When 1 Think Back...

by Neville Williams

Reader comments on the past, and Superregen. receivers in a new light

Faced with an assortment of letters and phone calls prompted by past instalments of this column, it is fitting that I should interrupt the present series on vintage receiver design to acknowledge readers' comments and contributions to do with the history of electronics. Of special interest is information about a little-known major wartime role of superregenerative receivers.

One thing that stands out from readers' letters is that no one writer or source has a monopoly on historical information. Mention almost any subject, it seems, and someone comes up with spontaneous personal recollections — or a clipping or article that didn't make it into accessible reference files.

It is saddening to contemplate, with hindsight, how much other electronics history must already have been lost with the passing of industry pioneers, along with their dusty old books and papers discarded by relatives in the subsequent dispersal of personal effects.

Maybe we should all take a lesson from the 'Talking History' series on ABC Radio, and leave behind a tangible record of our one-time way of life.

One recently retired electronics engineer, who has already recorded tapes for the ABC archives, told me how he is writing long personal letters to his children and grandchildren about personal, family and technical matters, which he hopes will be retained and re-read long after he is gone.

A New Zealand radio amateur, Bob Cooper Jnr. of Mangonui, relates how, in researching the history of VHF/UHF wave propagation, he came up against a blank wall when he tried to find out about Australian pioneer amateur Ross Hull. He was able to obtain an outline of his service with the ARRL (American Radio Relay League) and the circumstances of his tragic electrocution in Connecticut in 1938, but the ARRL had no record of his prior activities in Australia.

Prompted, however, by mention of his name in 'Think Back' for January 1991, Bob inquired as to whether we could help. Yes, we could, because Ross Hull had been the first pioneer to be featured in the series, back in February 1989. It so happened because Ross had served briefly as Technical Editor of our forerunner *Wireless Weekly.*

In the absence of any known biography, we had been able to piece together a reasonably cohesive story based on published references to his activities, deduction from his articles and the fading recollections of some who remembered his formidable reputation as an experimenter, technician and writer.

In getting it together, however, we could not escape the conviction that a lot of other information about him must surely have been published, beyond what we had access to.

Brunswick 78rpm Records

I am researching the history of the American Brunswick Record Company in Australia. No local artists appeared on the label, as the Company used American master stampers to press the records.

I have a small collection {approx. 300) of Brunswick 78rpm records, from classical to comedy. I am interested in locating the site of the Sydney pressing plant, and a description of the type of equipment that would have been in use for record production around 1924,

I was wondering whether you could suggest any suitable magazine/papers from the period that would have profiled the Company in Australia. Any information would be greatly appreciated.

J.D. (Neutral Bay, NSW)

Relevant to Bob Cooper's quest, we had to be careful not to confuse the various wavebands, which were described in different ways during Ross Hull's lifetime.

Transmissions in the present broadcast band were originally classified as 'short wave', as distinct from those on 'long waves' — around 1000m or 300kHz. They were later redefined as 'medium waves' with 'short waves' then signifying HF (high frequency) channels up to around 10 metres or 30MHz.

As late as 1936 the *ARRL Handbook,* which Ross Hull edited, did not recognise the term 'VHF' (very high frequency), which now signifies that part of the spectrum between 30MHz and 300MHz. It arbitrarily classified all frequencies above 50MHz as 'UHF' (ultra high frequency), which today signifies the range 300- 3000MHz. (The now internationally recognised frequency terminology dates back officially to the ITU conference in 1959).

Historic broadcast

Another amateur operator, Alan Elliott (VK3AL) of South Melbourne writes to say that, in researching the history of the Melbourne Club, he came across a reference in the minutes to a demonstration of wireless telephony presented to the Club on August 16, 1923.

Arranged by a Mr Cutler, the broadcast included musical items and a talk on the advantages of joining a progressive camera club.

Would it have been a genuine broadcast, he wanted to know? If so, would it have been a commercial station — 3AW for example? If not, when did that station commence broadcasting? Who was the Mr Cutler referred to in the minutes?

In an effort to help, we contacted S.M. (Syd) Newman, a long retired AWA Melbourne identity featured in our January 1991 issue. Syd had no recollection of the broadcast, having been on assignment in Britain during 1923.

