EQUIPMENT REVIEW

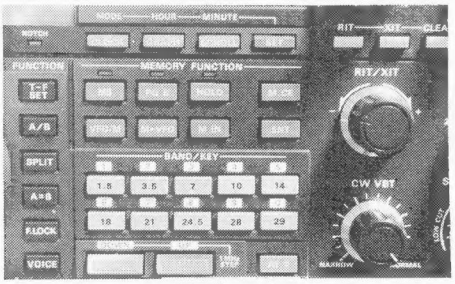
Ron Fisher VK3OM
3 Fairview Avenue, Glen Waverley, Vic. 3150

KENWOOD TS-940S ALL MODE HF TRANSCEIVER

The TS-940S is an updated version of the well known and respected TS-930S. The 930 became available around mid-1982 and quickly became a status symbol among amateurs.

However in many respects, the 930 was surpassed by the TS-430 released just a few months later. Perhaps the greatest draw back of the 930 was the inability of the memory system to store mode information. The 940S overcomes this and at the same time introduces many brand new and unique features.

At first glance, you might suspect that the 940 and the 930 are packaged in the same cabinet. There is certainly no doubt from their appearance that they are closely related. But in fact the 940S is both larger and heavier than the 930. Width is up from 374mm to 401mm, other dimensions remain the same, weight is up from 18.5kg to 20kg. Some of this increase in weight is accounted for in the automatic antenna tuner which now covers 160 metres, and in the improved cooling for the final which allows a longer duty cycle for RTTY. The most striking improvement in the 940 is in the tuning, memory and frequency selection areas. On the 930 this was limited to amateur band selection buttons, 1 MHz up/down selection and the eight position memory switching. All of this has been replaced with a multi function keyboard.

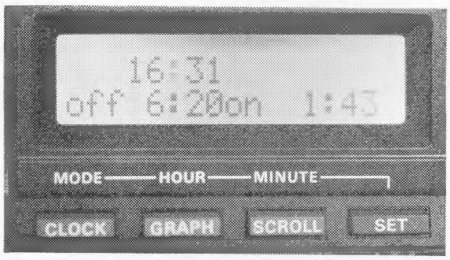


Keyboard.

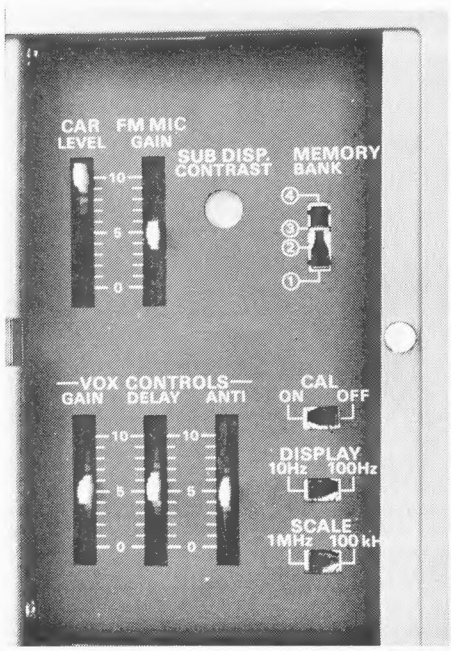
Let's look at this in some detail. Ten band/key buttons allow instant selection of each amateur band with two buttons for 10 metres at 28 and 30 MHz. When in the memory mode these same ten buttons select memories one through ten in any one of the selected four memory banks. There are now a total of forty memories.

The four memory banks are selected by a switch through the top hatch. Unfortunately the memories are not tunable. They can be shifted up to +/– 9.9 kHz with the RIT, but if a greater range is required, the memorised frequency must be transferred to VFO A or B which you then lose. Memory scanning works well with a 5 second hold on each memory as the scanning proceeds.

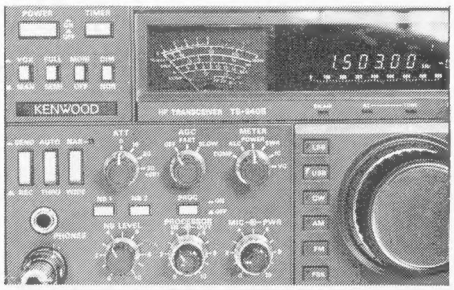
Finally, the same ten buttons can be used as a direct entry keyboard to provide direct access to any required frequency. 1 MHz up/down keys are also available.



