PILOT'S 'SUPER WASP'

Every industry has its landmarks – models which met a demand at the right time with the right price, performing well and setting the direction for future progress. One such radio was the Pilot Radio 'Super Wasp' shortwave receiver, introduced early in 1929.

Until the late 1920's radio amateurs, who in 1912 had been banished to the region above 2.0MHz, had the shortwave spectrum largely to themselves.

Some wealthy hams could afford receivers from the few manufacturers making shortwave equipment; but the great majority, in the best spirit of amateurism, made their own. In any event, receiver technology above 2.0MHz was very limited.

The superheterodyne did exist, but it had a long way to go before it was to be suitable for shortwave reception. It was very expensive and RCA, the patent holders, would not issue manufacturing licences.

Typical broadcast receivers had a couple of tuned triode RF stages, a grid leak detector and two audio amplifier stages. But for shortwave work, this type of receiver was quite unsuitable. It could not provide any worthwhile gain, its selectivity was completely inadequate and it was useless for unmodulated morse transmissions.

Regeneration essential

The regenerative grid leak detector was unchallenged for shortwave work. By contemporary standards it was sensitive and selective, and it also provided – in the oscillating condition – a heterodyne or beat note for code reception.

A single valve regenerative detector with tapped or plug-in coils, connected to a transmitting aerial could, and often did, constitute a practical receiver for hams. Where they could be afforded, one or two audio amplifier stages following the detector provided adequate level for headphone reception.

Shortcomings

Of course regenerative receivers have some limitations, which require 'trade offs'. The gridleak detector is a 'square law' device which, put simply, means that sensitivity falls off rapidly with decreasing signal strength, and no amount of audio amplification can compensate.

Attempts to improve matters by increasing aerial coupling leads to another problem. Resonances in the aerial and feeders damp the oscillating ability of the detector, at certain frequencies. (In fact this characteristic was used as the basis of the *grid dip oscillator*.) Increasing the amount of feedback to counter this effect results in difficult regeneration control.

The ideal regeneration characteristics are a smooth, almost imperceptible onset of oscillation, with no detuning as the control is advanced.

Successful broadcast band enthusiasts' receivers such as the Hammarlund Roberts and Browning Drake had shown that a solution to these problems was to include a neutralised triode tuned RF amplifier between the regenerative detector and the aerial. Unfortunately however, triode neutralisation was unsatisfactory over the range of frequencies involved in short wave RF amplification.

Screen grids arrive

In October 1927, America's RCA introduced the UX-222, and Britain's Marconi Osram released the S625. These screen-grid tetrode valves virtually eliminated grid-anode capacitance, and hence the need for neutralisation in RF amplifiers.

Here seemingly was the answer to some of the shortwave receiver problems. However attempts by amateurs to add tuned RF screen-grid amplifiers to shortwave receivers were not very encouraging. What was not generally appreciated was the need for thorough shielding, to prevent feedback and instability.

The best that could be done was to

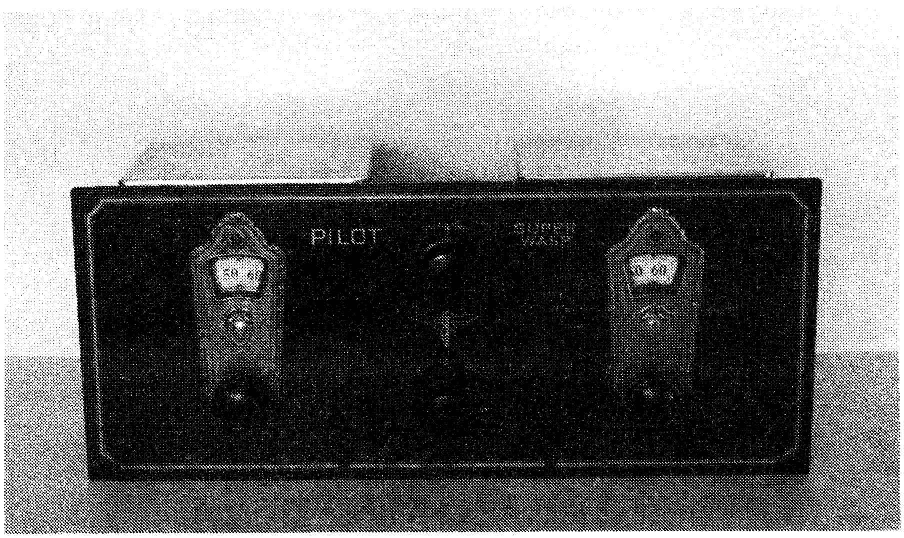


Fig.1: This 'Super Wasp' was discovered in pieces, in a cardboard box. The front panel was found in a garden shed at an entirely different location.