He confirmed, however, that AWA had a small transmitter in Melbourne which could have been used for a demonstration broadcast The broadcast could alternatively have originated from the coastal radio station VIM, under the callsign 3ME.

Syd remembered Cliff Cutler as a general engineer attached to the Australian navy when it operated the coastal radio service. When AWA took over the service, Cliff Cutler transferred to the AWA Melbourne staff.

3AW could not have existed in 1923, he said, but came into being much later (the actual year was 1931).

There the trail ended, but Allan Elliott had learned enough to reason that the broadcast in question would probably have been the first in Melbourne, and perhaps in Australia, to promote a camera club — of which he is a member.

Unfortunately, there as no point in encouraging him to inquire further from AWA. I gather that, in the current scramble for productivity and minimal overheads, one-time institutional indulgences like a captive historian have disappeared, along with a generation of AWA-bred executives with memories stretching back to that era.

Announcer's licence?

3AW features in another letter, this time from an officer of the Salvation Army in Fremantle, WA. He says that the Administrator of an Army WA senior citizens centre, Mr Jim McBride, was due to retire and they were keen to gain access to memorabilia of his earlier life, for the farewell function.

It seems that Jim McBride was involved in outside broadcasts for 3AW, about 35 years ago, in the time of Sir Eric Pearce. I could only explain that, unless involved in networking, program personalities were unlikely to be known or featured in the media outside their own city. The information he was seeking would have to be obtained direct from 3AW or Melbourne-based publications.

3AW could only apologise for their inability to assist, on the grounds that their archives had been lost. As for 35-year-old newspaper and magazine files, a systematic search is difficult enough if one is on the spot, with ample spare time. For a visitor from thousands of kilometres away, it could be a near-hopeless task. Alt the best for your retirement anyway, Jim!

Good wishes aside, there was one reference in the letter that caught my attention. I quote:

From information gleaned from Jim, it appears that he was involved with outside broadcasts when announcers were required to hold specific rating certificates authorising cad Jibbing' or preprepared announcing.

What gives? I've lived through the era of radio broadcasting, I've read about it and written about it, but I've never heard mention of radio announcers having to hold any kind of licence. Nor have any of my friends to whom I've mentioned the matter.

We've all simply assumed that people got to be announcers if their employer considered that they had an acceptable voice and presentation, an appropriate background and so on, and were in the right place at the right time when an appointment had to be made.

Was Jim McBride referring to an inhouse certicate used by 3AW — and possibly by other stations — to facilitate program planning and rosters? Or was it an accreditation required by the authority administering radio broadcasting at the time?

If the latter, then it's a spot of history that I (and others) seem to have missed out on. Some reader should be able to set the record straight.

Brunswick records

Speaking of records, I wonder whether the name 'Brunswick' stirs any memories. For me, it served as a reminder of a stack of surplus 78rpm discs which I gave away years ago, when I had to make room for the new LPs. Who, having once heard the sound quality from a microgroove record, could possibly want to listen to the old coarse-groove shellacs?

The answer people who treasured the musical heritage they contained, and who have since provided the raw material from which engineer/musician Robert Parker has reconstituted his amazing new recordings. Using state-of-the-art techniques, he has been able to discard the clicks and plops which marred the old pressings and to restore something akin to the original balance and dynamic range.

And again, there are people like Jim Dangarfield, whose letter is summarised in the accompanying panel. Music lover or not, Jim is obviously a vintage enthusiast who treasures his unique collection of Brunswick 78's, and who wants to know more about their sourcing in Australia.

In other days, I would have been able to pick up the phone and raise the matter with EMI's chief recording engineer R.V. (Reg) Southey, or with two or three other pioneers, still working hi the industry; men who had refined their skills in the 78 era. But that generation has long since disappeared from the everyday scene, to be replaced by younger engineers who know the 78 era only by repute. Indeed, the analog record industry itself is being ushered out by competition from tape and the digital compact disc.