Clock Display.

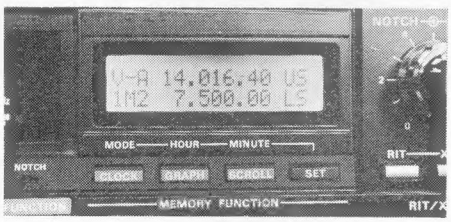


Controls within the Top Hatch.



Mode Selection Buttons.

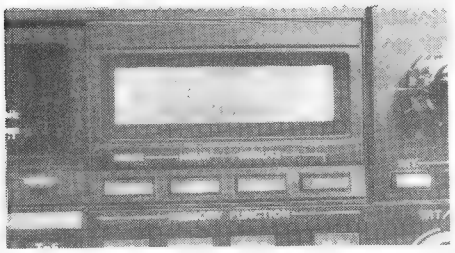
Six mode selection buttons to the left of the tuning control replace the old style rotary switch of the 930. As each mode is selected, a small indicator lights and the mode is signalled in Morse code — 'L' for LSB, 'U' for USB, etc. To the right of the VFO knob are five VFO controls and the voice frequency readout selection button. That is another of the new features of the 940. Along with the Morse code identifier this will make operating much easier for sight impaired amateurs. A voice readout is an optional extra. Eight memory controls are arranged above the keyboard,



Frequency Readout.

which allow for memory entry and recall, VFO to memory and memory to VFO transfer as well as memory scan.

Next is the Sub Display, simple name for an LCD display that imparts more information than anything seen before. Let's run through what it displays. A twenty four hour clock, on/off times for unattended switching of the transceiver mains power, frequency in the VFO not being used at the time, ie it displays VFO B if VFO A is in use. It displays, in turn, all the frequencies stored in memory and gives a graphical display of the status of the SSB slope tune and also the CW VBT. It indicates when the auto antenna tuner has been selected, when it is tuning, when it has completed tuning, and whether a match is possible or not. Selection of the various display functions is selected by the four buttons under the display except for the antenna tuner display which appears when the auto tuner is activated.



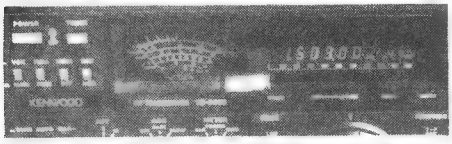
Slope Status.

SSB and CW tuning rate remains the same as the 930 with one knob revolution for 10 kHz shift but on AM and FM this is changed to one knob revolution for 100 kHz shift. I feel that this is too fast and that perhaps a 50 kHz rate might have been better.

It has been reported in some magazine previews (not AR) of the 940S that transmitter power output is 250 watts. However as we shall later see the output is around 100 watts and the INPUT is claimed to be 250 watts.

Antenna Readout.

Some of the other handy additions to the 940S include switching of the digital display to either 100 or 10 Hz resolution and the analogue slide rule frequency indicator under the digital display to either 1 MHz (where it was on the 930) or to 100 kHz.



Power Output Meter.

The power output meter, which is quite accurately calibrated in watts, now also indicates PEP output on SSB. I found the meter needed a bit more damping when reading PEP but at least this is a start.

Numerous facilities are available on the rear panel, although like the 930, they are a bit hard to get at. The IF output socket is now directly compatible with the SM-220 monitor scope and providing the 220 is fitted with a BS-8 adaptor the band display feature can be used.

On the cosmetic side of things, the S meter colour scheme has been changed. It now has a black background which I rather liked but a 930 owner, who tried the 940, preferred the light coloured meter on his rig.

As 930, the 940 has two cooling fans, one for the power supply and one for the transmitter's final amplifier. The power supply fan tended to operate quite a bit during receive-only operation. The noise produced was quite audible although not all that obtrusive. In fact I noticed more when it had switched off. The final amplifier fan was much quieter and only came on after several minutes of transmission.

The 940 RIT/XIT control deserves a mention. The offset required can be preset to any required amount up to +/−9.9 kHz by rotating the continuously variable control. Push the RIT button and there you are. Push the RIT button again and the receiver is back on the original frequency with the offset frequency still preset and available. Pushing the clear button resets the RIT offset to zero.

