

The KW 77
RECEIVER

Introduction

The KW 77 has a 'built-in power supply operating from a 110 v. to 245 V 50/60 c/s AC. supply.

The Receiver uses twelve valves in a triple conversion superhet circuit, plus four silicon diodes.

All controls necessary for optimum performance on AM, CW and SSB are brought out to the front panel. A nine-inch scale directly calibrated in frequency for each of the bands is used, with the addition of a logging scale for accurate re-setting to any frequency within a band. The maximum coverage on any band is 600 Kc. A built-in crystal calibrator provides marker signals every 100 Kc. for checking dial calibration accuracy.

The peaking of the RP stage is by means of a front panel control and dial, which is independent of the main tuning. This ensures maximum sensitivity and signal to noise. A manual RP gain control prevents overloading on strong Signals.

The oscillator section of the first mixer is crystal controlled on all bands, except the 3.5 to 4.1 Mc. bands, where the mixer becomes an amplifier, and the receiver a double conversion superhet.

The second mixer is the main tuning section on all bands. This incorporates a very stable oscillator, which is 450Kc. higher than the 1st I.F. signal. Between this mixer and the third mixer is a very effective "slot" filter to eliminate heterodyne interference. This slot frequency is controlled from the front panel.

The third and final mixer converts the 450 Kc.- IF to 50-47 Kc. upper or lower sideband, which is fed into a filter using Ferroxcube pots. The amplified 50-47 Kc. IF is then passed to the AM detector and to the product detector.

Amplified AVC with fast attack and other fast or slow decay is applied to the RF.stage, first mixer 3rd mix and IF amplifier.

Comparative 'S' meter readings are available, on all modes of reception at any setting of the RF gain control.

Three stages of audio amplification are used ensuring adequate loudspeaker reception of even the weakest signal. The loudspeaker is muted automatically by plugging headphones into the jack socket. . Low impedance headphones are recommended for use with the KW 77, especially Browns Type 'Super K' Low impedance.

SECTION 2 INSTALLATION

1 Power Connections

A selector for mains between 200 and 245 v. is provided on the rear of the receiver and must be adjusted for the nearest mains voltage in use. Should it be required to operate the receiver on 110V AC it will be necessary to remove the green lead from the rear of the selection panel, insulate it, and take the mauve lead, at present not connected and in the form of a pig-tail, to this vacated tag. The 200V tap then being read as 110V.

The green wire in the mains lead should be taken to the earth pin of a three-pin mains plug.

2. Loudspeaker

Connect a low impedance (2.5-5.5 ohm) loudspeaker to the top and either one of the bottom sockets at the rear of the receiver, by means of the plug provided. The third pin is for connection to any anti-trip circuitry that may be in use, such as in the KW Viceroy'-SSB Transmitter. A -speaker with a limited bass response provides increased readability e.g. not larger than 6" dia. 5" round, and having a high flux density of 8-10,000 gauss is ideal. A matching loudspeaker is available from K.W. Electronics Ltd. (price £5.10.0.)

3 Aerial

The Receiver is designed for an aerial input of 50-80 ohm from a co-axial line, and best results will be obtained when using this. However, almost any type of aerial may be used, such as a long wire, etc.

SECTION 3 OPERATION

(P.B. = Push Button)

Control	Setting for AM	Setting for CW	Setting for SSB
Mute	"On" P.B. IN	"On" P.B. IN	"On" P.B. IN
'Selectivity	3.8 kc.	2.1,1 or .5kc	2.1 kc.
Prod. Det.	"Off" P.B. OUT	"On" P.B. IN	"On" P.B. IN
N.L. (Noise Limiter)	"Off" P.B. OUT	"Off" P.B. OUT	"Off" P.B. OUT
Cal.	"Off" P.B. OUT	"Off" P.B. OUT	"Off" P.B. OUT
A.V.C. Rate	Fast P.B. OUT	Fast P.B. OUT	P.B. IN
A.V.C. ON-OFF	"On" P.B. OUT-	"Off" P.B. IN	"On" P.B. OUT
USB/LSB (see sub-heading SSB)	Either	Either	According to either transmission
Slot	"Off" P.B. OUT	"Off" P.B. OUT	"Off" P.B. OUT
Band switch	To desired "band	To desired bard	To desired band
RF Gain Control	Fully clockwise	To desired level	Fully clockwise
AF " "	To desired level	To desired level	To desired level
Slot Freq. Control	Immaterial	Immaterial	Immaterial
Pre-Selector	Peak desired signal using calibrated scale	Peak desired signal using calibrated scale	Peak desired signal using calibrated scale

1) AM Reception

For normal AM reception the 3.8 Kc. selectivity position is used. Under conditions of interference a narrower bandwidth may be used with a consequent loss of fidelity.

