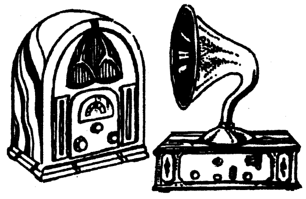
Vintage Radio

by PETER LANKSHEAR



Early mechanical TV systems

Public television came late to this part of the world. Australian transmissions did not commence until 1957, and New Zealand had to wait a further five years. Therefore, unlike the Americans and the British with their heritage of old and half-forgotten technologies, like pre-NTSC colour sets or old monochrome 405-line sets, we have little more than 625-line monochrome and PAL models.

Although we do not have a legacy of pioneer monochrome receivers, it is quite possible that in time there will be collectors delighted to get their hands on — for example — a classic Philips K9 colour receiver. For the present though, we will look at some of the early systems developed long before there was Australasian television.

In Britain and America, old monochrome TV receivers, many now well over 50 years old, do have an important place in collections. Most have small circular picture tubes, some so long that they had to be mounted vertically and viewed in a mirror. But there are even older sets, with mechanical scanning systems — including the 1928 Baird 30-line 'Televisors' with perforated scanning discs, and there are also a few sets with some very sophisticated mirror technology — which, but for the interruption by World War II, might today be far better known.

The fundamental principles of television were worked out in the 19th century, but the technology to make a working system was not available. In 1843, Alexander Bain published his ideas on a facsimile system, laying down the principles of horizontal and vertical scanning and synchronisation between transmitter and receiver. The photo sensitivity of selenium was discovered in 1873.

In Germany in 1884, only eight years after the invention of the telephone, Paul Nipkow suggested that the serial transmission of video data could be achieved by scanning the picture with a spirally perforated disc with one hole for each line. In 1911 the English scientist Campbell Swinton, with remarkable insight, stated that successful television would never be accomplished by mechanical methods. He also described an intricate electronic system, but no working example was then possible. It was only during the 1920's, with the availability of high speed sensitive photo-electric materials, that various workers were able to demonstrate the transmission of images.

Scotsman John Logie Baird, having first failed in a venture to manufacture a

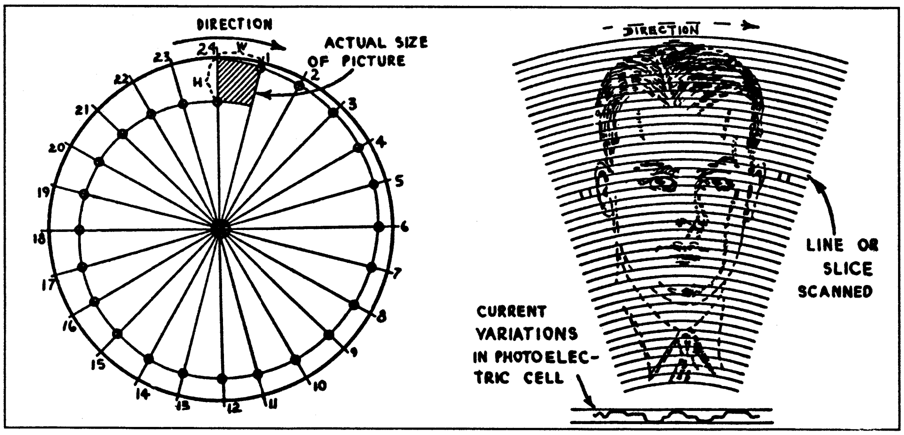


Fig.1: Best known of the early TV systems was the Nipkow disc. This diagram illustrates the size limitations and the wedge-shaped picture with its curved scanning lines. With only 24 or so scanning lines, resolution was quite poor.

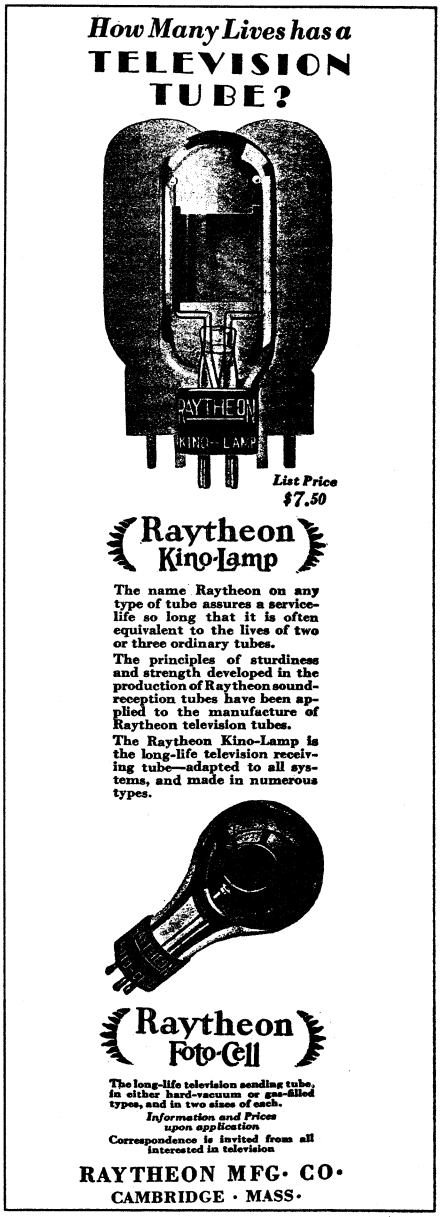
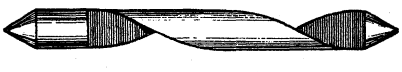


