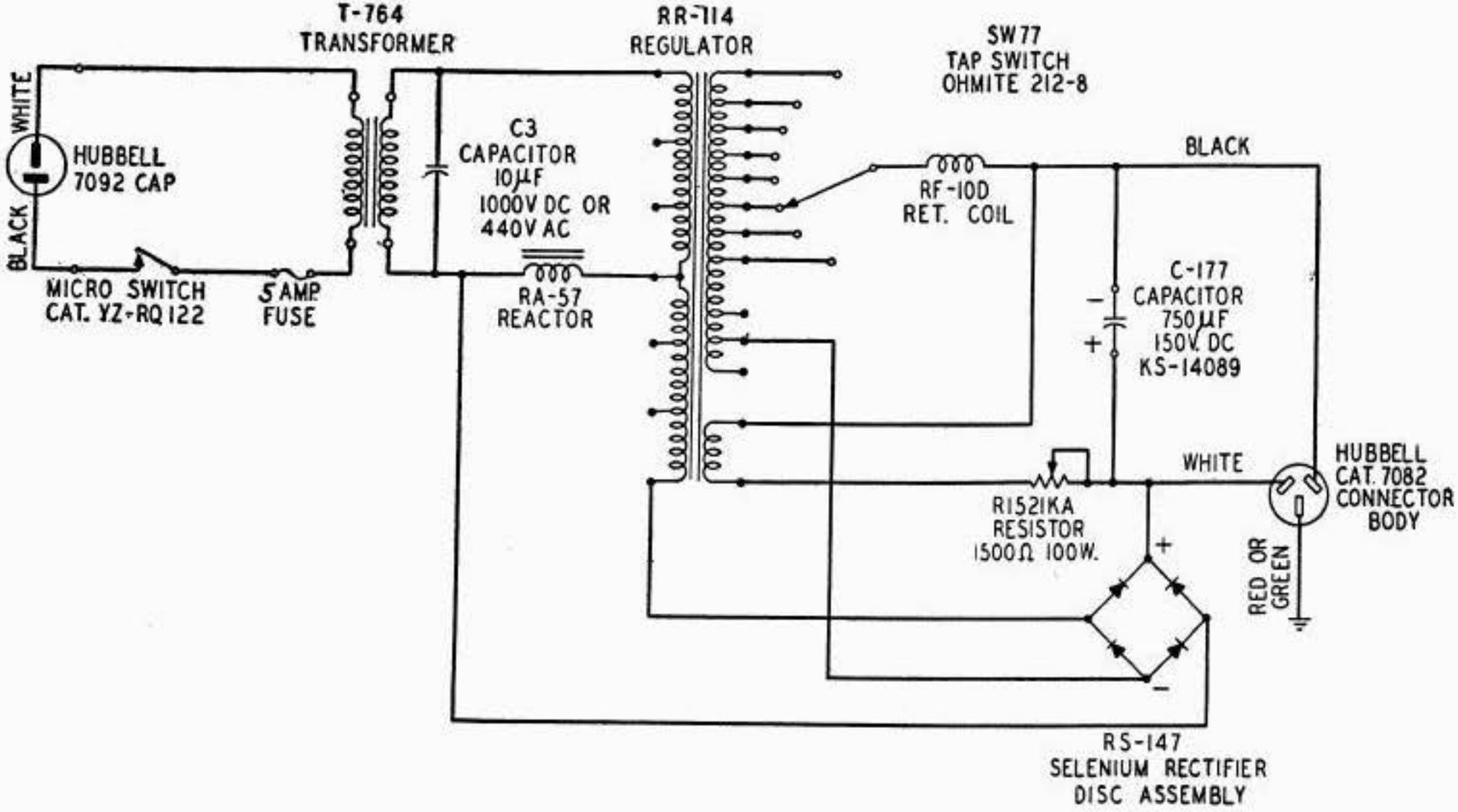


Fig. 23—KS-5928-L3—Circuit Schematic