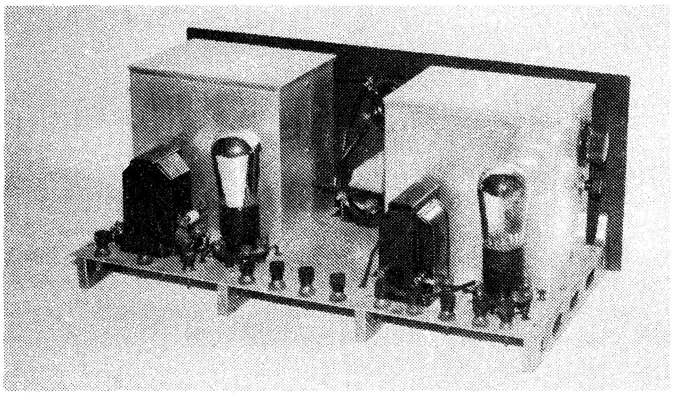
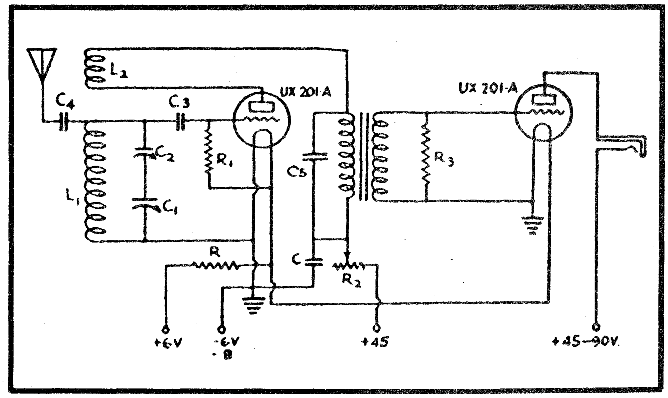


Fig.2: The audio amplifier stages and terminal strip at the rear, behind the shielding boxes. Note the chassis struts, for shielding and rigidity.



Schematic for a typical 2-valve amateur receiver of the 1920's. Given the right conditions, sets like this could receive signals from the other side of the world.

use an untuned screen-grid valve between the aerial and the detector. This did not give much amplification, but did eliminate aerial loading. However, as the lack of aerial tuning resulted in strong signals cross modulating the isolating amplifier, the majority of shortwave users continued with simple receivers.

By now, commercial interests and broadcasters were alert to the potential of shortwave communication. Not only had amateurs achieved remarkable results, but also the success of the Australian Beam Wireless project made a considerable impact.