According to EMI's one-time company publication *The Voice* (August 1954), Reg Southey had been responsible for setting up Australia's rust recording studio in Sydney's Homebush, in 1926 — coincident with the adoption of electrical recording. As to prior activities in the way of disc processing, it is silent.

I've read about old-time disc processing, and discussed it verbally and in print, but failed completely to find the kind of reference material that Jim Dangarfield is looking for. It is most likely to be found, I would think, in science/technical books and magazines from the early 1920's, and/or in early copies of the English *Gramophone* magazine, which began publication in 1926.

The book *From Tin Foil to Stereo* by Read and Welsh (Howard W. Sams Inc., New York, 1976) includes brief mention of the Brunswick Company, with particular reference to the era when the American record industry was dominated by local 'pop' music and heavily dependent on trans-Atlantic imports for more substantive material.

On that basis, a fair proportion of the more collectable Australian Brunswicks may well have originated in British recording centres.

The authors of the book have assembled a quite fascinating history of the phonograph, mainly from the American viewpoint, but the technology of processing discs is not covered.

Hopefully, someone reading this column will know whether Brunswick had their own disc production facility in Australia, or whether they were contracted out to another company. And/or you may know of an accessible article which describes the pressing process, as it was in the 1920's. If so, please contact me through the Editor, and we will pass the information on.

In the meantime, Jim Dangarfield may care to get in touch with the Powerhouse Museum in Sydney, and the National Film & Sound Archive in Canberra. They may well be able to help.

WHEN I THINK BACK

Kiwi picture show

Before taking up the major theme of this instalment, I must acknowledge three other letters.

E.G. (Ted) Baker from Bathurst, NSW says he was intrigued by the story in the Feb/March 1991 issues, of a country picture show. It came as an uncanny reminder of one he remembered as a boy in Otautau, New Zealand.

It too was set up in a community hall, and in the days when they had only one projector, there was similar uproar when the show was interrupted to change reels. Ted Baker won the coveted job of assisting the operator for one shilling per week, which meant that he saw the pictures for nothing!

Like the show in my story, it was ultimately equipped with two converted silent projectors and an 8-watt amplifier, using push-pull 2A5's. For the arc supply, they used a DC generator which was belt driven from a temperamental model-T Ford engine.

Ted's first task each Saturday evening was to start the engine — with his thumb in front of the handle as a precaution against a back-fire. Even then, he had to snatch his arm away, lest the crank do a full reverse spin and smash into the back of his hand.

Up in the box, his job was to adjust the arcs and the sound level, hopefully without getting so absorbed in the picture that he forgot what he was supposed to be doing! Thanks for your letter, Ted.

Spark transmitters

From Pascoe Vale South in Victoria, Rod Torrington (VK3TJ) takes up a different theme — that of spark transmitters. As recently as April 1939, he says, he was radio operator on the *Tanda*, plying between Melbourne/Sydney and Hong Kong/Shanghai/Japan. The main transmitter was a 1.5kW Marconi-C spark type, with a smaller 250W spark unit as a standby.

Operating from a rotary converter powered by the ship's DC supply, the main transmitter drew about 20 amps of primary current. During a long message, he says, the bug-key would become almost too hot to touch.

The main transmitter was housed in what looked like a butcher's cool room, with 6" thick walls and double doors — intended to suppress the noise of the spark, estimated to be at least 110dB. Changing frequency from 'call' (500kHz/600m) to 'traffic' (705m) involved leaping out of the chair, opening the doors into the 'cool room' to change the inductor tapping, closing the doors and getting back to the operating position.

One of the lurks, when passengers begged to see the radio gear, was to invite them to watch the transmitter in action with the doors open!

After the *Tanda,* Rod worked for a while on the *Bidelia* (John Burke line, ex-Sydney), which was equipped with an AWA spark transmitter and a Bellini Tosa direction finding receiver. Rod's contact with spark gear ended about then, when he joined the Marine and Aviation departments of AWA (Ashfield, NSW) and later DCA. As such, he regards himself as an AWA old-timer.

Thanks for your letter, Rod, and I'm glad that we were able to stir a few memories — even though it involved a technology with which I, personally, had no contact.

