M-6144

DUAL PEAK LIMITER

AMPLIFIER

INSTRUCTION BOOK

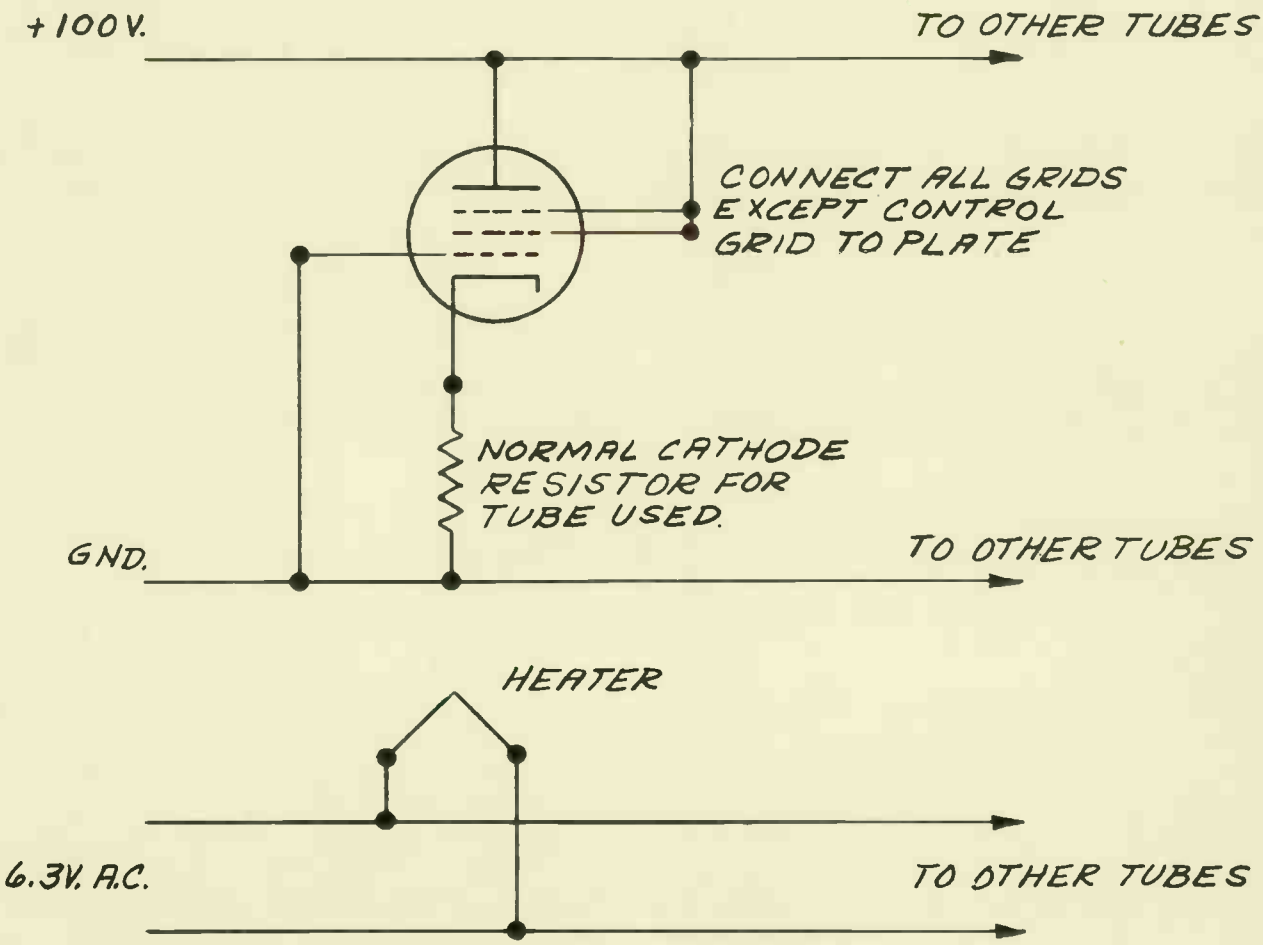
GATES

GATES RADIO COMPANY

A Subsidiary of Harris-Intertype Corporation

QUINCY, ILLINOIS

				FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS			813-7422-001	
								SCALE	
104	103	102	101	GR. NO.	LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.



STATUS		
	DEVELOPMENT	PRODUCTION
MECH. CHK.		
PROJ. ENG.	CWK	CWK
APPROV. PRODUCTION BY		

CH. BY DATE	MTL.		TITLE JIG - TUBE AGING DUAL LIMITER MG144	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GSM102.
DR. BY PHS DATE 4/10/62	ENG. KING	FIN.		813-7422-001