Fig.2: Essential parts for disc TV were a photocell for transmitting and a neon-filled 'kino lamp' for the receiver.

1,792,683. TELEVISION APPARATUS. PAUL R. EGGER, Davenport, Iowa. Filed Mar. 22, 1930. Serial No. 438,004. 5 Claims.



1. In a television set, a scanning element comprising a revolvable shaft, and a plurality of narrow mirrors formed integral therewith extending transversely of the shaft parallel to and in line with the axis of the shaft.

Fig.3: The mirror screw represented a major advance on the Nipkow disc This diagram is taken from the original 1930 patent.

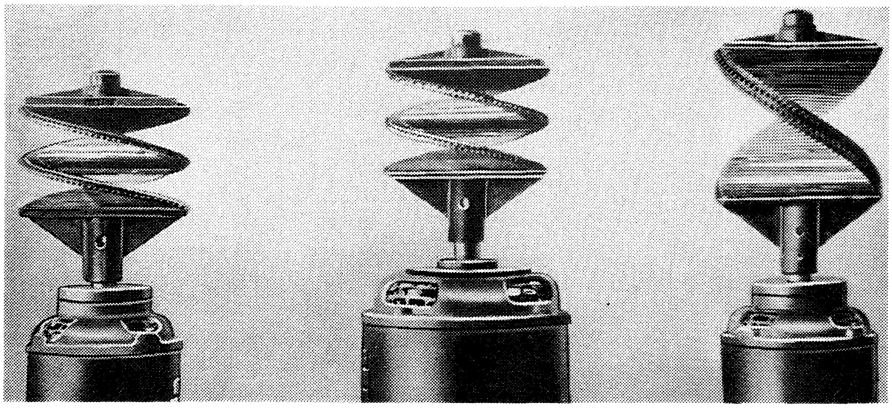


Fig.4: A selection of production model mirror screws (probably 180-line), mounted directly on their motor shafts. It is likely that the multi-turn models were to simplify setting critical mirror angles.

patented undersock and then in an equally unsuccessful jam-making enterprise, was determined to make his fortune from television. In October 1925, after two years of experimenting, he demonstrated a crude working system using Nipkow's disc; his dogged but ultimately unsuccessful efforts to develop a commercial TV system have given him a place in history.

Meanwhile, although details of Campbell Swinton's work were freely available in publications like Harmsworth's popular 1923 *Radio Encyclopedia*, other workers too, in Britain, Germany and America were persisting with disc scanning experiments.

In America, two farsighted pioneer inventors, Philo Farnsworth and the Russian immigrant Vladimir Zworykin, realised that although mechanical television scanning might give early results, it would ultimately be incapable of sufficient development. As a result they were working independently on electronic methods of scanning.

By 1926 Farnsworth had solved most of the problems of a workable all-electronic system. In April 1930 he was awarded patents for electronic transmitting and receiving technology fundamental to electronic television. Zworykin invented the Iconoscope, and it is the work of these two that provided much of the foundation for today's television systems.

Poor disc images

The images produced by the disc system were impractically small, often not much more than postage stamp size, with a resolution of between 24 and 60 lines. One limitation to the number of lines was the use of broadcast band transmitters with restricted bandwidth.

Initially, the only available source of light that could respond quickly enough to video signals was a neon tube producing a dim pinkish light — substituted for the loudspeaker in a standard receiver. Only head-and-shoulders shots of people had any chance of being recognisable, scenery was out and furthermore the scanning lines were curved with a wedge shaped picture. The electronics were simple, but about the only other merit of the disc system is that it clearly demonstrates the fundamentals of scanning and synchronisation.