Don Sutherland, ZL2AJL, to whom I am indebted for the further information on superregenerative receivers. Don says that he has assembled a considerable dossier on the subject.

Blunder explained...

An apparent error in one of my earlier articles (May 1990, p.37) concerned a reference to Lee de Forest as 'by then Professor of Physics at Cambridge University'. This was challenged by New Zealand author John W. Stokes, who maintained that my source, the *Australasian Wireless Review* of October 1923 "must have got its wires crossed". I admitted some puzzlement at the time, but assumed that, as a well known American pioneer/academic, de Forest may have been at Cambridge in a visiting role.

More recently, I was thumbing through the old *AWR's* for an entirely different mason, when I came across the preceding September 1923 issue — featuring a cover picture of Sir Joseph J. Thompson. Underneath, in small type, was the caption 'Professor of Physics, Cambridge University, England. The discoverer of the electron'.

Suddenly intrigued, I flipped over to the cover of the October issue. And what had happened was plain for all to see...

In preparing the October issue, the layout artist had obviously taken the basic cover artwork, stripped off the portrait of J.J. Thompson and replaced it with that of Lee de Forest.

He/she had also substituted the new heading and dateline, but had overlooked the small-type caption. So it was that Lee de Forest went to print as 'Professor of Physics, Cambridge University...' etc. Sorry about that, but such things can happen all too easily.

I remember that the March 1979 issue of this magazine, for example, was all printed, bound and ready for despatch when someone noticed that its front cover carried the date 'March 1978'. A hastily-assembled team spent a whole weekend in the printery, obliterating the 1978 figure on something like 50,000 separate copies with a coin-sized adhesive label marked 1979! You may well have the issue amongst your own back-numbers...

Superregen detectors

In the second part of an article on Edwin Armstrong, in the August 1990 issue, I mentioned his invention of the superregenerative detector (1922) and the longstanding uncertainty as to how it really worked. It caused me to speculate privately how well Armstrong himself understood the circuit, and whether he had devised it by analytical or empirical means.

Fortunately, having gained access to an American IRE paper by Hikosaburo Ataka (August 1935) by courtesy of Alan M. Fowler of Balwyn, Victoria, I was able to extract what may arguably have been the first explicit word picture of its operation to appear in a popular level electronics magazine. (*EA*, May 1991).

Re-stated very briefly, a superregen detector produces pulses or 'packets' of oscillation at the intended signal frequency, the pulse repetition rate being determined by a separate, cyclic and (normally) supersonic 'quench' signal.

Importantly, the oscillatory pulses do not commence spontaneously at precise intervals, nor are they uniform in terms of duration and energy content; neither are the resultant excursions of the detector's average anode current.

Individual pulses, rather, are triggered by 'noise' or extraneous signal components, which happen to be present around the time that the detector is being enabled or cycled into oscillatory mode by the quench voltage.

In consequence, the duration of the pulses of RF oscillation and of mean anode current are a resultant of what are effectively 'samples' of the noise/signal input.

When the circuit is optimally adjusted, the variations in mean anode current are very large compared with the miniscule 'trigger' samples; hence the extremely high detector gain.

In the absence of any external signal, the detector is triggered by its own 'shot' noise, creating the loud rushing sound that characterises a superregen detector under no-signal conditions. With a coherent signal present, triggering becomes more a function of the audio modulation and the noise component is progressively overridden.

Dossier on Armstrong

Subsequent to the publication of the May 1991 article, I was contacted by a New Zealand amateur operator D.C. (Don) Sutherland (ZL2AJL), who indicated that he had assembled quite a dossier on Armstrong and his superregenerative receiver.

It includes Ataka's paper but, as well, Armstrong's original presentation to the American IRE in June, 1922; another by F.R.W. Stratford, in 1945; and a 169-page book in the *Modern Radio Technique* series edited by J.A. Ratcliffe. Said to be the only known book on the subject, it is titled *Super-Regenerative Receivers* by J.R. Whitehead (Cambridge University Press, 1950).