Rear panel facilities have been increased and now include two accessory sockets for a computer interface and for the connection of data communications.

CIRCUIT DESCRIPTION

The TS-940 is a triple conversion circuit for transmit and also for the FM receive mode. Other receive modes include one extra conversion down to 100 kHz which includes a most effective notch filter.

The conversion set is: first IF at 45.05 MHz, output from the synthesiser at 45.08 to 75.05 MHz which converts the incoming signal to 30 MHz for the first IF. Second IF is 8830 kHz, and it is at this frequency, common to most Kenwood HF equipment, where the main IF shaping filters are located. Third IF is 455 kHz. The transmitter balanced modulator is at this frequency and a separate 455 kHz IF strip comes off at this point for FM reception.

Output from the synthesiser is in 10 Hz steps for SSB and CW and 100 Hz steps for AM and FM operation. Tuning around on AM there were plenty of clicks when tuning across strong signals as the synthesiser changed frequency. In this respect the 940 is very much inferior to the 930. The variable bandwidth controls operate at the second IF frequency and employ two variable carrier oscillators at 8.83 and 8.375 MHz. The noise blanker also operates at this frequency and uses a four diode switch ahead of the main filters.

It is interesting to note that the specified selectivity of the 940S is rated at 2.4 kHz at −6 dB and 3.6 kHz at −60 dB as against 2.7 and 4.0 kHz for the 930S. In a side by side test there was no detection of any difference in the two transceivers.

The RF output from the solid state transmitter output stage is diode switched to allow the full break in CW operation.

TS-940S ON TEST

The following equipment was used to produce the test figures. A Yaesu YP-150 terminating watt meter, Drake R-4 through line watt meter, Kenwood SM 220 monitor scope, AWA F242A noise and distortion meter, Daven terminating audio output meter and Marconi TF995A/5 signal generator.

Frequency Stability

The stability of the 940 is most impressive. It was checked against VNG, WWV and several broadcast stations over long periods and under various ambient temperature conditions. It is really hard to be sure that the 940 drifts at all but if it does, the total would be under 20 Hz. If this type of performance does not satisfy, an optional high stability master oscillator is available which claims a long term stability of +/− x 10-6/year.

Power output

As mentioned earlier, some previews of the 940 have indicated that the power output has been increased to 250 watts. Not so, but the input is claimed to be 250 watts and the output is around 100 watts.

Power was measured under CW conditions with full drive, referenced to the PEP output as indicated on the monitor scope. For good measure a two tone test was carried out.

Band	CW output	PEP output from scope	Two tone output x 2 to give PEP
1.8MHz	127 W	130 W	110 W
3.5 MHz	127 W	130 W	110 W
7.0 MHz	127 W	130 W	110 W
10.1 MHz	126 W	130 W	110 W
14.0 MHz	124 W	135 W	105 W
18.0 MHz	124 W	130 W	105 W
21.0 MHz	124 W	130 W	105 W
24.5 MHz	123 W	125 W	105 W
28 5 MHz	123 W	125 W	100 W

While doing these tests, the power output meter calibration on the 940 was checked. With steady carrier, the 940 meter was 10 percent low compared to reference meters. Under PEP conditions it was hard to arrive at an accurate estimation due to the rather fast ballistics of the meter. Perhaps Kenwood might consider the addition of a hold circuit or even a simple increase of the meter decay time.

The scope pattern indicated a very clean output at all times even with large amounts of speech processing in use.

The power control allows the operator to reduce output in all modes to about 5 watts. This can be easily monitored with the power output setting of the 940 meter.

Subjective tests of the transmitted audio quality was carried out in the three available modes. SSB quality was rated as very good with an actual perceived improvement with the processor in use. Many critical amateurs have noted the distinctive quality of the TS-930. It's pleasing to report the 940 retains the same sound. AM quality was smooth and clean particularly with the optional MC-60A microphone in use. But the big surprise was the superb quality of the FM mode. Over a given path, the FM gave much better quality and signal to noise ratio than either AM or SSB. Why don't more amateurs use this mode on the wide open spaces of the 10 metre band?