The noise limiter may be switched in to reduce impulse types of interference if required.

In the presence of extremely strong signals the RF gain may be reduced to prevent overloading,

To remove an unwanted heterodyne the slot may be switched in and the slot frequency control adjusted slowly until the heterodyne is eliminated or reduced to a low level. The effect of adjusting the slot frequency is to move a sharp notch (or slot) across the passband. It may be necessary to re-tune slightly the main dial to achieve optimum heterodyne rejection. The slot should always be switched off after-use

2) CW Operation

When receiving CW it will be found that the .5 Kc selectivity position is the most satisfactory. The slot can be used as in AM reception to remove unwanted signals. It may sometimes be an advantage to switch off the AVC at the push-button provided (see Table on page 2).

3) SSB Operation

Reception of single sideband with this receiver will be found to be much easier than with other receivers, there being only one adjustment to be made as with AM, that being the main tuning dial.

With controls adjusted as specified in the table on page 2, switch to the appropriate sideband, either upper or lower, and tune the desired signal for optimum intelligibility.

All positions of the selectivity control may be used dependant upon conditions, but the 2.1 Kc position will be found the most useful.

The slow AVC position will be found very advantageous when using full RF gain and listening to stations of different signal strengths.

The sideband switch provides upper sideband reception on all but the 80 m. band with the push button at the OUT position, and lower sideband when IN. On the 80 metre band this is reversed and the push button provides lower sideband reception when OUT and upper when IN.

The reason for this reversal is due to the different number of mixers on the 80 m. band, i.e. double superhet. It is normal agreed practice to use upper sideband on 10, 15 and 20 metres and lower sideband on 40 and 80 m. Therefore, best reception should be obtained on 10, 15 and 20 m. with the push button in the OUT position. On

80 m. this OUT position is correct for lower sideband reception, but is IN for lower sideband on 40 metres.

The slot filter when used in SSB reception will be found to be very useful in removing unwanted signals. Operation is similar to that adopted on AM and CW.

Either sideband of a signal may be received by merely operating the USB/LSB push button. It is usually not necessary to re-tune the receiver when doing this except on the 3,8 kc/s selectivity position, where both sidebands are received

SECTION 4

1 Calibration

Calibration may be carried out with the receiver in any mode of reception,

The Calibrator push button is pushed in, and the Cal. Set control located below the main tuning knob is used to accurately reset the dial accuracy to a 100 kc. Interval marker signal. This will be heard very close to the required position.

On AM, maximum indication on the 'S' meter may be taken as the correct setting. On CW and SSB zero beat is correct.

The Calibrator is adjusted at the factory and should not require further attention. The crystal has an accuracy of better than .01%, which is sufficient for practical purposes. Provision is made for checking the accuracy of the calibrator against WWV or the Russian standard frequency on 15,000 kc/s (see Para. below).

2 'S' Meter

The 'S' meter is provided to assist in tuning and to give an indication of relative signal strengths. The meter may be used on any type of signal and at any setting of the RF gain control. When adjusted at the factory the 'S' meter reads S9 for an input of 50 uV. and is calibrated at 6 db. each S point. This applies only at maximum setting of the RF gain control. The meter may be set to zero by means of the potentiometer at the rear of the chassis

3. Muting

The receiver is provided with a socket at the rear of the chassis, which is for muting and is used in conjunction with an external relay.

When the Mute push-button is in the OUT position the receiver is of course muted. Under this condition the receiver may be made operational by shorting the two connections of the non-reversible socket.