GATES RADIO COMPANY
QUINCY, ILLINOIS

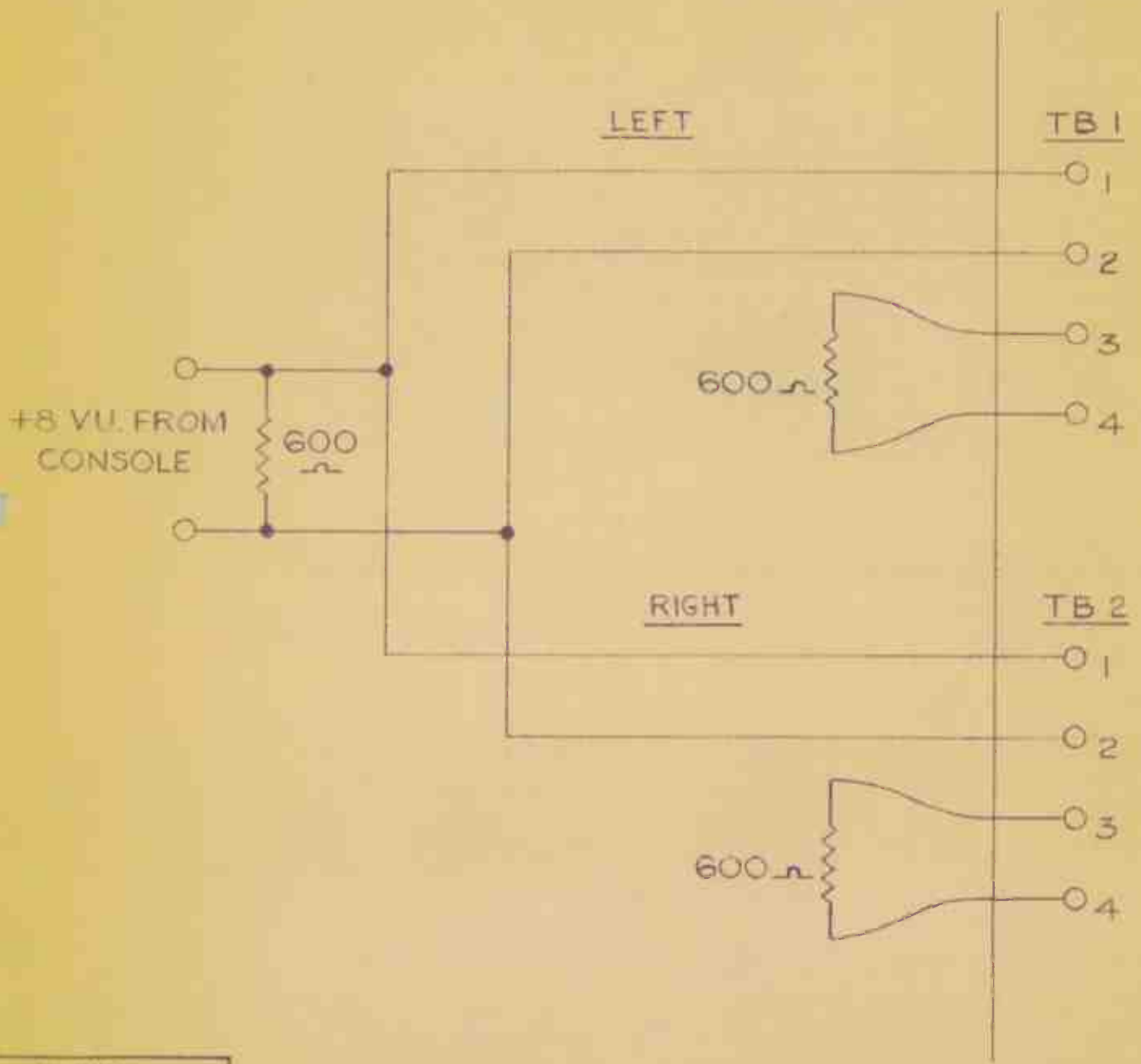
813-7424-001

SCALE

LIST OF PARTS

QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.

DUAL
PEAK
LIMITER



STATUS	DEVELOPMENT	PRODUCTION
MACH. CHK.		
PROJ. ENG.	CHK	CHK
MFG. DEPT.		

CH. BY
DATE
DR. BY HBC
DATE 4-11-64

MTL —

ENG. KING

FIN. —

TITLE SCHEMATIC DIAGRAM - STEREO
LEVEL INPUT BALANCING CONNECTIONS
DUAL PEAK LIMITER MG144

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC. SERIES

813-7424-001

INSTRUCTION BOOK
FOR
GATES' DUAL PEAK LIMITER
M-6144

I.B. #888 0789 001

Gates Radio Company
Quincy, Illinois

INDEX

D U A L P E A K L I M I T E R

SPECIFICATIONS

GAIN:

63 DB ±2 DB below the threshold of limiting @ 1000 cps.

FREQUENCY RESPONSE:

±1 DB, 30-15,000 cps up to 20 DB limiting.

HARMONIC DISTORTION:

Less than 1%, 50-10,000 cps up to 25 DB limiting.
Typically 1%, 20-20,000 cps up to 10 DB limiting.

INTERMODULATION DISTORTION (60/7000 - 4:1):

Less than 1% below threshold of limiting.
Less than 1.5% up to 20 DB limiting.

NOISE LEVEL:

-70 DB signal/noise ratio @ +24 DBM output, with maximum gain.

SIGNAL TO THUMP RATIO:

-20 DB minimum @ 25 DB of limiting.
-35 DB typical @ 15 DB of limiting.

THRESHOLD OF LIMITING:

Input: -45 DBM, matching, with maximum gain.
Output: +24 DBM, feeding into the 6 DB isolation pad.

CROSSTALK:

20-7500 cps: -70 DB.
7500-20,000 cps: -60 DB.

SOURCE IMPEDANCE:

600 ohms.

LOAD IMPEDANCE:

600 ohms.

MAXIMUM INPUT LEVEL:

0 DBM matching.
+24 DBM bridging.

POWER REQUIREMENTS:

60 Watts, 105/125 Volts, 50/60 cps.

FUSE:

3 AG - 1 Amp.

TUBE COMPLEMENT:

4 - 6K7	2 - 12BH7
2 - 12AX7	2 - OB2

DIODE COMPLEMENT:

4 - X5A6 (or equivalent).
4 - X5A2 (or equivalent).
4 - GO-1
1 - 2N1539 or 2N554 (transistor)

SIZE:

Width 19" - Depth 16" - Height 7".
Occupies 7" of vertical rack space in a standard relay rack.

WEIGHT:

38 Lb. Net - 50 Lb. Domestic Pack.

CUBAGE:

2.6 cu. ft. Domestic Pack.

DESCRIPTION

The Dual Peak Limiter is a self-contained dual amplifier that is equally adaptable to stereo operation or to completely separate operation such as AM and FM. Basically, the dual limiter consists of two identical peak limiting amplifiers with a common power supply. When switched into the stereo position, the amplifier allows the highest signal in either channel to determine the amount of limiting of both channels. Thus, the amplitude balance of the stereo signal is not degraded, yet the limiting function is fully utilized.

Each of the amplifiers has its own balance controls and meter. The amplifiers are built on identical printed wiring boards for uniformity of characteristics. The power supply has solid state rectifiers throughout; a bridge circuit for the high voltage, and a separate bridge for the low level tube heaters. A power transistor is connected in a "capacitor multiplier" circuit to reduce the ripple on the low-level filaments to a few millivolts. This contributes to the low noise level of the amplifier. The high level filaments are operated from a 6.3 V. A.C. winding on the power transformer. All controls are located behind a hinged drop down front panel. Terminations are made to two barrier type terminal strips on the rear of the unit.

The use of continuously variable input and output attenuators, together with a gain of 68 DB, allow the amplifiers to accommodate a wide range of input and output levels.

INSTALLATION

The Dual Peak Limiting Amplifier mounts in a standard 19" relay rack and occupies 7" of vertical space. It is recommended that the amplifier have a minimum of 2" clear space above it for ventilation, and to facilitate the replacement of tubes. All terminations are made to the rear of the amplifier and standard good engineering practice should be followed in wiring and cabling. All necessary adjustments can be made from the front of the amplifier after installation. All external connections are made at terminal boards mounted on the rear of the chassis.

For input levels of 0 DBM and lower, a 600 ohm source may be connected to terminals #3 and #4 on either terminal board. If an unbalanced input is connected, terminal #4 is the common. If the input is higher than 0 DBM, the bridging input (on terminals #1 and #2) should be used. When the bridging input is used, a 600 ohm loading resistor must be connected between terminals #3 and #4.