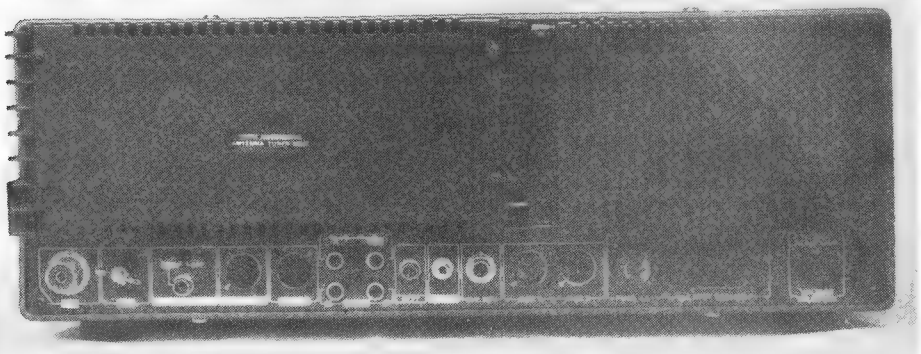
Receiver Tests

The extension speaker output was connected to the terminating audio power meter and the noise and distortion meter. An 8 ohm load was selected. Residual noise with the audio gain at zero was −55 dBm unweighted and −52 dBm weighted. This is a reasonable figure, better than many transceivers but well down on the best (the FT-102). Audio output power and distortion were:

Output Power	Distortion
.5 watts	1.6%
1.5 watts	1.6%
2.0 watts	3.5%
2.5 watts	13%

While these figures are reasonable and representative of modern amateur equipment, I often wonder why a transceiver of this class doesn't have 10 or 15 watts audio output. Surely the cost of producing 10 watts would be very little more than 2 watts but the improvement in recovered audio could be substantial.

Received audio response in LSB was checked by



Rear of the TS-940S.

tuning across the signal produced by the 940 internal crystal calibrator. The results were:

100Hz	200Hz	300Hz	400Hz	1kHz	1.5kHz
10	−2	.5	0	0	−1
2kHz	2.2kHz	2.5kHz	2.7kHz	3.0kHz	
−3	−4	−5	7	−26dB	

While this is very smooth, it shows that the carrier is set a little too close to the filter skirt. A slight adjustment would give a better HF response, although as shown above in the transmitter tests, this is not all that bad.

Frequency response was also checked in the AM reception mode.

100Hz	200Hz	350Hz	700Hz
−10dB	−4dB	0dB	0dB
1kHz	2kHz	3.5kHz	5kHz
0dB	3dB	−12dB	22dB

The fall off is surprising at the low frequency end, however feeding a good quality speaker the audio was clean and quite acceptable.

The action of the SSB slope tune controls were checked and should be referred to the overall response figures above.

SSB slopes tune, high. Control at centre (12 o'clock) point.

1kHz	1.5kHz	2.0kHz
0dB	1dB	20dB

Control full on (7 o'clock) point.

1kHz	1.25kHz
−13dB	−26dB

SSB slope tune, low. Control at centre (12 o'clock) point.

400Hz
20dB

Control full on (5 o'clock) point.

1.1kHz
-20dB

The notch filter was checked at four points through the audio range. It was able to produce a −30dB notch at 1kHz, 2kHz and 2.5kHz and a notch of −25dB at 500Hz. The notch was very sharp and its action had very little effect on the received audio quality. There was no overall drop of the received audio level as often happens with these devices. The notch filter can be used with equal effectiveness on all received modes.

The CW VBT (variable bandwidth tuning) operation was measured. No optional CW filter was fitted to the review transceiver and from the results obtained only the most dedicated CW operator would probably require one. Two are offered as options.

With the VBT at normal the band width was 2kHz at the −20dB points, but with it at narrow was reduced to 800Hz at 20dB points with an overall drop of 10dB in the actual audio output.

Receiver signal to noise ratio was next measured. This was checked at two frequencies.

At 14.2 MHz LSB.	1 uV	20dB
	.2 uV	10dB
	.1 uV	5dB
At 28.2 MHz LSB.	1 uV	22dB
	.2 uV	5dB
	.1 uV	2dB

FM quieting was measured at 14.2 MHz and turned in a remarkable 27dB. AGC action was also checked at 14.2 MHz. The signal generator output was slowly increased and the audio level monitored. From 1 to 10 uV there was a 7dB increase in output. From 10 uV to the maximum output of the generator the increase was less than .5dB. AGC decay time from S9 (100 uV) was 10 seconds with slow decay and 2 seconds with fast decay. The AGC was very smooth acting in all modes with no hint of pumping or clicking.