Care should be exercised due to these connections being 150 v. above chassis,

4. WWV 15 mc/s Frequency Check

To tune the KW 77 to 15 mc/s set the wavechange switch to 7 mc/s. band, the Main tuning dial to 7.0 mc/s and the Pre-selector to 15 mc/s as indicated on the small dial. Adjust Cal. set knob against 100 kc/s Calibrator for accurate dial reading of 7000 kc/s. Frequency standard station WWV and a Russian station can usually be heard during daylight hours.

SECTION 5

5-1 Service Instructions

This section covers maintenance and service of the KW 77 Receiver. It includes information on trouble analysis, signal tracing procedures, voltage and resistance measurements, and alignment procedures. The usefulness of signal level and alignment data given depends upon the accuracy of the test equipment used. Minor adjustments in alignment may be made using the crystal calibrator as a signal source. Except for an occasional touch-up to compensate for possible component ageing, alignment normally will be necessary only if frequency-determining components have been replaced. If servicing requires that the cabinet be removed, proceed as follows;

(a) Disconnect all power and external connections. Unscrew the four 4BA set screws under the cabinet; the receiver may then be completely withdrawn from its cabinet.

5-2 Trouble analysis

Most cases of trouble can be traced to defective valves. Many valve checkers cannot duplicate the conditions under which the valves work in the receiver. Substitution of new valves will sometimes clear an obscure case of valve trouble. Intermittent trouble conditions in valves can usually be discovered by lightly tapping the envelope. Occasionally, valve pins or socket terminals will become dirty or corroded causing an intermittent condition. When this situation is suspected, remove the valve and apply a few drops of contact cleaner to the valve pins. Replace the valve and work it up and down in the socket a few times. Shorted valves or capacitors will often cause associated resistors to overheat and crack, blister, or discolour. Making the measurements listed in tables 5-1 and 5-2 will help to isolate this type of trouble to a particular stage or component.

A logical process of elimination in conjunction with a study of the main schematic diagram and block diagram will aid in isolating trouble. For example, if the receiver functions properly in the AM position but fails to operate in the SSB or CW positions, trouble in the product detector should be suspected as this circuit is not used for AM reception.

5-3 Voltage and Resistance Measurements

Tables 5-1 and 5-2 list typical voltage and resistance readings at each valve socket terminal. It is recommended that a valve voltmeter be used for these measurements. A V.O.M. may be used if it has an input resistance of not less than 20,000 ohms per volt.

Voltage measurements made with a V.O.M. will yield lower readings in high impedance circuits such, as the AGC line.

5-4 Signal Tracing

Appropriate test points and normal signal levels are listed in table 5-3. The values listed are nominal. Signal levels in a given receiver may differ from those listed by a factor of plus or minus 20% without noticeable degradation in performance. A signal generator with an accurately calibrated output attenuator must be used to provide the RF signal source voltages indicated. A Marconi TF 144G or equivalent generator is recommended for this purpose. Be sure to consult the signal generator instruction book for information regarding adequate termination requirements.

TABLE 5-5

Signal Levels.

Equipment required:

Audio Generator @ 400 cps 1v. output
 RF Signal Generator modulated 400 cps. 30%
 Audio Output Meter
 All Gain controls MAX
 2.1kc Pass Band
 Mute ON
 All other controls OFF

Signal Injection Point	Generator Output Frequency	Generator Output Voltage	Audio Output
V 10 Pin 3	400 cps	1 V	25 mw
V 10 Pin 1	400 cps	80 mV	25 mw
V 6 Pin 1	50 kcs	50 mV	150 mw
V 5 Pin 1	50 kcs	900 uV	150 mw :
V 4 Pin 7	50 kcs	200 uV	400 mw
V 4 Pin 7	450 kcs	200 uV	400 mw
V 3 Pin 7	450 kcs	100 uV	400 mw
V 2 Pin 2	3.8 mcs	20 uV	400 mw
ANT	3.8 mcs	10 uV	400 mw

5-5 Alignment Procedure

Complete alignment of the receiver requires the use of an accurately calibrated signal generator, but slight touching up of the circuits may be accomplished by the use of the 100 kc. crystal oscillator. Proceed as follows?