The 600 ohm output appears at terminals #7 and #8 on either terminal board. With the output control (AT3 or AT4) at

minimum attenuation, a 6 DB pad is connected between the output transformer and the terminal board. A maximum level of +18 DBM is available at terminals #7 and #8. Lower levels may be obtained by adjusting the output control (AT3 or AT4) to the desired attenuation. The input and output of the left channel appear on TB1, and the input and output of the right channel appear on TB2. Terminals #5 and #6 on either TB1 or TB2 are ground connections for shields.

The A.C. connection plug is mounted in the rear center of the chassis, between TB1 and TB2. This A.C. wiring should be separated from audio signal wiring as far as practical.

THEORY OF OPERATION

Since the Dual Peak Limiter is composed of two identical amplifiers with a common power supply, only one amplifier and its associated control circuitry will be described.

Amplifier Section

The amplifier section consists of four stages: a push-pull variable gain stage, a single ended voltage amplifier, a phase inverter and a push-pull output stage.

A variable attenuator and a bridging pad, ahead of the input transformer, serve to accommodate most normal input levels. A 600 ohm matching input connected through the variable attenuator (AT1) will handle levels of 0 DBM and lower. A 20,000 ohm bridging input (with the 600 ohm input terminals loaded) will handle levels as high as +24 DBM. The input transformer (T101) has a center tapped secondary to feed the push-pull input stage. Resistors R101, R102, in shunt across the secondary of T101, reflect the proper load impedance to the primary of T101. The first stage has two 6K7 vacuum tubes connected in push-pull, and must be balanced very closely in order to prevent a shift in the D.C. operating point of this stage during limiting. Switching S1 to its #4 position (balance 1) connects an A.C. voltage to the center tap of T101's secondary, which applied this signal in phase to the control grids of 6K7's. If the signal through both tubes is equal, no signal will appear at the output of the amplifier. Control R32 (balance 1) is adjusted for minimum signal output as read on the meter (M1). This is the static balance. When S1 is switched to its #5 position (balance 2), a larger A.C. signal is applied to the 6K7 control grids, and cathode bias is applied, approximating the grid bias necessary for 10 DB of limiting. Control R34 (balance 2) is now adjusted for minimum output as indicated by the meter (M1). This is known as the dynamic balance. Since these two balance procedures interact with each other to some extent, it will be necessary to repeat these until no further improvement is noted.

If the ultimate in balance and operation is desired, choose

tubes that are quite similar in characteristics. Use an A.C. VTVM with high sensitivity, connected to the amplifier output, to read the closer indication of balance. Nearly all 6K7's may be balanced for good operation, but choosing tubes of similar characteristics will result in the best amplifier performance, because of lower distortion and a greater signal to "thump" ratio.

This first stage is coupled to the output amplifier section through an interstage transformer (T102), thus the "thump" or D.C. unbalance is cancelled here rather than being carried through to the output transformer.

The output amplifier section consists of a voltage amplifier, a phase inverter and a push-pull output stage. These stages are connected in a somewhat modified "Williamson" circuit, within an overall feedback loop of about 20 DB. C102 and C105, in the feedback loop, serve to correct the frequency response of the amplifier. A split load phase inverter is used since its balance depends only on component values, and is not affected by tube aging. The separate feedback winding on the output transformer (T103) allows feedback, from the push-pull output stage to the single-ended input stage, without grounding one side of the 600 ohm output winding. This amplifier section is capable of an output level of +30 DBM at quite low distortion, so there is an adequate overload factor at the normal output level of +24 DBM. The variable attenuator may be adjusted to provide any desired output level from about -20 DBM to +18 DBM. AT5 is a fixed attenuator with 6 DB loss, which serves as an isolation pad if the amplifier is used to feed a telephone line or a transformer load.

Limiting Control Section

As in most peak limiters, a sample of the output signal is applied to a gated rectifier which passes a negative bias to the variable gain stage to reduce its gain when a pre-determined output level is exceeded. This signal is sampled at the push-pull output stage (V104-12BH7) plates through R12, R13, C9 and C10. R10 and R11 form a voltage divider for the rectifier. The D.C. return (bias) of the diodes (CR9-CR10), through R8 and R9, connect to the junction of R10 and R11. When the peak output signal level is high enough to exceed this bias voltage, the diodes (CR9-CR10) conduct through their load, C4 and R5 in parallel. This negative bias voltage, developed across C4 and R5, is applied to the center tap of the input transformer (T10) and to the control grids of the 6K7's. The negative bias on the 6K7 grids serves to reduce the gain of this stage in proportion to the amount of bias. It is possible to decrease the attack time of this amplifier under certain conditions. Refer to the maintenance section for instructions.

Stereo-Mono Switch

A switch (S4) has been included so that the amplifiers may be used for stereo operation, or may be separated to carry two completely different programs at once. When the switch is in the "separate" position, the two bias rectifiers feed their own amplifiers and are, in effect, two separate amplifiers. In the stereo position, however, the time constant (C4 and R5) of the left channel is switched out of the circuit and the output of both feedback diodes are connected in parallel, using the right channel time constant (C3 and R4).

The center-taps, of both the left and right channel input transformer secondaries, are connected to the diode's output load (C3 and R4) so that the same bias voltage is fed to the first stage, of both the left and right channel amplifiers. Since the tubes, components, and circuits are identical in each channel, the amount of limiting in each channel is also identical. This equal limiting in each channel is necessary to preserve the original signal balance between channels. If each channel were limited separately, this amplitude balance would be seriously degraded. With the control sections connected in the manner just described; the channel carrying the higher signal level, at any given moment, causes both channels to limit simultaneously and to the same degree.

Power Supply

The power supply is quite conventional, except for the low-level filament supply, and needs very little comment. The high voltage supply uses a bridge rectifier of solid state silicon diodes, a conventional filter and de-coupling circuitry. Two OB2 regulator tubes furnish regulated voltage for the first amplifier stage of each channel, as well as the bias gate for the limiter rectifiers. Filament voltage for the high-level stages is provided by a winding on the power transformer. The low-level amplifier stages have D.C. applied to their filaments. This is provided by a silicon bridge rectifier and a transistor regulator, which is connected in a "capacitance multiplier" circuit where the capacity connected to the base is multiplied by the gain of the transistor (Q1).

The total power consumption for the amplifier is less than 60 watts. A one ampere slo-blo fuse is adequate for protection against shorts or sustained overloads.

replaced C-8 - 500 MFD at 50V - Leaky - also replaced regulator Q1 - RLK 8-27-79 corrected capacitance multiplier circuit problem - No output either channel.