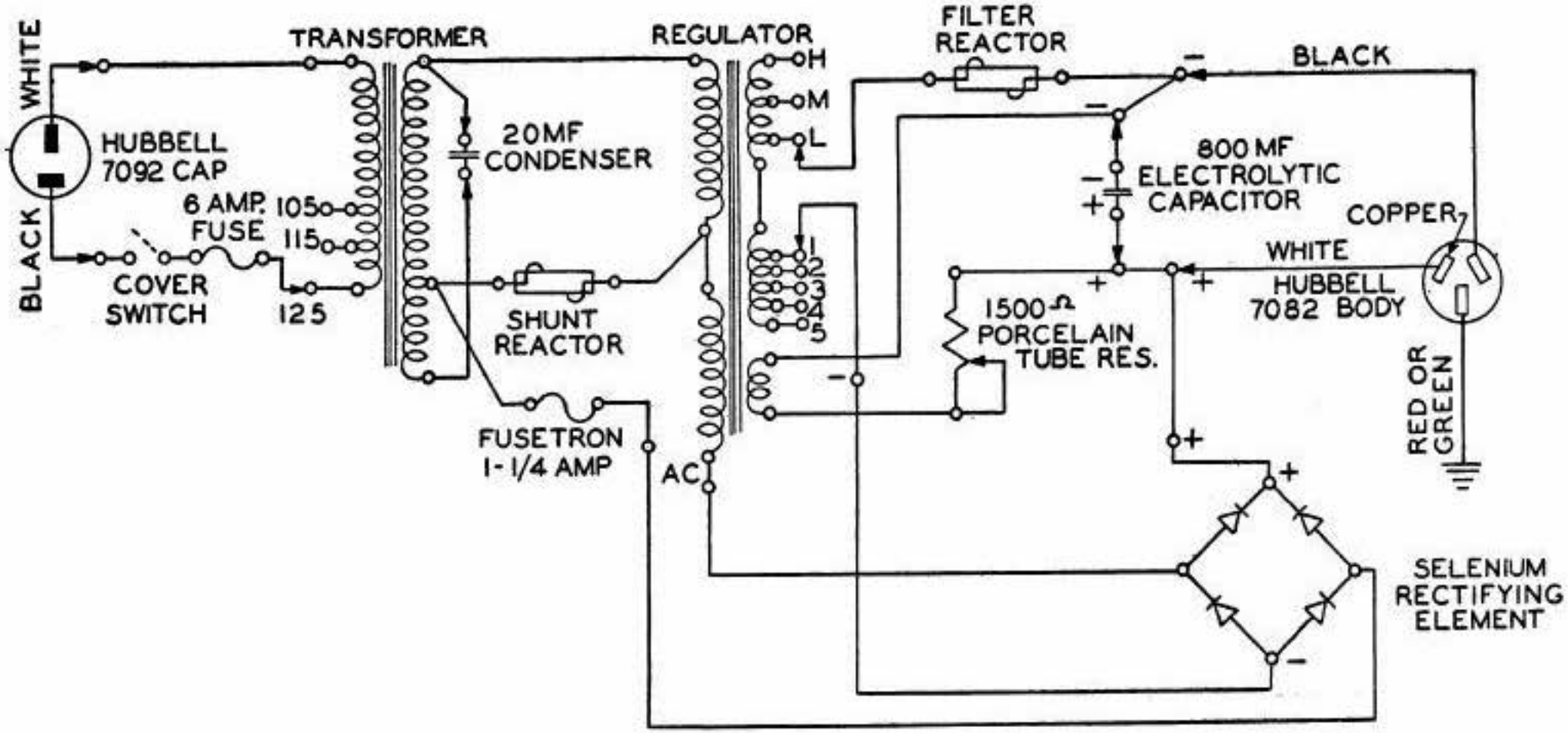


Fig. 24—REC 13-14—Circuit Schematic