Don Sutherland, by the way, was born in 1925 and was first enthused about wireless at age 11, when he read an article on the subject in Pears' Cyclopaedia. His interest was heightened about the same time when a family friend presented him with a miscellany of books, bits and pieces and a Philips A409 valve — which, he says, resulted in something of a 'soft spot' for the marque. Then followed a couple of RCA tube manuals, which created an awareness of valve curves and characteristics.

Mer secondary school, he got a job in a radio service shop in New Plymouth, where he got to work on a wide range of imported and NZ-produced radio receivers until returning to the family farm in 1945. But his heart was in radio, and he qualified for his amateur 'ticket' in 1945.

Obviously a lateral thinker, Don says he used to mentally digest technical papers and dream up circuit ideas while feeding the pigs. When faced with solid-state theory, he was bugged by the tendency of writers to contrast valves and transistors.

He reasoned that it should be possible to define areas of behaviour where they overlap. This I have passed on to Jim Rowe for possible use in 'Forum', but in the meantime, I am grateful to Don for his very considerable assistance in the matter of superregen detectors.

Original 1922 paper

Turning to Armstrong's original paper, it becomes immediately evident that he understood very well what he was grappling with. Significantly, perhaps, he acknowledged the assistance of Professor L.A. Hazeltine on the theoretical side, as well as practical assistance from a Mr W.T. Russell.

At the outset, the paper discusses the positive and negative tuned circuit resistance concept in regenerative systems, and explains the effect of changing the ratio between the two. Armstrong points out that excess negative resistance promotes free oscillation, which 'paralyses' the ability of the circuit to sense external signals.

In reading this preamble, it became evident where the explanation came from that I paraphrased on page 33 of the August 1990 issue. But while arguably correct, it leaves the reader no wiser!

Armstrong's paper reveals, however, that Turner in Britain had earlier patented the idea of modifying the natural behaviour of a regenerative system by the application of critical negative bias to the grid, and using a mechanical relay to periodically shunt and disable the feedback coil.

Another British inventor, Bolitho, had replaced Turner's relay with a valve paralleling the oscillator, but imposing degenerative feedback and operated from an AC supply. As such, it periodically suppressed the original oscillations.

Armstrong managed to translate these rudimentary ideas into more practical circuitry which he was duly able to patent. In the process, however, according to Don Sutherland, Armstrong took the precaution of buying the rights to both of the earlier British patents. When he ultimately offered the system to RCA, there was no way they could capitalise on such prior publication.

As reported in the August 1990 issue, he was able to negotiate for $200,000 in cash and 60,000 RCA shares — money which was to be dissipated by the ongoing litigation which seemed to be the story of Armstrong's life.

Armstrong's research

Having outlined these prior suggestions, Armstrong's paper explores various methods of manipulating the negative and positive resistance of regenerative configurations by superimposing voltages from separate valves, fed with a recurrent signal.

It makes somewhat tedious reading, requiring frequent reference to diagrams. In the process, I could not escape the feeling that Armstrong was rather too close to his subject and in a mindset more appropriate to compiling a patents document. He tends to separate the functions of the regenerative stage, the quench oscillator — a term that I did not find in the paper — and detection, or the means by which the message is recovered; this last because he had to consider both telephony and telegraphy, in the latter case involving both modulated and unmodulated spark/arc transmissions.

This leads into extensions of the superregenerative approach, by the possible use of signal frequency doubling or superhet frequency changing, to help stabilise cascaded superregenerative stages.

Back to the original theme, however, Armstrong claims that signals which might typically produce only the faintest heterodyne in a conventional regenerative receiver have been shown to produce clearly understandable speech on an uncomplicated superregenerative receiver.

The formal summary of the paper reads (in part):

A *system of circuits is described whereby the effective resistance of a regenerative circuit is periodically made positive and negative, though predominantly positive. Such a circuit will respond to an impressed electromotive force by setting up free oscillations during the negative resistance period, which oscillations are proportional to the exciting emf...*

There, in Armstrong's own words, lies the key to unlocking the seeming mystery of the superregen receiver, which I was at such pains to extract from elsewhere for the May 1991 issue. But overshadowed by the preceding 16 pages of circuitous discussion, it is no wonder that it was not picked up by popular level technical writers of the era, or communicated to the then generation of enthusiasts.