MAINTENANCE

Tube Replacement

Electron tubes exhibit the greatest change in their characteristics during the first few hours of operation, and most

tube failures occur during this same period. For this reason, limiting amplifier tubes should be "pre-aged" for at least 48 hours before putting them in service. Since "thumpless" limiting depends on tube and circuit balance in the limiter stage; the 6K7 tubes, V101 and V102, should be pre-aged for a minimum of 100 hours.

A tube aging jig is easily constructed, and would be a valuable addition for other amplifiers and similar devices using electronic tubes. The basic circuit of such a jig is shown in drawing 813 7422 001, and although only one tube is shown, it may be expanded to include as many tubes as desired.

Tubes should be checked periodically and replaced when the conductance has dropped about 20% from the new or rated condition. Replace the 6K7 tubes in the V101 and V102 position in pairs only. These tubes must remain balanced for proper operation of the limiter stage, and two new "pre-aged" tubes will retain their balance much better than a new and an old tube.

D.C. Filament Voltage Control, R25

Whenever tubes are changed and periodically during regular service, the D.C. filament voltage should be measured and, if necessary, adjusted. Connect a D.C. voltmeter to TP26(-) and TB28 (+) on either amplifier board and adjust R25 for 11 volts D.C. at these terminals.

Voltage Regulator Adjustment, R22

When components or tubes are changed, or when the A.C. power line voltage varies considerably from 115 volts, the adjustment of R22 should be checked. Temporarily disconnect the jumper between pin #2 or #7 of V2 (OB2) and ground, and connect a milliammeter between pin #2 or #7 (+) and ground (-). Adjust the sliding tap on R22 until 8 to 10 milliamperes of current is indicated on the meter. The amplifier should be at operating temperature when this adjustment is made. Caution should be exercised while adjusting R22 so that the resistance wire is not damaged by too great a pressure of the set screw.

After checking the current through V2, remove the milliammeter and restore the jumper between V2, pin #2 or #7, and ground.

Limiter Tube Balance

As mentioned above, when it is necessary to replace the 6K7 tubes in the limiter stage, both tubes should be changed. It is necessary for proper operation that this stage be balanced both statically and dynamically. Controls have been incorporated for this purpose, and must be adjusted

whenever the 6K7 tubes are replaced. The balancing procedure is quite simple and is set forth in steps:

1. Turn the amplifier on and allow it to warm up for at least 30 minutes before attempting the balancing procedure. If possible, re-balance the amplifier after the first day of operation before it is turned off. The balance should be checked periodically during the first week of operation, after a new pair of tubes has been installed.

2. Disconnect the audio input to the amplifier, or turn the input control (AT1 or AT2) to its full counterclockwise (off) position. Be sure the output of the amplifier is correctly loaded.

3. Switch the function switch (S1 or S2) to the "meter zero" position, and adjust the "meter zero" control (R33 or R36) so that the meter reads full scale or zero DB of limiting.

4. Switch the function switch to the "balance 1" position, and adjust the "static balance" control (R32 or R35) for a minimum reading on the meter (M1 or M2).

5. Switch the function switch to the "balance 2" position, and adjust the "dynamic balance" control (R34 or R37) for a minimum reading on the meter.

NOTE: These controls interact with each other to some degree, so it is necessary to repeat steps 4 and 5 until no further improvement is observed.

6. Switch the function switch back to the "meter zero" position and adjust the "meter zero" control for a full scale reading on the meter. The adjustments in steps 4 and 5 may have interacted with this adjustment.

7. Return function switch to "output" or "operate" position for normal operation.

Limiter Attack Time

The Dual Peak Limiter Amplifier, as shipped, has an attack time of 1-1/2 to 2 milliseconds. This time was deliberately chosen so that practically any pair of 6K7 tubes could be used in the limiter stage to give "thumpless" operation. Resistors R12 and R13 in the left channel, and R14 and R15 in the right channel serve to accomplish this. If it is desirable to decrease the attack time of the limiter to about 600 microseconds, these resistors may be shorted or strapped out. When this is done, it will be necessary to choose 6K7 tubes with quite similar characteristics since the limiter stage will not be as tolerant to circuit unbalance as before. However, it will be noticed that when a pair of tubes has been found that will operate without "thump", quite low distortion will be obtained with up to

25 DB of limiting.

Level Adjustment For Stereo

For stereo operation it is necessary that the gain in both channels be the same. This also applies to input and output levels, as well as the threshold of limiting and the amount of limiting. Many methods of calibrating and adjusting the peak limiter will probably become apparent to the station engineer as he uses the amplifier and becomes familiar with its characteristics. The most common place to connect the limiter is following the console, and feeding either the transmitter or the telephone lines to the transmitter. A simple method, using the above connection, will be described as a guide to the engineer who is installing the amplifier in his system for the first time.

Connect the output of one channel of the console to both inputs of the dual peak limiter, as shown in drawing 813 7424 001. A single channel is used because a true stereo signal seldom contains the same level signal in both channels at the same time; thus, a more precise adjustment may be made quickly by using one signal. Adjust the output of the console so that it is feeding a normal +8 VU signal to its load. The input level adjustment of the Dual Peak Limiter is controlled by AT1 for the left channel and AT2 for the right channel. Switch the "stereo-separate" switch to the "separate" position. Set the function switches for both channels (S1 and S2) to the "operate" position, and observe the meters (M1 and M2). The correct adjustment for input controls AT1 and AT2 is a setting by which the meters indicate an equal amount of deflection. It is recommended that no more than 5 DB of limiting be used under normal program conditions.

The adjustment of the output controls requires the use of an external V.I. meter. Connect a 600 ohm load to the output of each channel, terminals #7 and #8 of both TB1 and TB2. Connect the V.I. meter to the left channel output and adjust the output control AT3, so that the desired output level is read on the V.I. meter. Connect the V.I. meter to the right channel output and adjust the output control, AT4, so that the desired output level is read on the V.I. meter. These two readings should be the same, of course.

Warranty

This equipment is warranted under the liberal Gates Radio Company warranty, terms and conditions of which are fully set forth on the reverse page.

GATES RADIO COMPANY

PRESIDENT

WARRANTY

This equipment is warranted by Gates Radio Company of Quincy, Illinois to be free from defects in workmanship and material and will be repaired or replaced in accordance with the terms and conditions set forth below:

1. Gates Radio Company believes that the purchaser has every right to expect first-class quality, materials and workmanship and has created rigid inspection and test procedures to that end, and excellent packing methods to assure arrival of equipment in good condition at destination.

2. Gates Radio Company will endeavor to make emergency shipments at the earliest possible time giving consideration to all conditions.

