The Baird intermediate film process

During the early 1930s the intermediate film system enabled high-definition television transmissions of large studio scenes to be made at a time when electronic cameras were still in the development stage. Ray Herbert, who worked for the Baird Television Company, traces the development of the system and describes its operation.

In September, 1927, R. V. Hartley and H. E. Ives of Electrical Research Products in the USA, described a method of using an interposed film technique for television purposes involving the use of a cine camera and a means of rapidly developing and fixing the film in order that it could be scanned by a disc within a short period. At the receiving end a similar arrangement enabled the television image to be focused on to film emulsion, followed by instant processing and subsequent projection to a screen. This scheme was covered by British Patent No. 297,078 applied for in March, 1928.

During the next few years only brief descriptions appeared in the technical press, one of these being an account in a paper read by J.H. Owen Harries to the Television Society on 8 October, 1930. Fernseh AG, a consortium comprising Baird Television, Zeiss-Ikon, Loewe and Bosch, were the first to carry out serious development work on the intermediate film system. Dr Schubert commenced his pioneering work at the Zeiss factory in 1931 and the following year Fernseh exhibited a prototype at the Berlin Radio Exhibition. It consisted of three separate units – a cine camera mounted on a tripod, the processing tanks and a scanning cubicle, all connected by flexible, light-tight trunking. The film costs were considerable and in 1933 Fernseh had produced a means of re-using the film by passing it through an emulsion coating chamber This refinement added considerably to the bulk of the apparatus and it was not used in this country.

Practical considerations

In 1932 the BBC had assumed responsibility for the 30-line programmes and both Marconi-EMI and Baird Television had moved on to the problem relating to the provision of high-definition transmissions. Marconi-EMI worked on their Emitron in considerable secrecy, giving very few demonstrations and staking everything on their ability to produce a viable electronic camera by the time that the Television Advisory Committee commenced their review of current techniques The Baird Company favoured the practical approach and decided to transmit high-definition pictures at the earliest opportunity for demonstration to the GPO, Members of Parliament, the Press and the public. They obtained a lease on 60,000 sq ft of space at the base of the Crystal

Palace South Tower, fully equipped four studios and constructed both vision and sound transmitters. At the end of 1933 these studios were in operation and experimental transmissions were made using a definition of 30, 60 and 120 lines on a frequency of 48MHz. Early in 1934 a decision had been reached to concentrate on a 180-line standard for demonstration purposes. It was considered to be essential that the programmes should have good entertainment value, involving groups of performers in a large studio.

With electronic cameras still in the development stage, the choice lay between the spotlight system using a disc scanner and the intermediate film arrangement. The disc scanner however could only cope with head-and-shoulder shots. Even with a 3ft diameter disc and a 125-amp arc lamp, the very small holes resulted in so much loss of light that only scenes up to 3ft x 4ft could be contemplated.

The only practical solution appeared to be the intermediate film process but there were some inherent disadvantages. Due to the processing time, typically 30-50 seconds, the sound had to be recorded as well and this produced a significant deterioration in the quality. The equipment could only be used from a fixed position and the programme length depended upon the size of the film magazine. A soundproof booth proved necessary to contain the noise generated by the drive motors. Running costs were considerable largely due to the high price of film.

After a lengthy programme of development work, Bairds successfully produced a sophisticated piece of equipment capable of providing pictures superior to those obtainable with the experimental electronic cameras of that period. Interchangeable lenses enabled close-up shots to be obtained, fast film kept the lighting requirements to a reasonable level and the exposed film could be washed and dried for future use.

The Baird intermediate film system

The basic arrangement consisted of a cine camera, developing and fixing tanks, and a telecine scanner, all forming a single unit. The first laboratory model used 9.5mm Pathescope film having centre sprocket holes and this operated at a definition of 180 lines. As the processing time amounted to 11 seconds with the early models, a similar delay had to be introduced for the sound channel and this was achieved by recording the sound magnetically on an endless steel tape. This set-up worked quite well but had several deficiencies. The light shining through the centre sprocket holes overloaded the photocell in the telecine unit and the endless sound recording loop prevented a re-run of the film with accompanying sound. These problems were eliminated by choosing a wider film thus enabling a variable density sound track to be accommodated between the line of sprocket holes and one edge.

The first installation for studio use came into operation late in 1934 just before 180-line demonstrations were given to the Television Advisory Committee. Mounted on castors and situated in a booth with plate glass sides, scenes could be filmed in three separate studios. At this stage the film size had been changed to 17.5mm (split 35mm stock for reasons of economy).

Most of the problems encountered related to the processing side rather than the electronic equipment. Turbulence caused by the sprocket holes resulted in localised development changes, heat from the 80amp arc lamp generated tiny air bubbles in the

scanning gate and particles of emulsion became detached due to the scuffing action of the nip rollers in the sound reproducing head.