Having thus said, it is reasonable to suggest that Ataka's paper (IRE USA August 1935) was a response to the challenge to rationalise and quantify basic superregenerative receivers, taking advantage of the intervening decade of technical sophistication and instrumentation. According to Don Sutherland, the only oscillograph available to Armstrong in 1922 had been a Duddell electromechanical string model. Ataka's paper was discussed in this column in the May 1991 issue.

Mathematical analysis

A further paper brought to my notice by Don Sutherland was one by F.R.W. Strafford of A.C. Cossor Ltd and Belling & Lee Ltd *(Journal Instn. Elec. Engrs.* 93, March-May 1946).

According to the formal introduction, the paper seeks to clarify the performance criteria of superregenerative circuits 'in practical operation', ostensibly rendered uncertain because (I quote) 'a great deal of the mathematical analysis is clothed in obscurity from the engineering viewpoint because of the inclusion of second-order effects'.

Not surprisingly, the paper itself relies heavily on mathematical analysis. But helpfully, the conclusions are spelt out for non-mathematically trained readers.

Strafford shows that, in the circuitry under consideration, the onset of squelch should be gradual rather than abrupt, the logical choice being a supersonic sinewave no higher in frequency than strictly necessary. With appropriate ratios of signal frequency to modulation bandwidth and to squelch frequency, the amplification 'can be many millions'.

He shows mathematically that the demodulated output from a superregenerative detector is substantially independent of signal carrier amplitude, ensuring a high degree of self-AGC.

On the other hand the linearity of a superregen detector is shown to be 'apalling', rendering it unsuitable for use with normal amplitude modulated program signals. For reasonable quality, program modulation would have to be limited to 60%, with reasonable speech intelligibility being preserved up to about 80%.

On the vexed question of selectivity, Strafford indicates that it is optimised when the circuit resistance becomes negative at a relatively slow rate — even as low as 8kHz. Selectivity can be at least equal to or better than that of the same basic regenerative detector, adjusted manually to the fringe of oscillation. Given an appropriate degree of selectivity, a superregenerative detector can also resolve frequency modulated signals by deliberate detuning to achieve slope detection.

Again, a superregen detector has the potential to reduce pulse-type noise interference, but much depends on the duration of the pulses and whether they happen to synchronise with the quench intervals.

So to the textbook

If at this point you feel that you're reasonably comfortable about the superregen concept, I'm sorry to have to disturb your equanimity — because that was the effect of working through J.R. Whitehead's book on the subject.

While I lacked the time or the committment to study it in exhaustive detail, it nevertheless became readily obvious that, published in 1950, it reflects a level of wartime research and development, with designs that were not available to the earlier writers.

In fact, in chapter eight of his book, Whitehead suggests that early writers like Ataka (1935) Scroggie (1936) and Frink (1938) were concerned mainly with explaining the phenomenon of superregenerative receivers as they knew them.