3. Gates Radio Company warrants new equipment of its manufacture for one (1) year; and (six (6) months on moving parts), transistors, and diodes, against breakage or failure of parts due to imperfection of workmanship or material, its obligation being limited to repair or replacement of defective parts upon return thereof f.o.b. Gates Radio Company's factory, within the applicable period of time stated. Electron tubes shall bear only the warranty of the manufacturer thereof in effect at the time of the shipment to the purchaser. Other monufacturers' equipment covered by a purchaser's order will carry only such manufacturers' standard warranty. These warranty periods commence from the date of invoice and continue in effect as to all notices, alleging a defect covered by this warranty, received by Gates Radio Company prior to the expiration of the applicable warranty period.

   The following will illustrate features of the Gates Radio Company warranty:

   Transmitter Parts: The main power or plate transformer, modulotion transformer, modulation reactor, main tank variable condensers all bear the one (1) year warranty mentioned above.

   Moving Parts: As stoted above, these are warranted for a period of six (6) months.

   Electron Tubes: As stated, Electron tubes will bear such warranty, if any, as provided by the manufacturer at the time of their shipment. Gates Radio Company will make such adjustments with purchasers as given to Gates Radio Company by the tube manufacturer.

   All other component parts (except as otherwise stated); Warranted for one (1) year.

   Abuse: Damage resulting from abuse, an Act of God, or by fire, wind, rain, hail, in transportation, or by reason of any other cause or condition, except normal usage, is not covered by this warranty.

4. Operational Warranty — Gates Radio Company warrants that any new transmitter of its manufacture, when properly installed by purchaser and connected with a suitable electrical load, will deliver the specified radio frequency power output at the output terminal(s) of the transmitter, but Gates Radio Company makes no warranty or representation as to the coverage or range of such apparatus. If a transmitter does not so perform, or in the event that any equipment sold by Gates Radio Company does not conform to any written statement in a contract of sale relative to its operating characteristics or capabilities, the sole liability of Gates Radio Company shall be, at the option of Gates Radio Company, either to demonstrate the operation of the equipment in conformance with its warranty, or to replace it with equipment in conformance with its warranty, or to accept its return, f.o.b. purchaser's point of installation and refund to purchaser all payments made on the equipment, without interest. Gates Radio Company shall have no responsibility to the purchaser under a warranty with respect to operation of equipment unless purchaser shall give Gates Radio Company a written notice, within one (1) month after arrival of equipment at purchaser's shipping point, that the equipment does not conform to such warranty.

5. Any item alleged by a purchaser to be defective, and not in conformance with a warranty of Gates Radio Company shall not be returned to Gates Radio Company until after written permission has been first obtained from the Gates Radio Company home office for such return. Where a replacement part must be supplied under a warranty before the defective part can be returned for inspection, as might be required to determine the cause of a defect, purchaser will be invoiced in full for such part, and if it is determined that an adjustment in favor of the purchaser is required, a credit for an adjustment will be given by Gates Radio Company upon its receipt and inspection of a part so returned.

6. All shipment by Gates Radio Company under o warranty will be f.o.b. Quincy, Illinois or f.a.b. the applicable Gates Radio Company shipping point.

7. Gates Radio Company is not responsible for the loss of, or damage to, equipment during transportation or for injuries to persons or damage to property arising out of the use or operation of Gates equipment. If damage or loss during transportation occurs, or if the equipment supplied by Gates Radio Company is otherwise damaged, Gates will endeavor to make shipment of replacement parts at the earliest possible time giving consideration to all conditions. It is the responsibility of a purchaser to file any claim for loss or damage in transit with the transportation company and Gates will cooperate in the preparation of such claims to the extent feosible when so requested.

8. Gates Radio Company, in fulfilling its obligations under its warranties, shall not be responsible for delays in deliveries due to depleted stock, floods, wars, strikes, power failures, transportation delays, or failure of suppliers to deliver, acts of God, or for any condition beyond the control of Gates that may cause a delayed delivery.

9. This warranty may not be transferred by the original purchaser and no party, except the original purchaser, whether by operation of law or otherwise, shall have or acquire any rights against Gates Radio Company by virtue of this warranty.

10. Gates Radio Company reserves the right to modify or rescind, without notice, any warranty herein except that such modification or rescission shall not affect a warranty in effect on equipment at the time of its shipment. In the event of a conflict between a warranty in a proposal and acceptance and a warranty herein, the warranty in the proposal and acceptance shall prevail.

11. This warranty shall be applicable to all standard Gates catalog items sold on or after March 1, 1960.

PARTS LIST

Symbol No.	Gates Stock No.	Description
A1	396 0014 000	Lamp, 6 W, 135-145 V.
AT1,AT2, AT3,AT4	554 0255 000	Attenuator, 500 ohms
AT5,AT7	992 1298 001	Line Isolation Pad
AT6,AT8	992 1297 001	VU Meter Pad
C1	506 0013 000	Cap., .05 uf, 400 V.
C2	506 0005 000	Cap., .1 uf, 200 V.
C3,C4	506 0007 000	Cap., .5 uf, 200 V.
C5,C6	524 0019 000	Cap., Plug-in, 20-20-20 uf,450V.
C13,C14	502 0173 000	Cap., 250 pf. 500 V.
C7,C8	522 0307 000	Cap., 500 uf, 25 V, D.C.
C9,C10	506 0028 000	Cap., .1 uf, 400 V.
C11,C12	506 0028 000	Cap., .1 uf, 400 V.
C101	508 0044 000	Cap., .01 uf, 400 V.
C102	508 0215 000	Cap., .01 uf, 100 V.
C103,C104	508 0048 000	Cap., .047 uf, 400 V.
C105	500 0761 000	Cap., 150 uf, 500 V.
C106,C107	508 0051 000	Cap., .15 uf, 400 V.
C108	506 0015 000	Cap., .25 uf, 400V.
CR1,CR2, CR3,CR4	384 0061 000	Rectifier
CR5,CR6, CR7,CR8	384 0062 000	Rectifier
CR9,CR10, CR11,CR12	384 0073 000	Diode, Silicon GO-1
F1	398 0054 000	Fuse, Slo-Blo, 1 A, 250 V.
J1	250 0025 000	Receptacle & AC Line Cord
L1	476 0007 000	Filter Reactor
M1,M2	630 0104 000	Meter, Output Level
Q1	380 0016 000	Transistor, 2N1539
R1,R111, R114,R117	540 0097 000	Res., 100K ohm, 1/2 W, 5%
R2,R3	540 0073 000	Res., 10K ohm, 1/2 W, 5%
R4,R5	540 0218 000	Res., 2.2M, 1/2 W, 10%
R6,R7,R112	540 0049 000	Res., 1000 ohm, 1/2 W, 5%
R8,R9,R16, R17,R115, R118,R119	540 0114 000	Res., 510K ohm, 1/2 W, 5%
R10,R18	540 0091 000	Res., 56K ohm, 1/2 W, 5% 1%
R11,R19	540 0099 000	Res., 120K ohm, 1/2 W, 5%
R12,R13,R14, R15,R28,R29, R30,R31	540 0073 000	Res., 10K ohm, 1/2 W, 5% — 10K-1/3W-1%