(1) Set the receiver controls to the following positions;

N.L.	OFF	push-button	OUT
Prod. Del	OFF	" "	OUT
Slot	OFF	" "	OUT
USB LSB	LSB	" "	OUT
AVC	ON	" "	OUT
AVC Rate	FAST	" "	OUT
Cal	OFF	" "	OUT
Mute	ON	" "	IN
RF Gain	MAX		
Audio Gain	As required		
Slot Freq	Vertical		
Selectivity	2.1 kc.		
Wave Band	3.5 mcs.		
Pre-Selector	3.8 mcs.		
Main Dial	3.8 mcs.		

(2) Terminate the ANT with a 75 ohm non-inductive resistance.

(3) Tune in the 100 kc signal for maximum indication on the S1 meter.

(4) Adjust in turn for maximum indication on 'S1 meter.-C.64, L.22, L.21, L.20, L19, T.2 Pri and Sec., T.I Pri and Sec., T.5, T.6.

(5) The location of the components can be found by referring to Fig. 1.

(6) This completes the alignment on the 5.5 mcs. band.

(7)-To align the PRESELECTOR on all other bands it is first necessary to dissolve the fixative retaining the cores in their coils. This can best be done by applying a little Acetone to the coils, leave for one minute and carefully move the cores to and fro.

(8) Move the WAVEBAND switch to 29.2, the main dial to the 100 kc harmonic at 29.4, and the PRESELECTOR to 28.0. Adjust L.I and L.5 for maximum indication on the 'S' meter. It is not necessary to re-peak L.I and L.5 for the 28.6 and 28 mcs. band. Continue with the same alignment procedure on 21, 14 and 7 mcs. bands, tuning the PRESEIECTOR to the centre of each band. The alignment on 1.8 mcs. is accomplished by adjusting C.4 and C.9 for maximum indication on the 'S' meter.

(9) It is important -to align the PRESELECTOR in the order indicated, as it is an incremental tuner.

5-6 Adjustment of the 1st Mixer Crystal Oscillator

- (1) Should it be found that it is impossible to hear the 100 kc calibrator on any band except 3.5 mcs., it is probable that the 1st MIXER CRYSTAL OSCILLATOR is not working.
- (2) It is only necessary to adjust the cores on 14, 21 and 29.2 mcs. Bands, proceed as follows.
- (5) Connect a valve voltmeter reading DC- 5 v. range to Pin 9 V.2. Turn the WAVEBAND switch to 3.5 mcs, adjust the ZERO ADJ control on the valve voltmeter for 0 volts.
- (4) Turn the WAVEBAND switch to 29.2 and adjust L.9 to maximum indication on the valve voltmeter, this should read approximately - 1.4 v. Turn to the other 28 mcs. bands and check that the valve voltmeter reading is nearly the same.
- (5) Turn the WAVEBAND switch to 21 mcs. and 14 mcs. in turn, and adjust L.10 L.11 respectively.

5-7 Adjustment of the Product Detector

To determine whether the PRODUCT DETECTOR oscillator is on frequency.

- (1) Set up the receiver as in 5-5 (1,2)
- (2) Switch the CAL on
- (3) Tune in the 100 kc. signal at 3.8 mcs. for maximum indication on the 'S' Meter.
- (4) Re tune the receiver lower in frequency, so that there is a 20 db. drop on the 'S1' Meter.
- (5) Switch the PRODUCT DETECTOR ON, the oscillator should be at ZERO BEAT, if it is not, adjust L.25 for ZERO BEAT
- (6) ONE S POINT = 6 db.

5-8 Adjustment of the 3rd Mixer Oscillator

- (1) To determine if the 3RD MIXER OSCILLATOR (USB LSB OSCILLATOR) is on frequency, set up the receiver as in 5-5 (1,2)
- (2) Switch the CAL ON, PROD DET ON.
- (3) Tune in the 100 kc. signal at 3.8 mcs. for ZERO BEAT. Switch the USB LSB switch to USB (P.B. in) the receiver should still be at ZERO BEAT. If it is not, check that the PRODUCT DETECTOR osc is on frequency as in 5-7, tune for ZERO BEAT on LSB (P.B. out) switch to USB and adjust C.45 for ZERO BEAT.