Receivers were effectively standard broadcast types, but with a 'Kino' lamp in place of the loudspeaker. In fact, the early Baird 'Televisors' were intended to be driven from the family radio. As line rates increased, the frequency response of receiver audio amplifiers became more important, and resistance coupling became essential.

Synchronisation of mechanical systems was not very sophisticated. If the transmitter and receiver were supplied from the same mains grid, synchronous motors could be kept in step. If however this was not the case, a line synchronising signal could be derived from the video waveform. Fig.6 shows an American system using a 'phonic wheel'. There was no frame synchronisation.

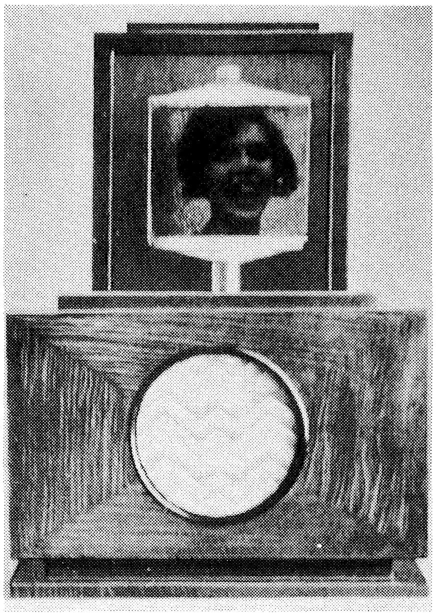


Fig.5: A mirror screw receiver in operation. The light source was probably modulated by a Kerr cell.

The physical constraints of the disc system presented the really insurmountable problems. In line with today's TV, a scanning speed of 25 frames per second or 1500 per minute was commonly used, requiring a rotational speed of 1500rpm — safe for small discs only.

To provide a sharp image, the holes needed to be small, but these attenuated the already low intensity light. Increasing the size of the scanning holes reduced the picture detail. With the dim light produced from neon lamps, only a very limited reduction in disc size was made possible by using magnifying viewing lenses.

Supersonic speeds

An example will demonstrate the utter impracticality of using a disc to provide a reasonable image size. An acceptable picture would be 30cm square, and would use 240 lines at a frame rate of 25 per second. The scanning disc would therefore require 240 holes, spaced at 30cm intervals in a one turn spiral. Simple arithmetic shows that the disc circumference would need to be 240 times 30 centimetres, or 72 metres — giving a diameter of about 24 metres!

With a speed of 25 revolutions per second, the rim of the disc would also have a velocity of nearly 6500 kilometres per hour, over five times the speed of sound...

There is one story of Baird nearly killing himself with an experimental disc only one tenth this size, fitted with 30 large lenses. A disc of even this size with lumps of glass around the rim rotating at 1500rpm is not the sort of device to delight a safety inspector — especially when, as happened in this instance, the lenses became dislodged at 650 kph!

Clearly, the spinning disc was completely impractical for a viable commercial system and better scanning systems were essential for further progress.

New light sources

Major problems to be solved were the need for more effective light generation, better picture resolution and size. Although by 1931, teams from RCA in America and Marconi-EMI in Britain were at work on all-electronic TV systems, many experimenters including Baird were still spending much time and effort in persisting with the disc system. Within a year, however, the physical problems of the scanning disc were finally acknowledged, and development switched to the use of mirrors.

To obtain a faster response and brighter illumination, a scientific curiosity, the Kerr cell, which had been a solution waiting around for a problem, was dusted off and improved.

Photographers will be familiar with the ability of two polarising filters to block the passage of light if the plane of one is rotated 90°. A Kerr cell consists of two correctly oriented polarising prisms separated by a suitable liquid. If a field of several hundred volts is applied to the liquid, polarisation is set up in the liquid itself. This polarisation is proportional to the applied voltage, permitting modulation of the amount of light transmitted through the assembly.

Baird experimented with various liquids in the Kerr cell, finally settling on nitrobenzine. A major improvement was the incorporation of twin prisms, splitting the light into two rays which, after passing through the liquid were recombined by another pair of prisms. However, the light transmission of even this double-image Kerr cell was still very inefficient, some workers even resorting to arc lamps in attempts to provide sufficient image intensity.

The mirror drum

The first and simplest mirror scanning system was a series of mirrors mounted around a drum. Baird Television, who had persuaded a reluctant BBC to permit a pair of their broadcast band transmitters to be used for experimental transmissions, was in 1932 able to sell an improved 'Televisor' with a 9" by 4" picture, using this system. There were 30 mirrors, each carefully aligned so that in one revolution of the drum, their reflections successively scanned the frame (one line to a mirror). Much more compact than the equivalent two-metre diameter disc, and illustrated in Fig.7, this mirror system remained the Baird standard receiver until the end of the low definition service in early 1937.

