

Audio perspective

Peter Walker OBE, founder of the Acoustical Manufacturing Company (Quad) celebrated his 80th birthday last month. He talked to **Ivor Humphreys** about his life and work



Peter Walker, left, with the harmonica player Larry Adler at one of the London Audio Fairs in the late 1940s

Ask anyone connected in some way with the audio industry, whether as a professional or simply a knowledgeable amateur, for a list of its ten most influential figures and it could be guaranteed that the name Peter Walker will be prominent on it. Founder of the Acoustical Manufacturing Company, or simply Quad as it became known after the success of its early amplifiers, designer of innovative, eminently practical circuits, above all the man who

ened at a very tender age, as a result of hearing the early broadcasts from the BBC. Indeed by the time he was ten years old he was building radio sets from blueprints and off-the-shelf components. "Two-valve or three-valve circuits, yes. There was a wooden base plate and an Ebonite front panel. You assembled this lot and hoped that it worked." He went to school at Oundle in Northamptonshire where music, and jazz in particular, became a dominant extra-curricular interest. He learnt the saxophone (and later the flute, which he continued to play in a local county orchestra until quite recently) and with some friends formed a group, playing at dances and various social gatherings. Upon leaving school he went to work initially in his father's wholesale ironmongery business but at 17 joined EMI in Hayes where he was employed to inspect soldered joints in radio circuits, working at the end of a conveyor belt

which turned out some 600 sets per day. Boredom with this, and an incident in which he managed to stop the production line for half an hour ("I was an absolute rebel, quite unemployable") led to his moving back to ironmongery and then on again to GEC where he was occupied in the radio repairs department, at the same time continuing his studies at the Polytechnic, Regent Street, London. After 18 months at GEC he took a job with Trix Electrical

same year. The first product was a small 7 watts amplifier which would work off AC or DC mains (there was quite a lot of 100V DC mains in London at the time) but all the while he was working on ideas for more powerful high-quality circuits. A breakthrough of sorts came in 1938 with the launch of the C25, a 30 watts design which ran either off a 12 volt battery ("Address 15,000 people from your car battery", the advert ran) or the mains. A favourable review in the August 1940 edition of *Wireless World* meant that he began selling one, sometimes two a week, enough to keep him, his wife Peggy, who had now joined the business, and one other worker who did most of the assembly. [As we were preparing this article for press we had the sad news that Peggy Walker has died.]

A series of lectures on electro-acoustics by the mathematician Dr N. W. McLachlan, the man who had introduced the moving-coil loudspeaker to the UK from the USA – the original Rice-Kellogg loudspeaker – fascinated Walker, who began to experiment with transducers himself, further inspired by meeting the horn loudspeaker pioneer Paul Voigt at his works in Sydenham. "I asked Voigt a question about volume controls – why it was that people had to 'correct' for the volume control – and he took pencil and paper and explained it to me: about the impedance being higher at the halfway point than when it was at the top or the bottom, which is why you lost a bit of treble. He took a lot of trouble over that and I take my hat off to him for doing it. Very good man. He was an inspiration from the high fidelity point of view".

During the war, Acoustical was contracted to make tuning coils and IF coils for government-issue wireless sets and to make amplifiers for use in aircraft intercom systems – two-valve, battery-driven units of which they made some 1,500 in all. Various other projects were undertaken for the Ministry of Supply and then in 1940 Acoustical was bombed out of its Lever Street premises, taking temporary accommodation in Wardour Street. A project for the police in Huntingdon led Walker to make an offer on premises owned by a local radio dealer in the town, so in 1941 the company moved again, continuing there with work for the Ministry and with 'essential' PA products. With the resumption of 'non-essential' work in 1945 new amplifier designs were brought out, including the QA12/P (Quality



The Corner Ribbon Loudspeaker of 1949 – an outstanding performer in its day

Amplifier, 12 watts, with Preamplifier) which, though intended primarily for studio and laboratory use, began to make an impact on the domestic market. The PA market expanded too and Walker wrote a celebrated guidebook called *Addressing the Public* to assist radio dealers who took up the work.

Peter Walker's work on loudspeakers first saw the commercial light of day with the launch of the Corner Ribbon in 1949, a two-unit design using a Goodmans 12in twin-cone bass driver and a horn-loaded ribbon high frequency unit made by Acoustical themselves. It also made the first use of what later became known as coupled-cavity bass loading. "It was a very good loudspeaker of its time, with a very good top-end response, but was a little lacking in the midrange between 1-2.5kHz, where the ribbon didn't go down quite far enough to integrate well with the bass driver".