(4) The operation of the 3RD MIXER oscillator is as follows, with the receiver on 3.8 mcs. and the USB LSB switch OUT (LSB) the 3RD MIXER oscillator is on 500 kc, with the switch IN it is on 400 kc. The frequency change is accomplished by switching in capacitance, when the USB/LSB switch is in. If it is suspected that the oscillator is off .frequency with the P.B. out, then it will be necessary to carry out the full alignment procedure as in 6-3.

5-9 Adjustment of the Slot Frequency and Depth

- (1) Set up the receiver as in 5-5 (1,2)
- (2) Switch on the CAL and PROD DET
- (3) Tune for ZERO BEAT at 3.8 mcs.
- (4) Check that the SLOT knob pointer is vertical, the condenser should be at half mesh.
- (5) Switch the SLOT ON. The 'S1' Meter should drop at least 40 db. If it does not, adjust R.26 for maximum depth of slot, and L.16 for slot frequency.

5-10

The above alignment procedure is adequate if the receiver is slightly out of adjustment, due to a. change of valve etc.

SECTION 6 **Complete RF Alignment Procedure-**

6-1 Equipment required:

The following equipment is required for the complete alignment of the KW 77 Receiver.

- a.) RF Signal Generator covering 40 kcs to 50 mcs. With termination impedance 75 ohms
- b) Valve Voltmeter
- c) Audio Output Meter

6-2 Alignment of the 50 kc. Filter

- (1) Set up the receiver as in 5-5(1) Switch the selectivity to .5 kc.
- (2) Connect the Valve Voltmeters to the AVC 1 Line, a convenient point is where the 68 K 1/2w. resistor on the secondary of T.2 joins the 1000 pf feed through condenser. Set the valve voltmeter to 5 v. NEG- range.
- (3) Connect the Signal Generator modulated 30% to Pin 7 of V.4, set the frequency to 50 kc.

(5) The tracking of the oscillator is best left until the RF AMP has been aligned then the 100 kc. calibrator can be used. See SECTION 6-9

6-6 Adjustment of the Variable Intermediate Frequency (VIF) and RF Stage

- (1) Move the generator to the ANT socket
- (2) Set the PRESELECTOR POINTER to 3.8 mcs.
- (3) Adjust L.12, T.5 and T.6 for peak valve voltmeter reading.
- (4) When the receiver is aligned, the generator output should be better than 3 uV for an AVC voltage of - 1.5 v.
- (5) The alignment of the RF STAGE and 1st MIXER CRYSTAL OSCILLATOR on all other bands can be carried out as in SECTION 5-6 using the signal generator or 100 kc. calibrator as the signal source.

6-7 'S' Meter Calibration

- (1) When the receiver has been aligned on all bands the 'S' Meter calibration can be checked.
- (2) Short the ANT socket to EARTH
- (3) Check that the 'S' Meter reads 0, and adjust if necessary by the 'S' Meter ZERO control R.51, located on the rear of the receiver.
- (4) Connect the generator to the ANT socket, adjust the output to 50 uV unmodulated and the frequency to 21.2 mcs.
- (5) Move the WAVEBAND switch to 21 mcs. and the main dial to 21.2 mcs.
- (6) Adjust the PRESEIECTOR for maximum 'S' Meter reading.
- (7) Adjust the 'S' Meter SENSITIVITY control R.49, for a reading of S.9 on the 'S' Meter.

6-8 Adjustment of the Product Detector, USB LSB and Slot

The adjustment of the Product Detector Oscillator, USB LSB and Slot can be carried out as in SECTION, 5-7-8-9 using the signal generator or 100 kc. calibrator as the signal source•

6-9 Main Dial Calibration

- (1) Set the receiver up on 3.5 mcs.
- (2) Switch the PRODUCT DETECTOR ON, also 100 kc CAL ON

- (3) Set the CAL RESET control 25° off fully counter clockwise.
- (4) Check that the receiver is at ZERO BEAT with the 100 kc signal, if it is not adjust L.15 for ZERO BEAT.
- (5) Check that ZERO BEAT occurs at 100 kc. intervals up the band. If it does not, and the receiver is overtracking reduce the capacitance of the 3-60 pf. Phillips Trimmer located close to L.15 under side of chassis. If the receiver undertracks increase the value of the 5-60 pf trimmer,