Although a considerable improvement over the disc, the mirror drum was not suitable for more than 60 lines. Setting up the mirror angles was very critical and centrifugal force threw them out of alignment. However, as we shall see, development of the mirror drum was not finished.

Meanwhile, *vibratory* scanning was being tried. A suspended mirror was rocked horizontally and vertically to scan the screen. To improve efficiency, the mirror mount was made resonant at the two sweep frequencies, but unfortunately this produced a sinewave rather than a sawtooth motion, making the trace incompatible with the other systems.

Mirror screws

In 1930, Paul R. Egger, of Davenport, Iowa USA filed a patent for a 'mirror screw' array, with a series of angled mirrors, equal in number to the number of lines. Much of the development of the mirror screw was done in Germany. For a 180-line system, there would be 180 long thin metal mirrors, each displaced 2° (360°/180) from the previous one, making the array like a spiral stairway. The picture line thickness was the same as the mirror thickness, and the mirror lengths became the picture width. When the screw was rotated, persistence of vision made the mirrors ap-

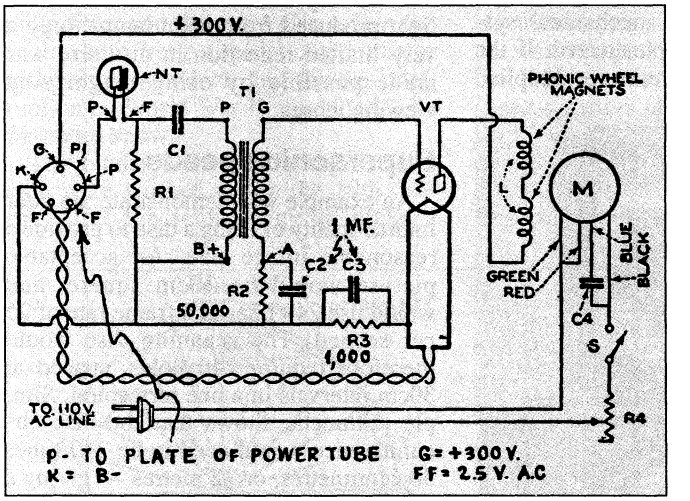


Fig.6 (above): Flywheel synchronisation, 1930's style. This unit was plugged into the output stage of a standard broadcast receiver. The scanning mechanism was driven by a synchronous motor in approximate synchrony. Attached to the drive shaft was a serrated 'phonic wheel' with a tooth for each line, running past the electromagnets in the valve anode circuit. The valve was overdriven so it clipped off the video and passed only the sync pulses.

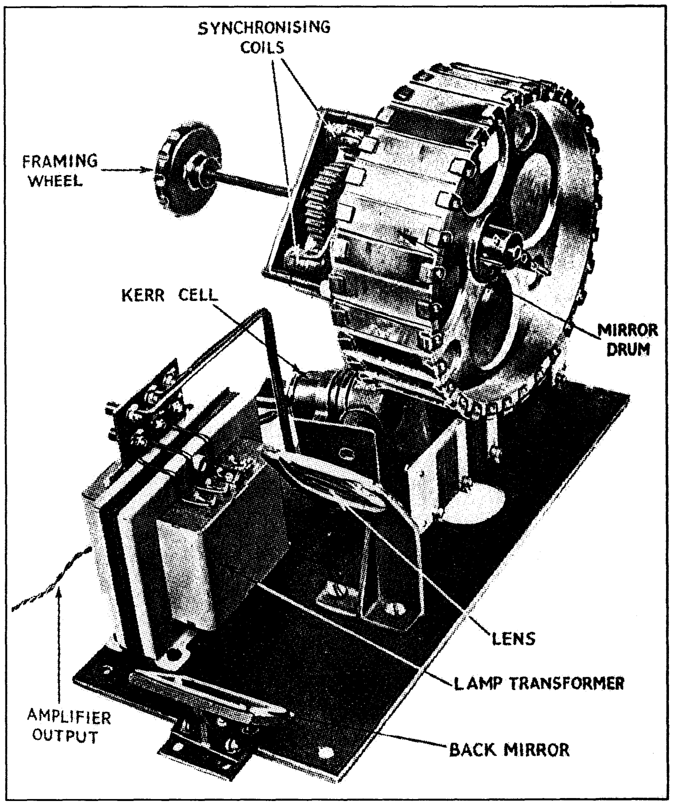


Fig.7 (right): The 30-line mirror drum from a Baird receiver, as pictured in 'Television, a Guide for the Amateur' (1936).

pear to run together, the image appearing to be as tall as the stack, and as wide as the mirror length.