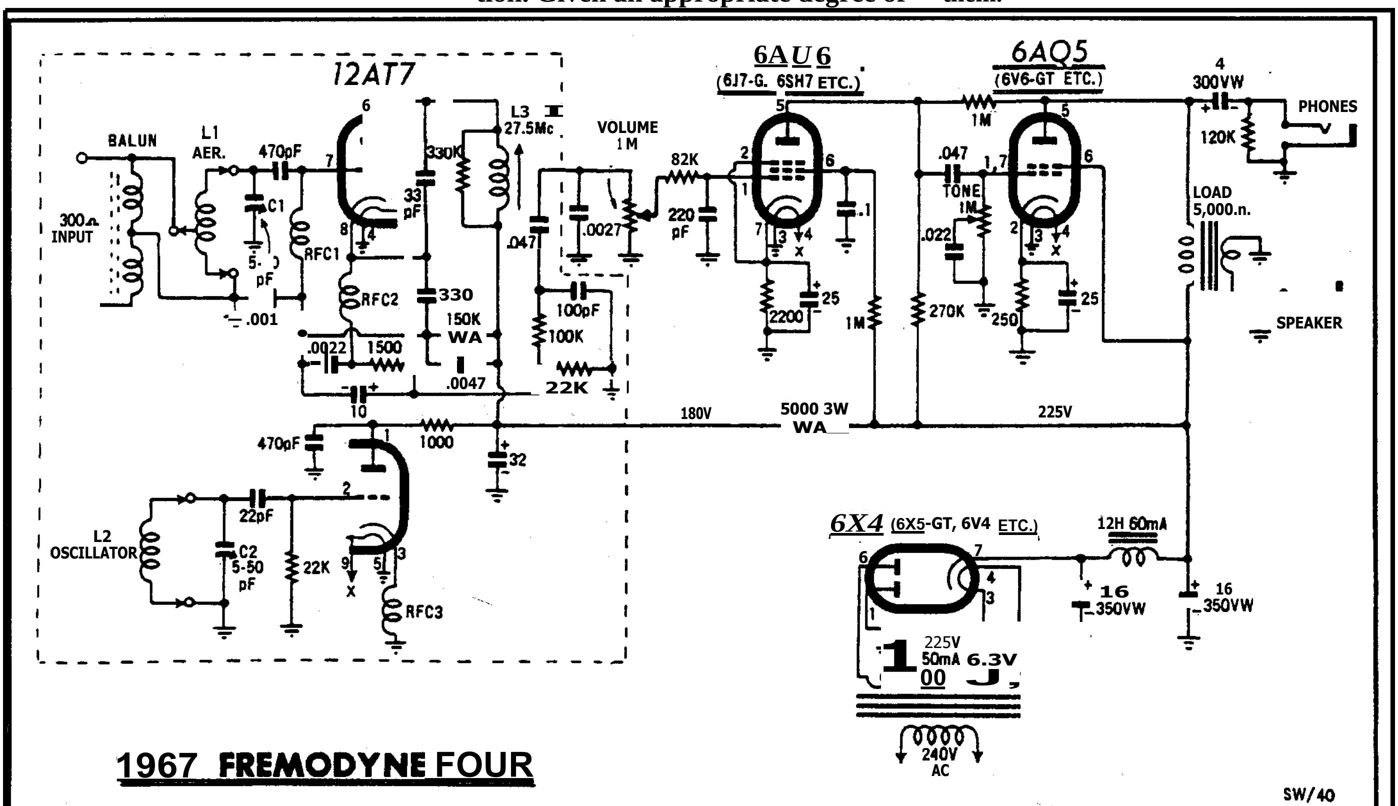


***Fig.1:** A 'Fremodyne' superregenerative superhet. One half of the 12AT7 operates as a self-quenched superregen detector/mixer, at a signal input frequency determined by L1C1. The other half of the same valve operates as a superhet local oscillator, tuned by L2C2 to produce resultant modulated energy pulses in the output of the detector/mixer at an intermediate frequency of 27.5MHz. Picked up by an R/C network and the modulation content passed on to the audio amplifier section.*

It was during this period (1935-38) that the superregen principle was finding favour with amateur operators as the basis of inexpensive VHF/UHF receivers. In fact, during 1933-6, the US Army Signal Corps also adopted a 'walkie-talkie' using a superregen receiver, which saw limited service durind the war.

But far and away the most notable wartime use of the concept was as a receiver for the top secret 'IFF' (Identification, Friend or Foe) responders devised for military aircraft and ships. On being exposed to an incoming radar beam, the equipment would respond with a distinctive pulse which could be recognised as that of a 'friend' by a potential attacker.

The refined Mark III IFF was fitted with AGS (automatic gain stabilisation) which held its absolute gain over a 30MHz scanning bandwidth (157-187MHz) to within +/-5dB and eliminated the need for manual adjustment.

According to Whitehead, something like 200,000 such units were produced in the UK and USA and fitted to virtually every allied ship and plane. Similar responders were fitted to early radar beacons, including the Eureka paratroop beacon. Across the channel, the Germans also exploited updated superregen circuits, although to a lesser degree. The Lichtenstein air interception receiver is quoted as an example.

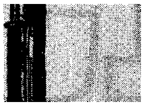
Such widespread use of the system provided an incentive to pursue aspects and possible applications that had remained hitherto largely unexplored, and put to rest the longstanding impression that superregen receivers were intrinsically unpredictable and unstable.