The Quad II (Quality Unit Amplifier, Domestic) control unit and power amplifier

made the electrostatic loudspeaker a commercial reality, 'PJ' is universally admired as a no-nonsense, clear-sighted thinker about all aspects of sound reproduction. He is also a very kindly man, able to explain difficult technical concepts in matter-of-fact, layman's terms without a hint of condescension. Spend an hour or so with him and the complex world of sound reproduction seems altogether more straightforward.

Peter James Walker was born in London in 1916. His interest in sound reproduction was awak-

as the manager of the hire department, installing public address equipment, a job which opened his eyes to the possibility of starting his own business. "The amplifier they made cost about £30. There was about £8 worth of parts in it so I thought all I had to do was buy the parts, screw the thing together, sell it for £20 and make a lot of money. It wasn't quite as easy as that, of course!"

Walker formed his own company in London on March 26th, 1936, renaming it The Acoustical Manufacturing Company later the



Peter Walker in the 1950s, the era of the original Electrostatic loudspeaker

QUAD

The name QUAD was coined for the first Acoustical amplifier designed specifically for the home – the Quality Unit Amplifier, Domestic – which was launched in 1951 and went on to sell over 100,000 units. At a time when monophonic long-playing records and lightweight pickup cartridges were to the fore, the matching Quad II control unit, launched in 1953, was unique in having four push-buttons which selected a variety of equalization curves, to match the differing recording characteristics which were employed by the record labels before the AES, later RIAA, standard was agreed. This wide divergence also led to the development of Quad's elaborate variable high frequency filter system, whereby the corner frequency and the rate of attenuation, the "Slope", could be set to taste, with a Cancel button for quick and easy reference to the unadulterated signal path. It was as a result of the huge success of these units that Acoustical finally abandoned work on public address systems, turning its focus now on the domestic and studio equipment which was to make Quad a byword for quality and reliability throughout the world.

It is not widely known but at around this time Walker also spent some time designing and working on an excellent two-manual electronic church organ in conjunction with the Alfred E. Davies Organ Company of Northampton. This was later put into production and around 50 were made. [Observant readers may have noticed one of these offered for sale in our Classified Advertisements section on page 140 of the August issue.]

In the mid to late 1950s Walker collaborated with Gilbert Briggs of Wharfedale in a series of live versus recorded concerts using Quad amplifiers and Wharfedale loudspeakers. These occasions at a packed Royal Festival Hall in London, St George's Hall in Bradford, Philharmonic Hall in Liverpool, Tempus Anderson Hall in York and at the Carnegie Hall in New York did much to demon-

strate the possibilities, and thus champion the cause, of high fidelity.

Walker's 'Little Wonder'

For some years Walker had been thinking about electrostatic loudspeakers and by 1955 he had examples up and running in the laboratory. The principle itself wasn't new at all; indeed the first documented demonstration – of an electrostatic telephone system



The world's first full-range electrostatic

– was more than 70 years earlier at the 1881 Paris Electrical Exhibition. In the 1920s and '30s a number of electrostatic microphones and loudspeakers were made, notably in Germany, and in the UK before the war a midrange/high frequency unit called the Primustatic was actually marketed. In 1955 Harold Leak demonstrated a tweeter and there were several other high frequency ES units around in the USA. Goodmans also exhibited a full-range electrostatic unit at the 1956 Audio Fair.

The transition from laboratory prototype to viable production model is quite another matter, however. The essential 'rightness' of the electrostatic transducer and its basic mechanical simplicity were powerful incentives to the development of a practical full-range device but there were tantalizingly difficult problems to be overcome, not least in finding a suitable plastics material for the membrane and in resolving well documented problems with distortion. Professor F. V. Hunt in his 1954 book *Electroacoustics* (Harvard University Press and John Wiley & Sons, 1954) provided a rigorous mathematical model which answered the distortion problem, showing that if the so-called push-pull configuration was adopted, very low distortion could be achieved even with large signals provided the diaphragm (or membrane) was given a constant charge instead of the more usually applied constant potential (voltage). Again, though, theory is one thing; practice something else.

"The electrostatic diaphragm is the natural way of matching the air, because air is very light: 1,000th part of one gram per cubic centimetre. With the very light diaphragm of an electrostatic loudspeaker you're effectively putting the electrical forces directly on to the air, whereas with a moving-coil loudspeaker you have to move the speech coil, which then moves a cone, which is perhaps 300 times heavier than the air that it's moving. And that breaks up of course, which is why you have to have separate low and high frequency drive units.