The S meter calibration was checked at 14.2 MHz with the following results:

S 0 — 2dB	S 6 — 4dB	9+20 — 8dB
S 2 — 2dB	S 7 — 4dB	9+30 — 9dB
S 3 — 6dB	S 8 — 3dB	9+40 — not checked
S 4 — 4dB	S 9 — 9dB	9+60 — not checked
S 5 — 5dB	9+10 - 8dB	

It took a signal level of 2 uV to reach S1 and S9 was calibrated at 100 uV. Apart from its reluctance to move off the stop with relatively weak signals, the action of the S meter was very good. You might find quite a few S0 readability 5 signals though.

The increase in the noise floor with an adjacent S9 signal was checked. With 3kHz separation the noise came up 1.5dB with the adjacent signal increased to S9+20dB the noise rose to 14dB. With 5kHz separation these figures decreased to 1 and 8.5dB respectively.

Tuning the receiver from 30 MHz down to 100kHz, a time consuming job, revealed a total of 22 birdies. Of these, only six reached an equivalent input of .2 uV. All of the others would be lost in the noise with an antena connected. Below 500kHz several gurgles were noted possibly eminating from the digital display. Again these were not audible with an antenna connected.

It was noted, during the transmitter tests, the SWR meter was indicating 1.3 : 1 when feeding a 50 ohm dummy load.

No tests were conducted to determine losses, if any, in the auto ATU. Most of the time it was not used during on air tests but a quick evaluation with a trap verticle well off its resonant frequency showed that a 3 : 1 SWR could be easily corrected.

INSTRUCTION BOOK

From an operational point of view, the sixty page instruction manual is well presented. There are three pages devoted to a description of the circuit and three more to basic adjustments and maintenance. The installation of the optional filters, auto antenna tuner and voice synthesiser is also covered.

With a transceiver of the complexity of the 940, operating instructions are of great importance. Each mode of operation is explained with a two page spread showing the operation of each control that is used with that particular mode. Several pages are devoted to memory entry, recall, scanning and direct keyboard entry. Also supplied with the review transceiver was the optional service manual. This consists of 108 pages of technical and service data. I am not sure if a copy of this is supplied with each TS-940. If not, I would recommend that a new owner should invest in one.

SUMMARY

The quickest way to sum up the 940S is to say that it has the lot. Of course if you require a mobile or portable transceiver then one of the smaller, lighter transceivers will perhaps suit better. For home station use it is hard to imagine a more complete rig or how Kenwood are going to improve on this transceiver in the future. Facilities offered are second to none and the overall performance is excellent in all respects.

The TS-940S used for this review was supplied by Trio-Kenwood (Australia) Pty Ltd and all enquiries regarding price and delivery should be addressed to them or one of their authorised local dealers.

EVALUATION AND ON AIR TEST OF THE KENWOOD TS-940S — Serial No 5100619

APPEARANCE
Packaging
*** Strong carton with foam inserts.*
Size
*** Large*
Weight
*** No lightweight (20kg) but everything self contained.*
External finish
**** Superb finish.*
Construction quality
*** Good quality boards and components. Accessibility seems fair.*

FRONT PANEL
Location of
Controls
**** With 64 separate controls, layout excellent.*
Size of knobs
*** All frequently used knobs bigger than average.*
Labelling
**** Clear labelling. Mode selection also identified in CW tone.*
Status indicators
*** Most functions well indicated.*

VFO ACTION
Tuning knob
**** Large and smooth action.*
Tuning rate
*** Well chosen for SSB and CW. Too fast for AM and FM.*
Digital readout
**** Would have to be the best available.*
VFO stability
**** Impossible to fault. High stability optional oscillator makes it better.*