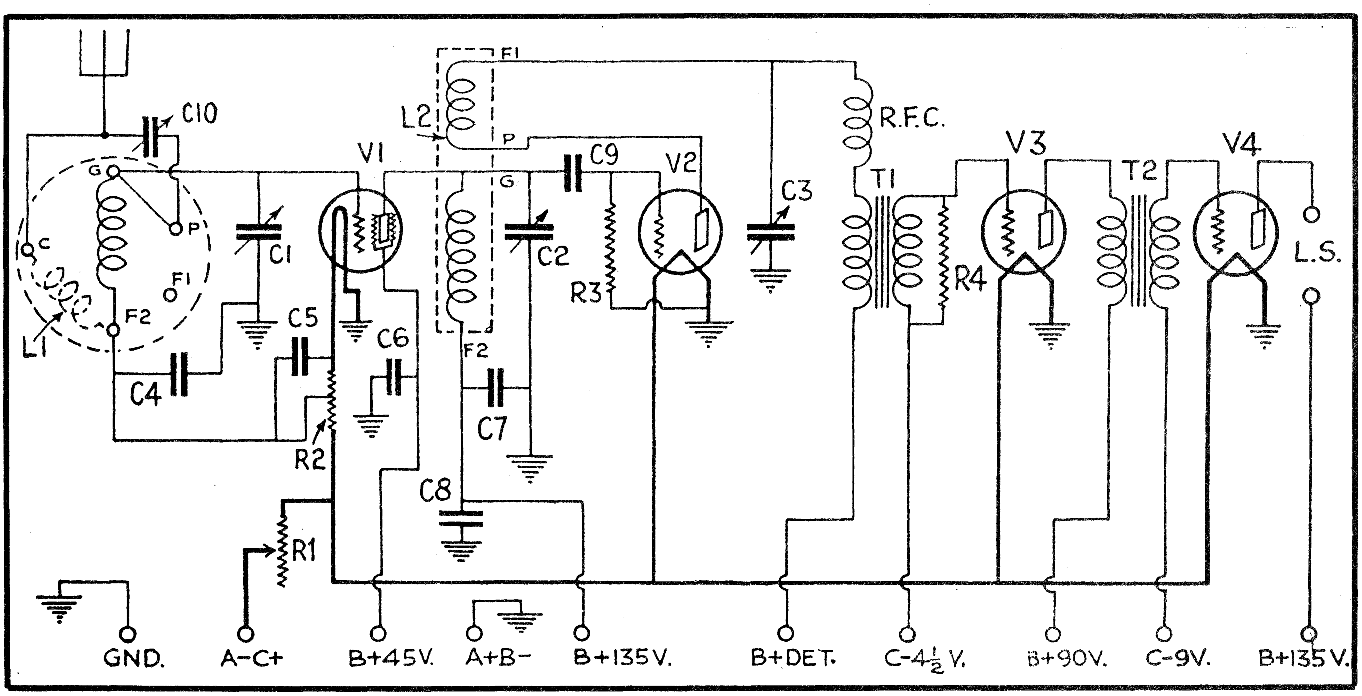
In 1928, General Electric, who understood the importance of shielding and solid mechanical construction, produced a successful shortwave receiver for RCA. Called the AR-1496, it used a UX-222 tuned RF amplifier followed by a regenerative detector and two transformer coupled audio stages. Intended for commercial work only, production of AR-1496 receivers was limited, and only three are known to exist today.

Enter Pilot

A major firm catering for the amateurs and home construction enthusiasts was the Pilot Radio & Tube Corporation of Brooklyn, New York. Pilot turned out a wide range of well made components, and sponsored a quarterly magazine called Radio Design, featuring projects for home construction. Needless to say, Pilot marketed kitsets for all these designs.

Towards the end of 1928, Pilot featured the 'Wasp', a conventional regenerative detector and two audio stage receiver using five plug-in coils to cover from 500 down to 17 metres. Using low loss coil formers, rigid construction and a metal panel, the Wasp proved to be a superior receiver of its kind and represented the best that could be achieved with the simple regenerative receiver.

Clearly, the way to further development of the amateur shortwave receiver lay with taming the RF amplifier. Pilot commissioned a team headed by Robert S. Kruse to come up with some answers. A consulting engineer in receiver design, Kruse was one of the leading shortwave receiver designers of the day. He had been Technical Editor for Sterling's authoritative *Radio Manual*, and had written extensively for the leading amateur magazine *QST*.



The Super Wasp's schematic. Fixed capacitors were all mica: C4, C5, C6, C7 and C8 were all 10nF, while C9 was 100pF. R1 was 6 ohms, R2 was 5+10 ohms, R3 was 3M and R4 was 100k.

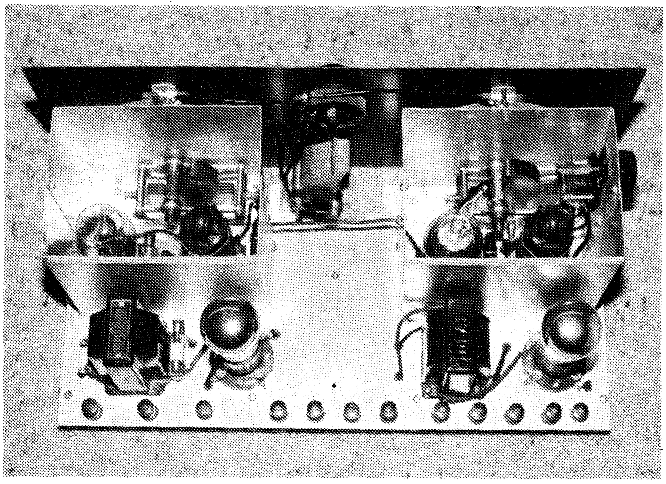


Fig.3: With the shield lids removed, the RF and detector stages are revealed. The second audio transformer is an AWA replacement.