Between February and June 1935, over 40 high-definition programmes were radiated from the Crystal Palace to various demonstration locations in the London area. Professional artists provided full-scale stage presentations and these were transmitted by the intermediate film process. The Television Advisory Committee had recommended a minimum definition of 240 lines and in preparations for the forthcoming service from Alexandra Palace, the Baird Company redesigned the equipment for this standard. The new version embodied a number of refinements but the twin disadvantages of bulk and immobility remained.

The 240-line intermediate film installation is shown in the accompanying photographs. A Vinten camera with four lenses in a turret was mounted in a position which allowed full use to be made of pan and tilt operations. The magazine contained 1000ft of film, sufficient for a 20-minute run. Pneumatic jacks either side of the processing tank enabled the film transport mechanism to be withdrawn for threading and cleaning purposes.

With the tank temperature maintained at a constant 28 degrees centigrade, the time taken to process, wash and scan the film was about 50 seconds. For development the solution comprised pyrocatechin, hydroquinone, sodium sulphite, potassium metabisulphite, sodium hydroxide and formalin. The only fixer capable of providing satisfactory results with standard film in the short time allowable was sodium cyanide and its use entailed special handling and disposal precautions.

A 60-amp arc illuminated the film gate, scanning being carried out by a disc driven by a half-horsepower, 3-phase, 100Hz motor at 6000rpm. This disc contained 60 small holes spaced around the periphery and equidistant from the centre as opposed to the usual single spiral formation. By using 60 holes instead of 240, the disc could be kept down to a reasonable size but this arrangement required a fourfold increase in rotational speed. The horizontal scanning component was provided by the rotating holes, whereas the vertical displacement came from the continuously moving film. To avoid weaving due to air resistance and as a means of preventing dust from clogging the minute holes the disc ran in a vacuum.

Synchronising pulses were produced from the scanning disc by an additional series of slots which interrupted an independent light source and photocell combination. The main photocell and preamplifier were contained within a box mounted on top of the motor casing.

The intermediate film era lasted for only a few years and credit is due to the Baird design engineers who carried out some unique research work during this period. The arrival of a viable electronic camera led to the abandonment of this equipment for studio use but it is interesting to note that further development resulted in a miniaturised version which operated from an aircraft in 1939 (*see RTS Journal **Television**, 1987, Vol. 24/2*).

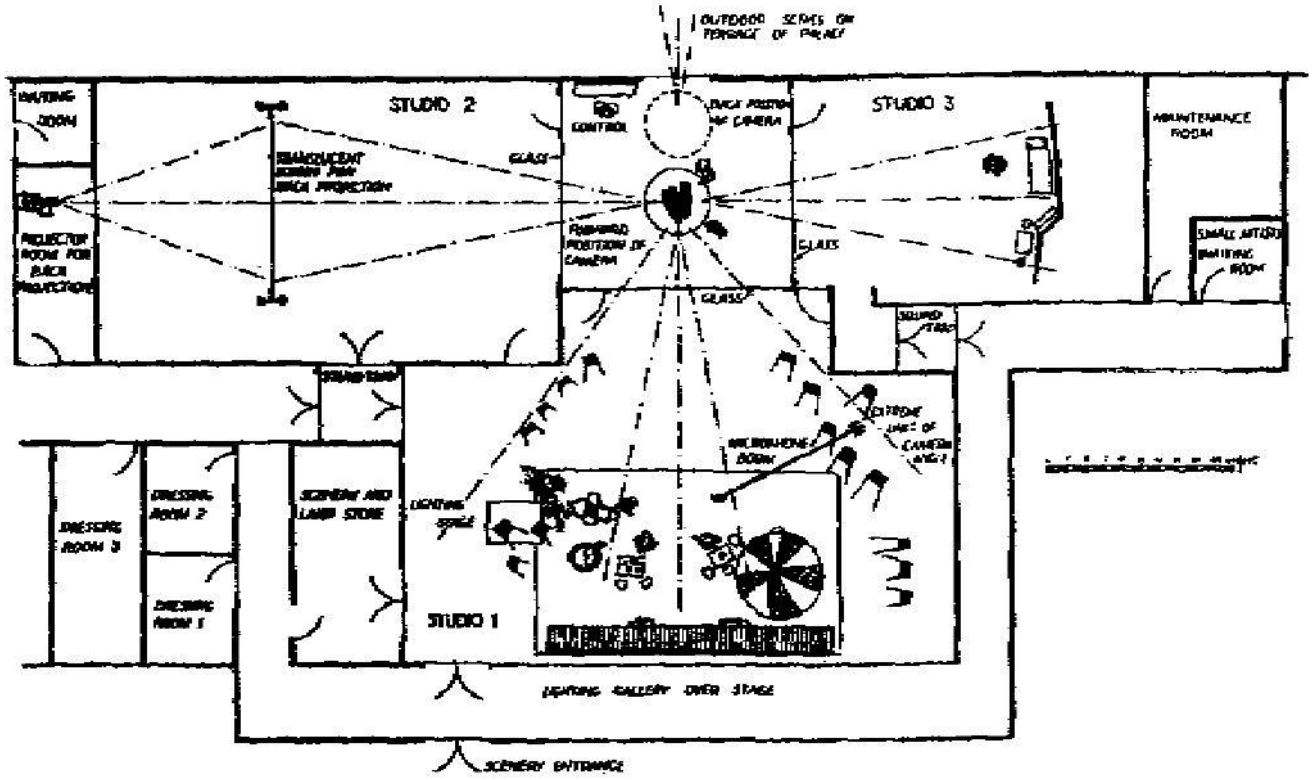
The author wishes to thank G.J. Craig, a member of the Baird design team at that time, for his assistance in the preparation.