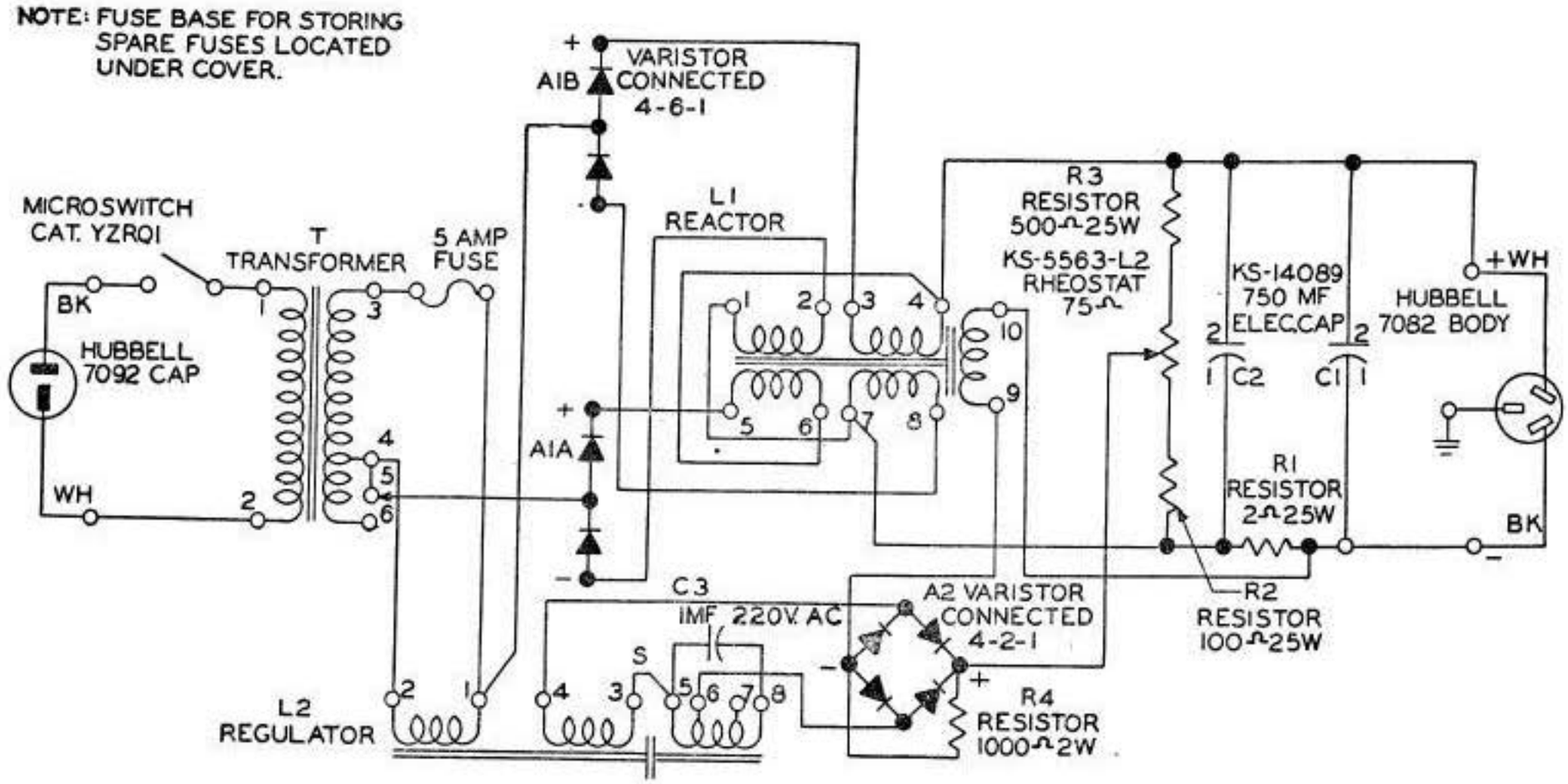


Fig. 25—KS-5769-L1—Circuit Schematic