RECEIVER OPERATION
Memories
*** 40 available with mode storage, but only 10 at one time. Memories not tunable.*
Slope tune
**** Both high and low end independently variable.*
Notch filter
**** One of the best. Sharp notch with little effect on received audio quality.*
CW VBT
**** Gives excellent CW selectivity without the use of special CW filters.*
CW pitch and tune
**** Selects required CW pitch and changes bandpass tuning to suit.*
Spurious responses
*** Quite a few throughout tuning range but all very low level.*
S Meter
*** Sluggish at low signal level. Otherwise good — see test section.*
AGC performance
**** Excellent response — see test section.*
Signal handling
**** No sign of overload.*
RIT/XIT
**** +/− 9.9kHz on both transmit or receive (selectable) separate offset readout. Main digital display also follows.*
Sensitivity
**** Excellent — see test section.*
RF attenuator
*** 10, 20 and 30dB-handy for checking S meter.*
RF gain
**** Smooth progressive action.*

NOISE BLANKER
Woodpecker
*** Better than most. Very effective when pulses are sharp and clean.*
Ignition noise
**** Cuts it dead.*
General electrical
Noise
*** Very good with most types of domestic noise.*

QUALITY OF RECEIVED AUDIO
Internal speaker
** Better than usual quality from upward facing speaker.*
External speaker
NA Matching speaker available as option. Quality very good on my usual station speaker.
Headphone output
*** Stereo phones compatible. Output level ideal.*
Cooling fan noise
** Power supply fan often runs during receive. Quite noticeable but not intrusive.*

TRANSMIT OPERATION
CW and PEP output
*** Output very flat from band to band. See test section.*
Audio response
**** Very smooth quality on all modes.*
ALC action
**** Most effective. No flat topping even when overdriven.*
Compressor
**** Really adds some punch to speech with no audible distortion.*
Metering
**** Compression, ALC, Power in watts, auto SWR, IC and VC (PA stage metering).*

Relay noise
**** None!
VOX operation
**** Very smooth and of course no relay noise.
CW operation
**** QSK (full break in) available. Should suit the most ardent CW operator.
Cooling
*** Two fans, one for power supply, one for final amp. Runs cool at all times.

MANUAL
(Owners handbook)
** Operational information good. Not much else. Workshop manual recommended.

Rating Code: Poor * Satisfactory ** Very Good *** Excellent *

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Next month the Icom IC-735 All Mode HF Transceiver will be reviewed.

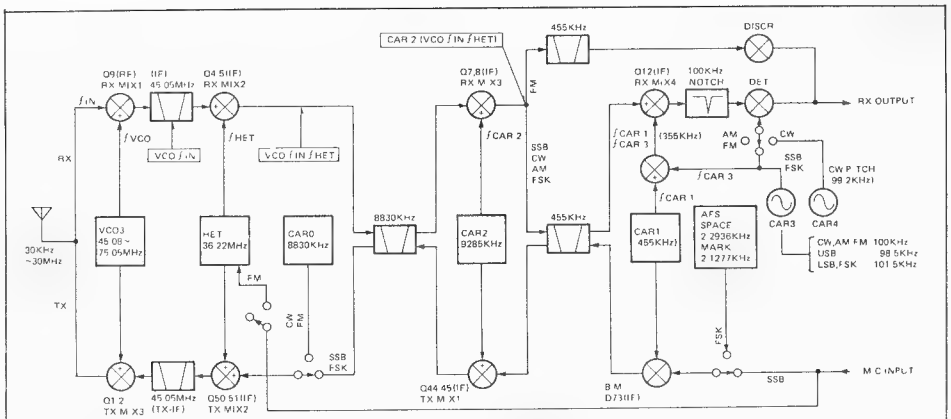

Fig. 1 TS-940S signal channel

75th Nostalgia

THE RIPPLE FROM THE SOUTH

Alf Chandler VK3LC

15 Point Avenue, Beaumaris, Vic. 3193.

The writer first became interested in wireless about 1920, when he was fifteen. He had been listening to Broadcast Station 3UZ on his cousin's wireless set which had been built by George Graham, a celebrity from Brunswick Street, Fitzroy, so the first project was to build a crystal set for myself to listen to the broadcasts. However, living in Beaumaris was a bit far for good reception on a crystal set so the next step was to build a one valve set.

By 1923 the equipment had advanced to a three valve set detector and two audios using 201A valves which I used to receive Madame Melba's opening of 3LO. My father ran a guest house which had a large hall and billiard room and it was in this hall that the wireless set became installed so the neighbours could come and listen to this new fangled set-up. Unfortunately, it was not realised that a hall full of people would dampen the reception and it was necessary to be quite near the set to hear anything.