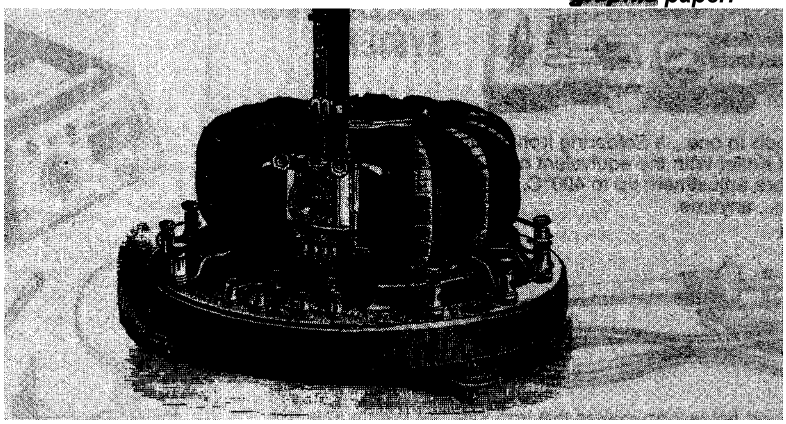
It showed that, given appropriate design and quality control, they had earned the right to be considered for specific applications, against other circuit configurations, particularly in the VHF/UHF region.

Other matters mentioned in this final chapter include superregen two-way receiver/transmitters and the use of superregenerative superhet circuits for FM or other VHF reception, including the Hazeltine 'Fremodyne'. (Fig.1 shows the circuit of a Fremodydne receiver described for home construction in the March 1967 issue of *EA*.)

In considering these more recent applications, Whitehead emphasises that there are two fundamentally different modes of superregenerative behaviour, which he describes as 'logarithmic' and `linear' — an important distinction that may have escaped early researchers and,

When Armstrong first developed the idea of the Superregenerative receiver in 1922, the only oscillograph available was the Duddell string type shown here. It was essentially a D'Arsonval string galvanometer with a small mirror attached to the strings; a light beam reflected by the would allow plotting of a current waveform on photographic paper.





consequently, those who have relied on pm-war literature.

In the logarithmic mode, the free oscillation enabled by the quench voltage and triggered by noise/signal components is allowed to achieve a maximum amplitude determined by the circuit constants, before being quenched.

As illustrated in *EA* May 1991 on page 40, the packets of free oscillation all achieve the same maximum amplitude but vary in duration, depending on the exact timing of the triggering signal. Whitehead says that most pre-war literature and designs tacitly assume this mode.

Certainly, the May 1991 diagram comes from the Ataka paper, and is repeated in modified form by Strafford. According to Whitehead, the description `logarithmic' refers to the distinctly non-linear relationship between signal modulation depth and detector output in the above situation, and is the basic reason for high distortion with heavily modulated transmissions. It also accounts for the self-AGC effect referred to earlier in the article.

The alternative mode, which was not pursued in the early stages, involves manipulating the applied voltages and quench amplitude, frequency and waveform to ensure that the build-up of free oscillation is interrupted or damped before the amplitude achieves the self-limiting level.

As a result, the burst amplitude reflects that of the relevant triggering sample. This being the case, the relationship between modulation depth and detector output becomes substantially linear, and the circuit can cope with high levels of modulation.

The linear mode called for a more deliberate design approach, and commonly, the provision of AGS (automatic gain stabilisation) to ensure that signal levels stayed within the required tolerances. By that time, Whitehead says, you have a receiver with about as many valves as you'd have been prepared to put into a superhet!

Thinking back, I seem to remember stacks of war surplus IFF responders that seemed useful for nothing except the parts. I don't recall anyone ever saying that they included a superregen receiver, even though they were serviced and possibly manufactured in Australia.

Maybe it doesn't matter any longer, but at least I know now that there was/is a lot more to a superregen receiver than a couple of valves and an off-putting hiss.

But at this point prudence, in the form of a bespectacled Editor, reminds me that I must sign off! ■