Symbol No.	Gates Stock No.	Description
R20,R21	540 0363 000	Res., 20K ohm, 1 W, 5%
R22	552 0077 000	Res., Adj. 10K ohm, 25 W.
R38,R40	540 0325 000	Res., 510 ohm, 1/2 W. 5%
R23,R24	540 0332 000	Res., 1000 ohm, ~~1 W~~, 5% 2W
R25	550 0061 000	Control, 1000 ohm
R26	540 0080 000	Res., 20K ohm, 1/2 W, 5%
R27	542 1065 000	Res., 1 ohm, 5 W, 10%
R32,R35	552 0544 000	Pot., Bal. #1, 500 ohm
R33,R36	552 0545 000	Pot., Mtr. Zero, 1000 ohm
R34,R37	552 0729 000	Pot., Bal #2, 10K ohm
R39,R41	540 0101 000	Res., 150K ohm, 1/2 W, 5%
R101,R102, R107,R108, R123	540 0090 000	Res., 51K ohm, 1/2 W, 5%
R112	540 0049 000	Res., 1000 ohm, 1/2 W, 5%
R113	540 0079 000	Res., 18K ohm, 1/2 W, 5%
R116	540 0051 000	Res., 1200 ohm, 1/2 W, 5%
R120	540 0039 000	Res., 390 ohm, 1/2 W, 5%
R121,R122	540 0025 000	Res., 100 ohm, 1/2 W, 5%
R124	540 0105 000	Res., 220K ohm, 1/2 W, 5%
	540 0025 000	Res., 100 ohm, 1/2 W, 5% (AT5 & AT7)
	540 0041 000	Res., 470 ohm, 1/2 W, 5% (AT5 & AT7)
	540 0023 000	Res., 82 ohm, 1/2 W, 5% (AT5 & AT7)
	540 0041 000	Res., 470 ohm, 1/2 W, 5% (AT6 & AT8)
	540 0069 000	Res., 6800 ohm, 1/2 W, 5% (AT6 & AT8)
	540 0061 000	Res., 3300 ohm, 1/2 W, 5% (AT6 & AT8)
S1,S2	600 0218 000	Selector Switch
S3	604 0029 000	Power Switch
S4	604 0033 000	Stereo Switch
T1	472 0428 000	Transformer, Power
T101	478 0216 000	Transformer, Input
T102	478 0215 000	Transformer, Interstage
T103	478 0209 000	Transformer, Output
TB1,TB2	614 0116 000	Terminal Board
V1,V2	370 0002 000	Tube, 0B2
V101,V102	370 0180 000	Tube, 6K7
V103	370 0116 000	Tube, 12AX7
V104	370 0196 000	Tube, 12BH7A
XA1	406 0002 000	Socket
XC5,XC6	404 0016 000	Socket

Symbol No.	Gates Stock No.	Description
XF1	402 0023 000	Fuseholder
XQ1	404 0136 000	Transistor Mtg. Kit
XV1,XV2	404 0032 000	Socket
XV101,XV102	404 0065 000	Socket, Tube 8 Pin Printed
XV103,XV104	404 0059 000	Socket, Tube 9 Pin Min. Printed Novel

REPLACING COMPONENTS ON THE PRINTED CHASSIS

Since this is a destructive operation, the engineer must be reasonably sure that the part is defective before removing it. He may determine this from the D.C. and signal voltage measurements or by visual observation.

WARNING: The copper conductors are only .0027" thick on the printed chassis. They are easily damaged! Do not attempt to pull one component lead loose to check the component. Use only the approved procedure as outlined in the sketches and the sub-paragraphs listed below.

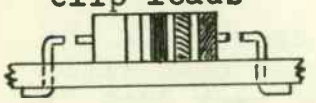
Use a small electric soldering iron (60 watts or less) and allow it to come up to full heat before starting the repair job. The tip must be clean and well tinned.

CAUTION: Do not use a soldering gun. The extremely high temperature of the tip will damage the phenolic board.

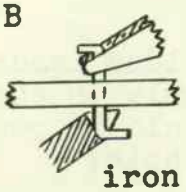
Put the iron tip on the fillet under the chassis, right beside the component lead being removed. Put a gentle, but firm pressure on all leads and components being moved while the heat is applied. Do not hold the iron to the printed chassis for long periods of time. If the lead or component is difficult to remove, make repeated short passes at it rather than one long period that may overheat the board.

1. REMOVING PARALLEL MOUNTED COMPONENTS WITH AXIAL LEADS:

A clip leads



B pliers

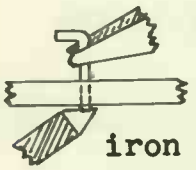


iron tip

push wire through hole until hook can be clipped off.

clip off hook that was soldered to chassis.

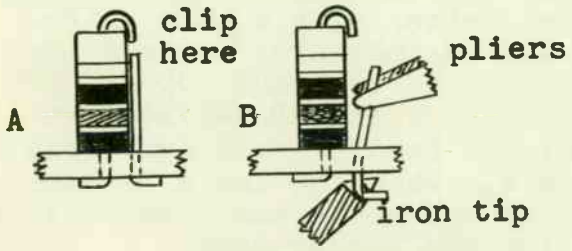
C pliers



iron tip

place iron on fillet again and pull the wire out of the hole on the top side of the chassis.

2. REMOVING VERTICALLY MOUNTED RESISTORS AND COMPONENTS WITH AXIAL LEADS:

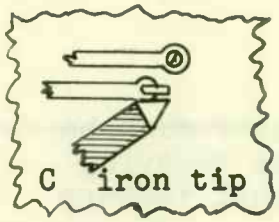


place iron on fillet and push wire through the hole until the hook can be clipped off.

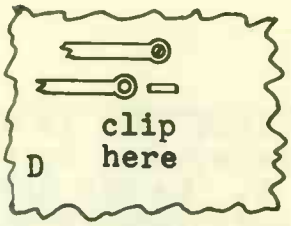
clip off hook that was soldered to chassis.

remove wire as illustrated in paragraph 1. (c).

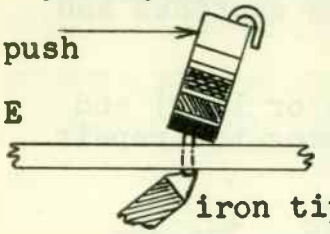
2. (continued)



place the iron against the folded wire and rotate it away from the conductor leading into the fillet (2-c).