Illuminated by a Kerr cell, the mirror screw was a major advance in light efficiency and compactness. By the standards of the time, the resolution was high, and it had a wide viewing angle. Some German 180-line mirror screws were 9" by 12" (about 23cm by 30cm), which would produce an image equivalent to that from a Nipkow disc about 16 metres in diameter.

Mihaly-Traub system

The Mihaly-Traub scanning system overcame the mirror drum problems in a very ingenious way. In the first development, the mirror drum was made stationary, with the mirrors now on the inside and aimed at a double-sided mirror rotating at half line speed at the centre of the circle. Not only were the mirrors in solid adjustment, but each was used twice each revolution, once for the upper half of the picture and once for the lower half.

Later it was realised that with a suitable alignment of the mirrors, and by using a multifaceted rotating prism, a full ring of mirrors was not required. The transmitting unit in Fig.8 used a 10-sided prism and six adjustable stationary mirrors, for 240- or 360-line systems.

Scophony

Scophony, a name derived from the Greek for sight-sound, was the name of the advanced system first conceived in Britain by G.W. Walton. Although based on mirror scanning, Scophony came close to holding its own with all-electronic television. In an innovative split-focus optical system used in the scanning process, the picture was divided into horizontal strips, each one representing one line. Focusing of the light beams was accomplished by crossed cylindrical lenses which concentrated the light in two planes. This allowed the use of smaller lenses and mirrors, thereby reducing the cost and size of the equipment. Scanning was by a 20-sided stainless steel polygon 60mm in diameter.

Although the Kerr cell had been a considerable improvement over the neon lamp, a still brighter light source was required. In 1934, J.H. Jeffree of the Scophony Company developed a modulator with a light transmitting ability two hundred times greater than the Kerr cell. The Jeffree cell operates on the principle that when a supersonic mechanical oscillation passes through a transparent liquid, through which is also passing a beam of light, a series of accelerations and retardations will occur in the light beam. This property can be used to modulate the light beam, with minimal loss in transmission.

The first Scophony receivers had mirror screws, but eventually mirror drums and rotating prisms were used. In 1938, Scophony demonstrated three mirror drum receivers for the new high definition 405-line system. A domestic model with a 22" by 24" picture was never sold, but theatre models with 5 x 6 foot and even 9 x 12 foot pictures were operated successfully. The scanner operated smoothly at 30,750rpm and could be used on the American 441-line system at 39,600rpm!

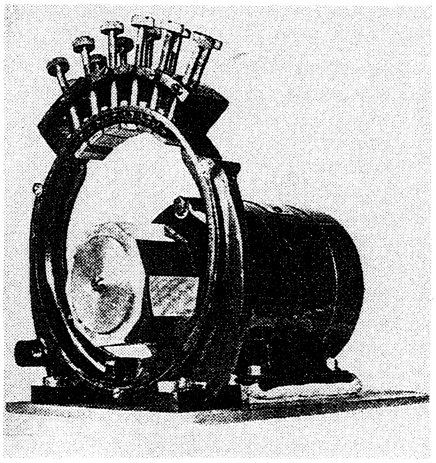


Fig.8: A Mihaly-Traub 240/360-line scanner, with six mirrors and a 10-sided rotating prism, was a considerable advance on the simple 30-line scanner of Fig.7.

With its brighter and larger pictures, rugged reliability and absence of a lethal EHT supply, it is likely that Scophony, had World War II not intervened, would have provided electronic TV with some real competition. As it was, by the time transmissions were resumed after the war, experience gained with radar had given electronic TV such an advantage that mechanical systems were never resurrected.

What's it worth?

As a footnote this month, one question I am frequently asked is "What's that radio worth?" There are no standard values for vintage radio equipment and prices are very dependent on condition, age, fashion and demand.

One recent transaction has caused a few raised eyebrows. If a report, with photograph, in the English *Daily Mail* for September 15, 1993 is to be believed, a 1934 Ekco AD65 sold at a West London auction for £7500 — which, according to my calculations is about A$16,000!

Admittedly, the AD65 with its circular Bakelite cabinet is a very collectable model and this was a rare coloured version. But even so, I do not know any enthusiasts who would be prepared to pay even one tenth of this price.

This report gives credibility to recent American articles asserting that classic radios are a good investment, as they will increase in value in the same way that old cars did a generation ago. This is not a good trend from the point of view of the enthusiast, who is interested in vintage equipment for its own sake, rather than as an investment. ❖