"Previous electrostatic speakers weren't very satisfactory because the materials weren't available: Kellogg, for example, took out patents on an electrostatic unit but he hadn't got the materials he needed. There were no thin plastics of the right kind and there were no good insulators available to cope with the very high polarizing voltage; porcelain was too cumbersome. I'm quite sure Kellogg would have produced a good ES loudspeaker if he'd had the materials. You need a very thin diaphragm – about 3 microns we use – which weighs virtually nothing compared with the weight of the air. It's difficult to do because it's in a stretched state and stretched things tend to creep and go slack. We eventually found out how to do that. The other problem is how to make the diaphragm slightly conductive so that you can have a constant charge across it which doesn't migrate... The distortion with this arrangement is very low, yes, much lower than any moving-coil speaker, even now."

Walker demonstrated two electrostatic designs at the British Sound Recording Association

Wharfedale Wireless Works Ltd.
BRADFORD ROAD
IDLE - BRADFORD
YOXCUMBE
TELEPHONE 1045 (22-42 LINES)
TELEGRAMS: WHARFIDEL IDLE BRADFORD
CONTRACTORS TO THE ADVERTISING, D.D.C. & C. & C.

GAB/XI

27th April 1955.

R. E. Cooke Esq., B.Sc.
175 Westcombe Hill
Blackheath, S.E.3.

Dear Raymond,

Many thanks for your letter of the 25th instant.

As a matter of fact, I am going down to Huntingdon tomorrow to listen to F.J. Walker's new speaker. He invited me to go a month ago, but I could not fit in the journey. I will let you have a report next week.

I am rather pleased myself that P.J.W. has jumped the queue here.

Yours sincerely,

LOUDSPEAKERS - TRANSFORMERS - VOLUME CONTROLS - CABLES

Letter from Gilbert Briggs to Raymond E. Cooke
(who was later to found KEF Electronics)

Annual Exhibition in May 1955. One was an open-baffle (doublet) design and again was a high frequency unit only; the other was a full-range model, however, but employed a closed cabinet to maintain the bass response. Work continued apace and in 1957 the now famous open-baffle Quad Electrostatic loudspeaker came on to the market, remaining in production for an astonishing 25 years and becoming for many the yardstick against which all other loudspeakers were judged. [Serial No. 1 was raffled at the BSRA exhibition in September 1957 and is now owned by Beryl Horn, wife of our famous contributor GH.]

The Transistor era

The stereo version of the control unit came in 1959 and was followed in 1964 by a multiplex stereo decoder for the matching FM tuner. The inevitable move from valves to transistors was longer coming at Quad than with many other manufacturers, largely

The Gregorian two-manual organ jointly developed by A. E. Davies and Acoustical



The first Quad transistor units, the 33 control unit and 303 power amplifier

because Walker felt that unless the performance of the existing valve units could be bettered there was no significant advantage. The first marketed transistor amplifiers tended to use germanium devices



Walker with Mike Albinson, co-inventor of the 405 ...



... and with the Lord Lieutenant of Cambridgeshire – the Queen's Award for Technological Achievement

which weren't very 'fast' (i.e. had a poor slew rate), with the result that distortion increased with frequency. Distortion in many of these early designs also worsened with temperature. The biasing of the output transistors (which is required to make them work in the linear part of their operating range) commonly changes as the circuit warms up – so-called thermal tracking which makes the distortion level dependent on the recent history of the music signal. Heavy biasing into Class A operation guarantees low distortion but is grossly inefficient since the output devices conduct fully the whole time, regardless of the signal, this wasted energy dissipated as heat (which is fine with low power units but generally unsatisfactory for high-power amplifiers).

The availability of silicon transistors addressed the slew rate limitation but the biasing problem remained. Quad's solution was the novel "Triples" output circuit of the Quad 303 power amplifier, which appeared in 1967 together with its partnering 33 control unit. The 33/303 and matching FM3 tuner again sold in enormous numbers and were selected for the Council of Industrial Design Award in 1969.