In 1924, having left Scotch College and working in the guest house I decided it was time to learn more about wireless and perhaps go to sea as a wireless operator; I took a correspondence course in Wireless Telegraphy with the Marconi School of Wireless. A valve set was constructed to listen to VIM and ships in the bay on 600m. This set used three honeycomb coils inductively coupled on hinges, and 201A valves. A gramophone with records of Morse code was also attained which assisted the learning of the code.

After about eight months, a call was received to attend the school in Melbourne and complete the course, and in 1925 their exam was passed for 20WPM Morse, theory and practice.

For the practical exam we had a rotary gap spark transmitter in the basement at Queen Street, power is forgotten but there was a ventilator above into the footpath. (When the key was pressed, passersby would get the fright-of-their-lives!) There was a fault in this transmitter and I was asked to find it. What a fault! A piece of paper had been placed between the contacts of the key.

After the exam, the instructor lined the class up (about six or eight lads) and introduced us to a fellow who said, "I have a job for one of you, whoever steps out first gets the job." I was first out and started employment with Crystal Clear Radio on the corner of Bourke and Swanston Streets. After about nine months an offer was made to join a tramp steamer plying from Darwin to Broome as a Wireless Operator/Purser. Being only 19 at the time and not being too versed in the ways of the world, the offer was declined and I remained with Crystal Clear until their demise in 1927.

An experimental licence was applied for in 1926 with the call sign 3WH being allocated. I then became quite active with CW on the 30 and 80 metre bands. Trevor Evans 3NS initiated me into the "Rag Chewers Club" in 1927.

Upon joining the newly formed Victorian Radio Transmitters League (VRTL) in 1927 as Communications Manager I met with Jack Kling 3BJ, Harry Clift 3HC, Bill Gronow 3WG, Geoff Frew 3PM, Allan Reid 3JR, Chris Rainbow 3CR, Bill Martin 3MJ, Leo Paul 3LP, Bill Seivers 3CB, Charlie Whitelaw 3BH, Ron Jardine 3PR, Col Chirnside 3WQ and many others. This organisation, a branch of the Australian RTL with Mat O'Brien 4MM as President and Leo Feenaughty 4LJ as Secretary, was a break-away group of members who were disillusioned with the WIA at that time.

I joined the WIA in 1928 when, after a meeting between the secretaries of the WIA and ARTL, the two bodies merged with the WIA retaining its identity and the ARTL being totally absorbed. This meeting was ostensibly to present 3WH with a pennant as winner of an 80 metre contest.

After being a member of the WIA Airforce Reserve for some years, resigning in 1937, I enlisted in the RAAF in October 1940.

Training was done at Point Cook and after passing out parade posting was to Ballarat, No 1 WAGS (Wireless Air Gunners School) mustered as Wireless Operator Ground. After many promotions a posting came through to Townsville and then to Cairns in charge of signals at the Radar Zone Filter Station.

In October 1945 I was discharged from the RAAF and it was to be another ten years before amateur radio became an interest again. It was during a reunion of WAGS personnel when Fred Bail, Roth Jones and Peter Lemprierre were talking of what they were doing on 20 metres, that the bug bit again. An application was made for a call sign and VK3LC allotted, a call sign which is still heard quite frequently today.

FOOTNOTE:

From 1963-1970 Alf was a member of the WIA Publications Committee, firstly as Circulation Manager and subsequently as Magazine and Publications Manager.

In 1967 he became Intruder Watch Co-Ordinator for VK3, a position he held until 1970 when he became Federal Intruder Watch Co-Ordinator. In 1975 the IARU were in need of a co-ordinator and Alf filled the bill, a position he retained until 1982.

Awards presented to Alf in recognition for his services to amateur radio are:

1978 — the Ron Wilkinson Achievement Award 'In recognition of outstanding achievement in the field of Intruder Watch activities'.

1983 — a silver medallion 'For meritorious service to the Victorian Division of the WIA'.

1984 — a silver plaque which reads 'Our appreciation to AWH Chandler VK3LC for his long term (1975-1982) contribution to the Association as Regional IW Co-Ordinator. IARU Region 3 Association'.

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