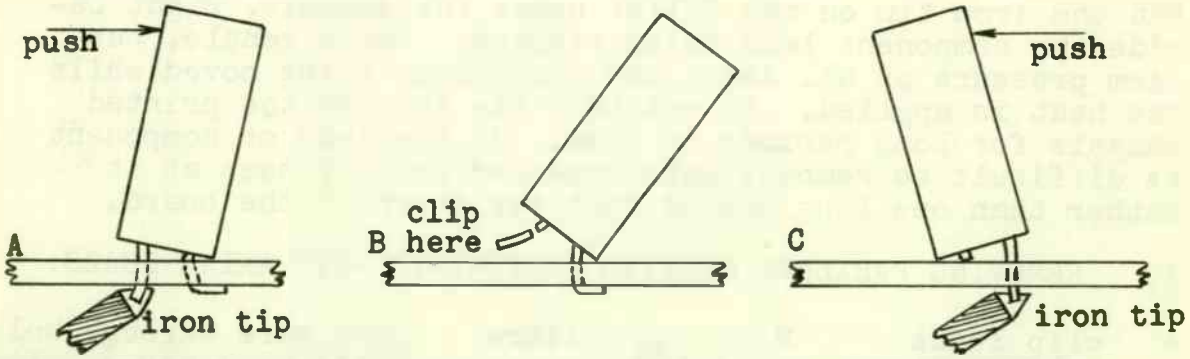


cut the wire as near the chassis as possible after removing as much excess solder as possible. Remove solder by carrying it away with the iron tip and wiping the tip on a clean cloth. Repeat until the hook can be clipped with small sharp diagonal cutters, illustrated in (2-D).



place iron on fillet again and push the resistor body over until the lead comes out of the hole.

3. REMOVING PRINTED WIRING TYPE CAPACITORS:

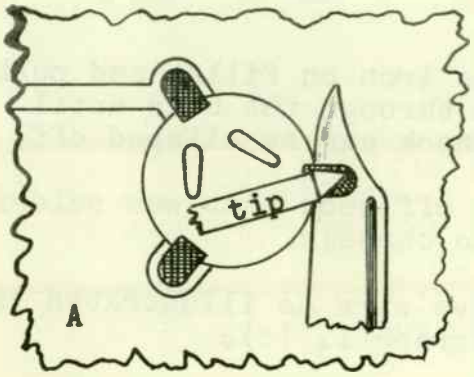


(A) hold iron tip on one of the folded leads, as soon as the solder melts - push gently but firmly on the side that will lift this lead. The capacitor should be pushed over just far enough to clear the lead from the hole.

(B) cut the lead off to prevent it from going back into the hole when removing the other lead.

(C) hold the iron tip to the other lead and push the capacitor over until it comes free.

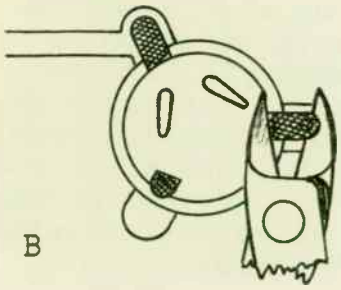
4. REMOVING SADDLE TYPE ELECTROLYTIC CAPACITORS:



Place the iron tip on top of the folded over mounting ear. As the solder melts, slip a thin knife between the mounting ear and the copper conductor pad. DO NOT PRY THE TAB UP WITH THE KNIFE! See (4-B) for bending ears away from chassis. When the knife is completely under the ear, remove iron and let the solder cool.

Repeat on other two mounting ears.

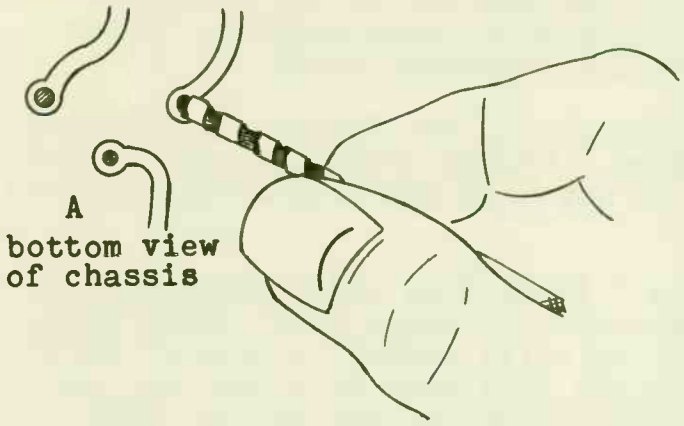
4. (continued)



Using a pair of small sharp diagonal cutters, bend the mounting ears up and away from the copper conductor pads. DO NOT PRY THE MOUNTING EARS UP WITH A KNIFE OR SCREWDRIVER!

Repeat the process on the other two mounting ears and drop the capacitor off the board.

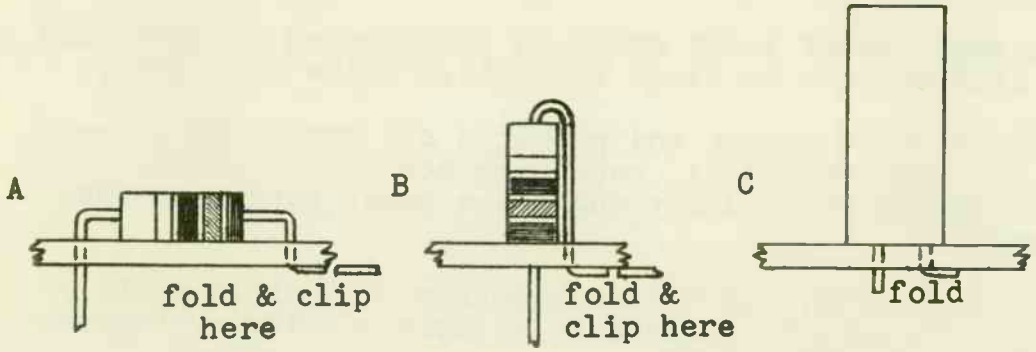
5. PREPARING THE HOLES FOR THE REPLACEMENT COMPONENT:



Use a small metal twist drill (1/8" dia. or less) to clear the hole only in the fillet of solder. Twirl the drill by hand. Do not attempt to remove all of the solder in one turn, do it slowly and carefully.

Do not attempt to increase the hole size, just remove the solder. It is soft and easily removed in this way.

6. REPLACING THE COMPONENTS:



(A) & (B) Fold the leads on the new part to the same spacing as the mounting holes. Insert the part and fold the leads under the chassis to hold the part tightly against the top of the chassis. Clip off the excess wire.