In 1975 Walker and his colleague Michael Albinson presented a paper at the 50th

International Convention of the Audio Engineering Society on a new technique for power amplifier design. Nicknamed "Current Dumping" this combines a high-power Class B circuit, which provides the output 'muscle', with a low-power, very high quality Class A control circuit which is solely responsible for determining the overall quality. This arrangement makes it possible to produce a high-power, very high performance amplifier without using very carefully matched, fragile and expensive output devices and without any need to adjust biasing either during manufacture or at any stage in the amplifier's life. An outstanding success, it earned Quad the Queen's Award for Technological Achievement, the first for the audio industry.

Waiting for FRED

Rumours abounded for more than a decade about the existence of a second electrostatic loudspeaker before the ESL-63 finally appeared in 1981. The model number is significant, referring to the year in which Walker's first ideas were set down on paper. The *original* model, which was designed of course in the mono era, employed three panels: two bass units, one on each side of a central high frequency unit. The gaps between the fixed (perforated) electrodes and the diaphragm were different – larger for the bass to permit the greater excursion required at low frequencies. Walker had long wanted to make an electrostatic loudspeaker which would have the integrity of a single diaphragm (and thus need no crossover) but which might also emulate the theoretical ideal of a point source – a tiny pulsating sphere.

Such a source is impractical, certainly with an electrostatic because it isn't possible to generate the necessary sound pressure from so small a diaphragm. But could he not simulate it by arranging for his diaphragm to replicate the sound wave from an *imaginary* sphere placed some 30cm further back? Such a sound wave would pass through the centre of the diaphragm first and then propagate across it like ripples on the surface of a pond caused by a dropped stone, and at this distance from the imaginary source the pressure needed to generate a given sound level would be much lower because the radiating area is much larger.

All this is realized in the ESL-63, or FRED as it is affectionately known (Full Range Electrostatic Doublet), by an arrangement of fixed electrodes which are formed into a series of annular rings. The signal is fed via a frequency-dependent delay line first to the centre section and then to successive outer rings. The success of the design is such that, like its predecessor, it has had a huge impact worldwide and is used both in the home and in the studio, where its supremely transparent behaviour, acting almost literally like a window on the original event, makes it ideal as an analytical tool.

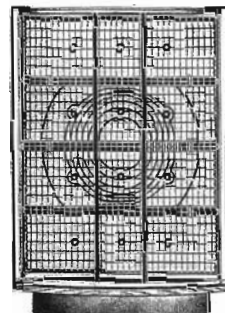
Later amplifier, tuner and CD developments at Quad – the 44 and 34 control units, FM4 tuner, the '6' and recent '7' series – have been made since Peter Walker's son, Ross, took over the running of the business, PJ himself working more in the background on his research. Full retirement a decade ago brought relief from the formal business commitments but the ideas have continued to flow. Work on an alternative electrostatic, a 'pressure' loudspeaker using four circular diaphragms, one behind the other, set into a 20in plastics sphere, reached an advanced stage six or seven years ago but in the end was thought not to be a commercial proposition; it was too big even though it was intended to go against the rear wall rather than well out into the room like the doublet. "It could actually go right up in the corners, yes. You could make the sound appear further down by altering the response."

Peter Walker celebrated his eightieth birthday last month, an age which will surprise many who know him, not least because of his remarkable mental energy. During

my visit I noticed some papers covered with jottings and equations. "Oh that. I suppose I'm getting too old now but I would like to have a go at a moving-coil loudspeaker that distributes sound on a single membrane with the same sort of delays as the '63. It would have to be a flat membrane and also very lossy so that the wave going out attenuates very quickly with rising frequency, so that you get an effective diaphragm which gets smaller as the frequency goes up. You could get much more power from quite a small unit that way."

Since retirement, formal recognition of his achievements has come in the form of the OBE and an honorary doctorate from Keele University, but although such accolades have always been politely accepted he is likely to suggest that really he was simply lucky enough to have been in the right place at the right time. That may be true to an extent, but without the gift, the vision and the sheer application none of this could have happened.

In Gilbert Briggs's book *Audio Biographies* (Wharfedale Wireless Works Limited, Bradford, July 1961) Walker himself wrote: "Many people have said to me how fortunate it must be to have a job and a hobby which are one and the same. It is, in fact, a double edged weapon. Though fascinating, technical problems are with you all your waking hours including, very often, most of the night. When you try to read the daily paper you inevitably finish up by scribbling little circuit diagrams and figures all round the edge, not having read a single word." Thirty-five years on and it seems that the margins are hardly less peppered. "Yes, well you can't stop thinking, can you?" Happy birthday, PJ ☺



The ESL-63: single membrane and idealized 'point-source'



'PJ' in the listening room at his home in Bedfordshire