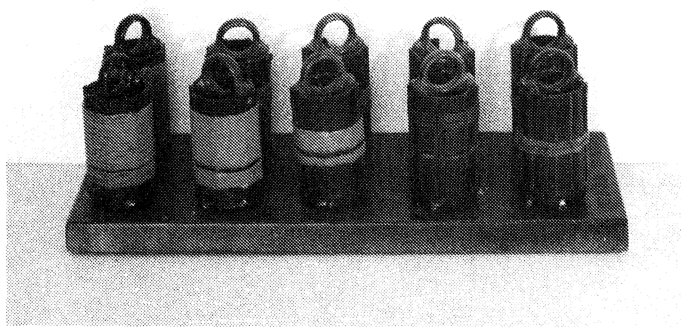


Fig.4: Bandswitching for shortwave receivers was still in the future. The Super Wasp's plug-in coils were inconvenient, but efficient.

Wasp with more sting

The results appeared early in 1929, as the 'Super Wasp'. Similar in concept to the AR-1496, the Super Wasp was a well-screened version of the earlier Wasp, with the addition of a tuned screen grid front end.

The 1928 edition of the *Radio Manual* includes a full description of the AR-1496 and as editor, Kruse would have been familiar with General Electric's work. This knowledge would have been of considerable assistance in the Super Wasp project, but whereas the commercial receiver would have been prohibitively costly for private ownership, the Pilot had to be inexpensive and suitable for home construction.

At each end of the Super Wasp's metal chassis, immediately behind the panel, were aluminium shielding boxes complete with lids. One housed the RF amplifier while the other contained the detector. Along with a valve, each had its own tuning capacitor and plug-in coil.

As tracking with ganged tuning capacitors had not been successful, each stage was independently tuned. Between the shields was the regeneration control capacitor, and at the rear of the chassis were the two audio amplifier stages.

A detailed study of the circuit is worthwhile. Aerial coupling to the RF tuned circuit was by means of a small variable capacitor, or in the case of the broadcast coil, to an automatically connected primary winding. Whereas the '01A triodes had 5.0 volt filaments, the UX-222 had a 3.3 volt filament. R2 provided the necessary voltage drop, which also became the '222 grid bias. With no primary winding for the detector tuned circuit, the tuned winding served as the anode load for the RF stage.

Also on the detector coil was the all important feedback winding, connected to the detector anode. RF energy from the detector anode was controlled by the variable capacitor regeneration control C3, at the other side of this winding.

The RF choke filtered the audio fed to the first audio transformer T1. Just at the most sensitive point of operation, transformer coupled regenerative detectors have a nasty habit of breaking into an audio howl. A 0.1 megohm (100k) resistor (R4) shunted across the secondary of the transformer suppressed this tendency. The remainder of the audio system was quite conventional and typical of the period.

An AC Super Wasp

A combination of wide publicity and good performance insured the success of the Super Wasp. Not only was its introduction timely, but it performed well. The Super Wasp's arrival had coincided with the release of the 224, the mains operated equivalent of the UX-222.

Immediately the 224 was released, the Pilot team set about modifying the Super Wasp for mains operation. Modulation hum and power supply filtering provided serious problems, but after the best part of a year's research the AC Super Wasp was produced – as what was claimed to be the first successful AC regenerative, shortwave headphone receiver.

With a 224 RF amplifier, and type 227 valves for the detector and audio stages, the AC Super Wasp was similar in concept to the battery set, but with additional filtering and RF bypassing.

Advances after 1930

Pilot soon had competition. By mid 1930, National with the assistance of the indefatigable Mr.Kruse, had produced the superbly made AC powered 'SW-5 Thrill Box'. Again, it was a regenerative TRF – but with a tetrode detector, ganged tuning, pushpull output stage and a metal cabinet. However, compared with AC Super Wasp's $34.50, the US price of the SW-5 was $114. This was the price of large broadcast console, and would have been a deterrent to most enthusiasts.

From 1931, with the release of superheterodyne manufacturing rights, rapid changes took place in receiver technology. Within two or three years there was a succession of such classic superheterodynes as Hammarlund's 'Comet' and 'Super Pro' and National's 'FB7' and legendary 'HRO'. These professional quality receivers were the ultimate, but for many were prohibitively expensive and right up to World War II many amateurs, particularly those outside the US, used receivers of the Super Wasp pattern.

The Pilot Super Wasp gave the home constructor an affordable instrument that was a considerable improvement on the existing receivers, and was the precursor of the communications receiver. As such it was a landmark development, and well worthy of a place in any collection of vintage receivers.