6-10 Adjustment of L.13 L.I 4

- (1) Two series resonant traps are provided in the KW 77. They are, L.13 resonant at 14060 kc. and L.14 resonant at 21360 kc.
- (2) Adjustment of L.13. Tune the receiver to 14060kc. With the PRODUCT DETECTOR ON. With the PRESELECTOR off tune, a beat note will be heard, adjust L.13 (top core of IF can) for minimum signal.
- (3) Adjustment of L.14. Tune the receiver to 21360 kc, a beat will be heard, as on 1406.0 kc. adjust L.14 (bottom core of IF can) for minimum signal. It is possible to reduce both beats down to a level below the equivalent to 1 uV signal at the ANTENNA terminal.

6-11 Using the KW 77 on other than the Amateur Bands

It is possible with the crystals supplied in the KW 77 to cover 2 additional 600 kc, segments of the spectrum as follows:

<u>Band switch</u>	<u>Tune Preselector to</u>	<u>Frequency</u>
14	28	21.5 - 22.1 mcs
7	21	14.5 - 15.1

6-12 Aerial Change over Relay

It is advisable to use an AERIAL CHANGE OVER RELAY that earths the receiver ANT socket when in the transmit position. Alternatively use a CHANGE OVER RELAY that has an electrostatic shield between the transmit and receive contacts, such as the Dow Key DK.60G.

6-15 Removing the Main Scale for Cleaning

- (1) It is not necessary to withdraw the receiver from the cabinet. To remove the main scale merely unscrew the two 4BA mushroom-head screws at the top of the scale and pull the scale forward.
- (2)To clean the scale use an anti-static cleaner such as is recommended for Television tubes. Use only light pressure on the side on which the lettering etc. is printed, otherwise damage may occur.

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TABLE 5-2

VOLTAGE MEASUREMENTS

AVO Model 8 Mark II

RF Audio Gains MAX
 Prod Det ON
 Cal ON
 Mute ON
 All other controls, OFF
 Band 20M Receiver tuned off 100 Kc harmonic

* Measured with Valve Voltmeter.

Valve	Base Pins								
	1	2	3	4	5	6	7	8	9
V 1 EF183	0.25	-1*	.25	6.3AC	0	0	110	65	0
V 2 ECF82	40	-1.4	110	0	6.3AC	120	2.5	1.5	-2.3
V 3 6BE6	1	1.4	6.3AC	0	105	50	0		
V 4 6BE6	-2.8*	0	0	6.3AC	105	35	-1*		
V 5 6BA6	-1.3	0	0	6.3AC	105	120	0		
V 6 6AT6	0	1.4	0	6.3AC	-0.2*	-1*	125		
V 7 12AU7	150	-1*	7.6	0	0	35	0	1.2	6.3AC
V 8 0A2	150	0	-	0	150	-	0		
V 9 6BE6	-3.5*	1.35	0	6.3AC	60	75	0		
V10 ECL82	-0.1	8	0	0	6.3AC	105	110	0.4	54
V11 EF91	-15	0.4	6.3AC	0	20	0	70		

TABLE 5-1
RESISTANCE MEASUREMENTS

AVO Model 8 MARK III

'Power OFF Supply not plugged in.

Audio Gain MAX

Prod. Del. ON

Mute ON

Cal. ON

N.L. ON

All other controls OFF

Band 20 m.