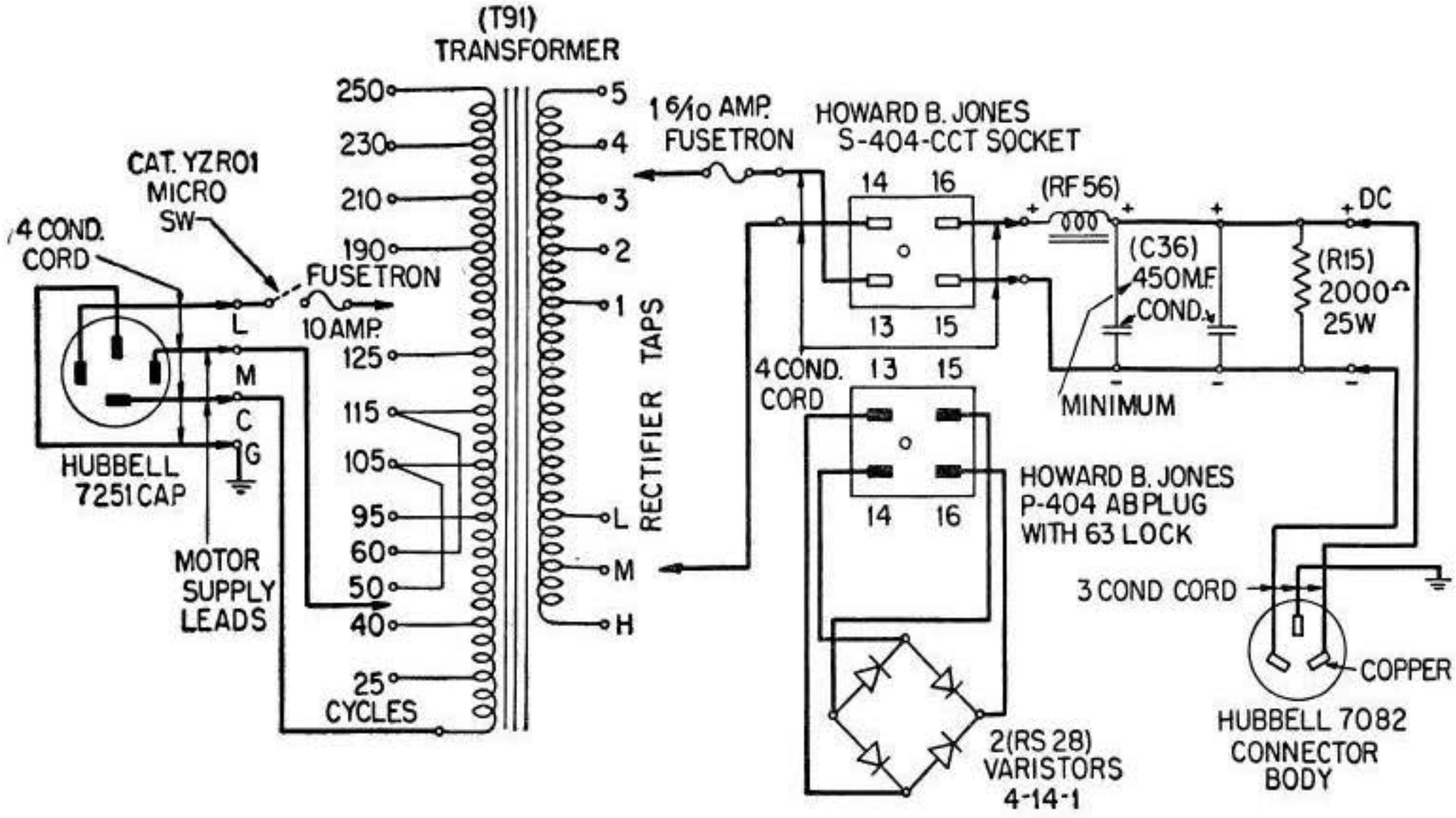


Fig. 26—KS-5988-L1—Circuit Schematic