Put the iron tip on the fillet and lead. Solder swiftly and securely. If the printed chassis is damaged by accident it is seldom necessary to scrap it. If one of the conductors is broken, lay a piece of small wire (#18 to #24 AWG) across the break and solder each end to the conductor. If a fillet is pulled loose, break it off to get rid of the loose end. Fold the new component lead toward the end of the conductor and solder the lead to the conductor. If the component lead is cut too short, lay a small piece of wire across the gap solder it in.

7. REPLACING TUBE SOCKETS:

Tube sockets are very difficult to replace and should not be replaced until you are positive that the one in question is actually defective. Resolder all of the socket pin fillets to assure that this is not the trouble. Inspect the top side to see if the tube pin sleeve is bent and can be straightened. Use a socket alignment tool to re-size. Check continuity from the top to the bottom side of the chassis. If there is a connection and the socket sleeve is not out of alignment or spread open, the socket is O.K. and should not be removed.

(A) If the socket has been damaged or is excessively corroded it must be replaced. Stand the unit so that the chassis is vertical. Hold a small iron to the hex nut in the center of the socket (if the socket is retained in this manner). After the solder has melted, unscrew the retaining screw.

(B) Remove the excess solder from all pin fillets by carrying it away with the tip of the iron. Repeat until all solder that will come loose is removed. Do not hold the iron to the chassis for long periods of time.

(C) Starting at pin 1 or pin 7 (8 or 9 on other sockets), apply the iron and push against the socket to raise it at this point. Use the thumb and fingers only to raise socket to prevent damage to the board. The socket will not move very much but any movement at all is helping. Place thé iron on each pin in rotation around the socket while pushing up on the side of the socket adjacent to the pin being heated. After several passes around the socket it will no longer be held in by solder. Gently rock the socket and pull it free of the holes.

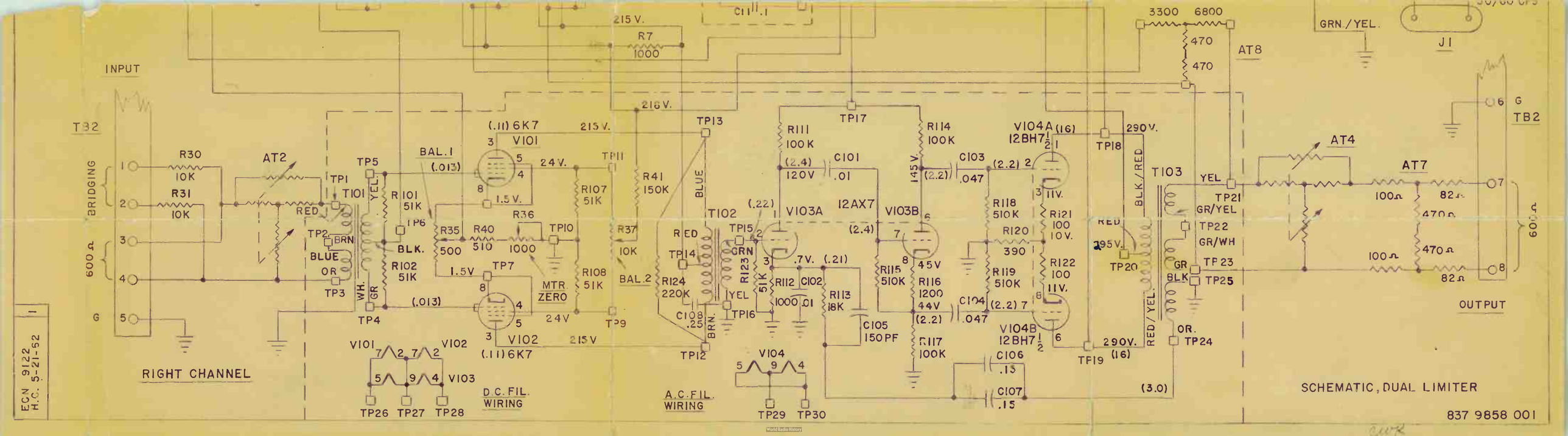
(D) Use a small metal twist drill as illustrated in paragraph 5 of these instructions to clear the fillet holes of solder.

(E) Install the new socket and put in a new retaining screw similar to the one removed (if retaining screws are used). Do not tighten the nut excessively and put a great strain on the phenolic board.

(F) Solder the screw, nut and each socket pin fillet swiftly and securely. Be sure that there is no solder bridging between adjacent fillets or conductors.

(G) If one of the fillets was damaged in the replacement operation, form a small loop on the end of a small piece of wire. Drop the loop over the socket pin and lay the wire to join the proper conductor. Flow solder on the connections and clip off the excess wire.

From the Engineering Department of
The Gates Radio Company
A Subsidiary of the Harris-Intertype Corp.


INPUT
T32
BRIDGING
600 Ω
G
R30 10K
R31 10K
AT2
TP1
TP2
TP3
TP4
TP5
T101
R101 51K
R102 51K
R35 500
R40 510
R36 1000
TP6
TP7
TP10
R107 51K
R108 51K
MTR. ZERO
BAL.1 (.013)
BAL.2 (.013)
1.5V.
24V.
V101 (.11) 6K7
V102 (.11) 6K7
215 V.
216 V.
R7 1000
C11 .1
TP11
R41 150K
R37 10K
TP13
TP12
TP14
TP15
TP16
T102
R123 51K
R124 220K
C108 .25
BLUE
RED
GRN
YEL
BRN.
V103A
12AX7
V103B
(.22)
.7V.
(.21)
R111 100K
R112 1000
C102 .01
R113 18K
C105 150PF
R114 100K
C101 .01
C103 .047
C104 .047
R115 510K
R116 1200 44V
R117 100K
145 V.
(2.4) 120V
(2.4)
(2.2)
V104A 12BH7 1/2
V104B 12BH7 1/2
(16)
R118 510K
R120 390
R119 510K
R121 100 10V.
R122 100 11V.
11V.
TP17
TP18
TP19
290V.
290V. (16)
V104
TP29
TP30
A.C.FIL. WIRING
D.C.FIL. WIRING
V101
V102
V103
TP26
TP27
TP28
3300
6800
470
470
AT8
GRN./YEL.
J1
50/60 CPS
T103
BLK./RED
RED/YEL.
OR.
TP24
TP20
TP21
TP22
TP23
TP25
YEL
GR/YEL
GR/WH
GR
BLK
295V.
(3.0)
AT4
AT7
100Ω
82Ω
470Ω
100Ω
82Ω
600Ω
G
TB2
6
7
8
OUTPUT
RIGHT CHANNEL
SCHEMATIC, DUAL LIMITER
837 9858 001
ECN 9122
H.C. 5-21-52
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