Resistance of less than one ohm shown as 0

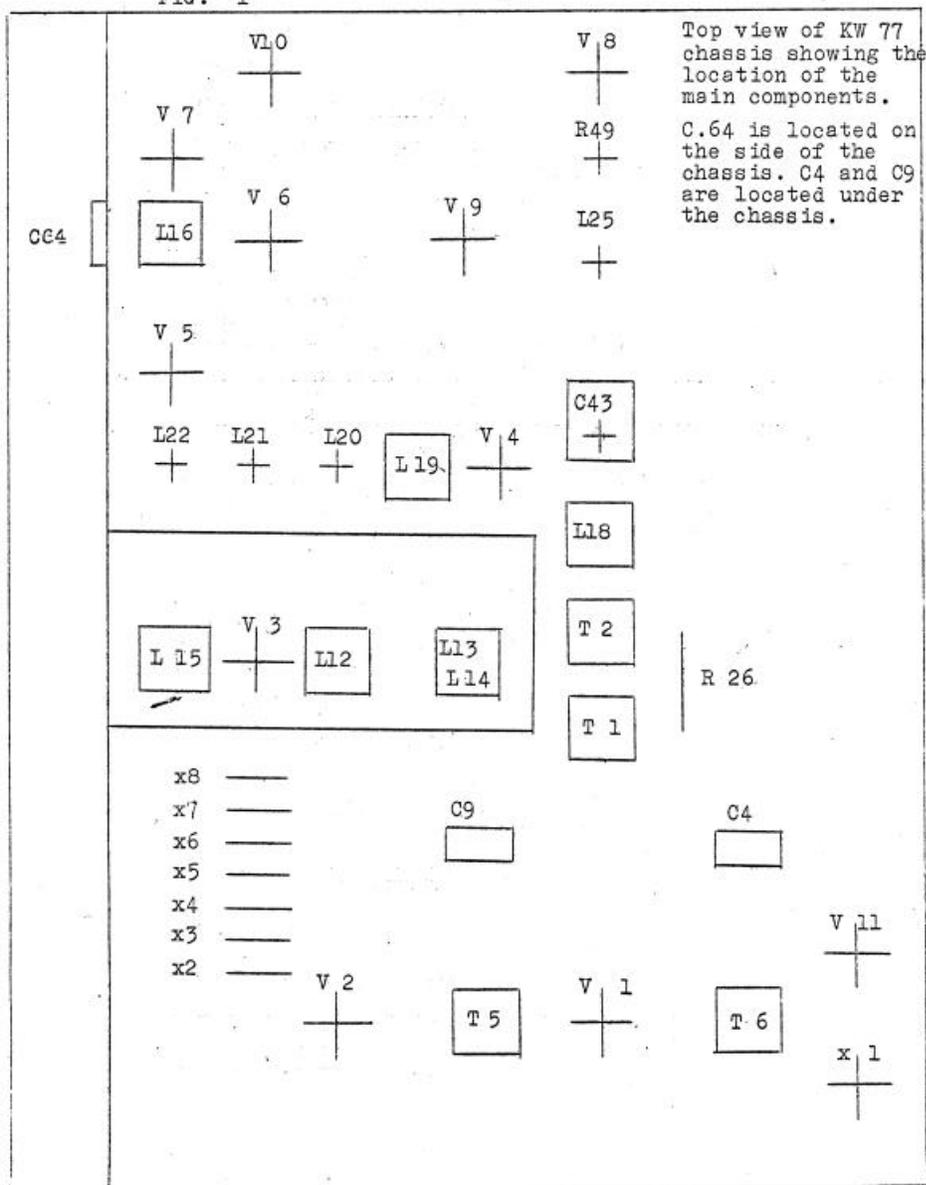
Valve	Base Pins								
	1	2	3	4	5	6	7	8	9
V 1 EF185	22	4M	22	0	0	0	9k	30k	0
V 2 ECF82	60k	4M	60k	0	0	8k	680	500	150k
V 3 6BE6	100k	470	0	0	15k	60k	6.8k		
V 4 6BE6	150k	0	0	0	8k	85k	3m		
V 5 6BA6	3m	0	0	0	8k	13k	0		
V 6 6AT6	50k	1.5k	0	0	650k	3m	30k		
V 7 12AU7	5k	3m	3.3k*	0	0	140k	1.2m	2.2k	0
V 8 OA2	5k	0	—	0	5k	—	0		
V 9 6BE6	22k	220	0	0	60k	30k	33k		
V 10 ECL82	1.2m	270	470k	0	0	8k	7.5k	2.2k	280k
V 11 EF91	1m	1k	0	0	500k	0	108k	108k	
D 1 S35	+	-							
	330k	320k							
D 2 S35	+	-							
	1.2k	0							

- SD 1) Forward Resistance 850k)in
 2) DD006 Reverse Resistance 50k)circuit
 3) Forward Resistance 1k)Out of
 4) Reverse Resistance INF)circuit

* Depending on setting of 'S' Meter Sens. Control.

All measurements are given in ohms unless otherwise specified.

FIG. 1



KW 77/2