Tail Piece

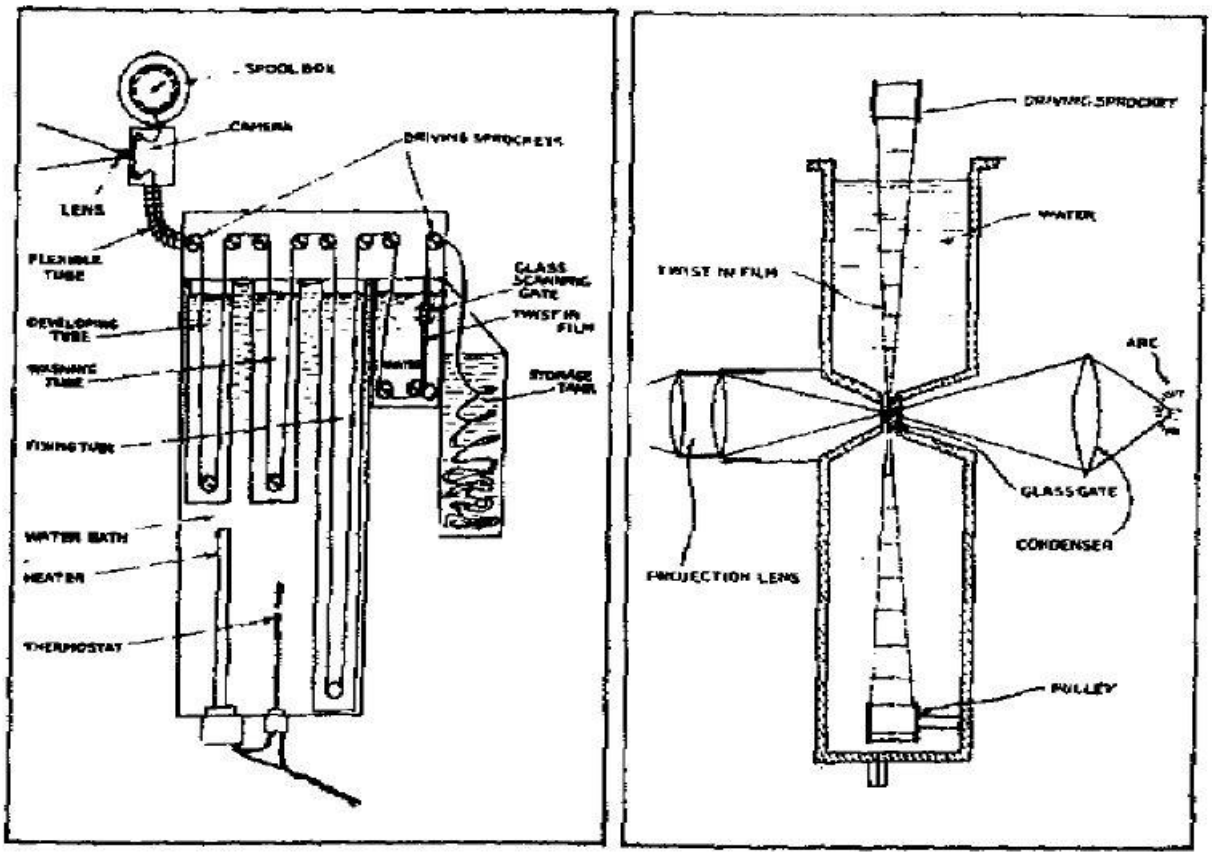
Concerning more recent discussion, Ray adds:

The story about cyanide fixer sloshing about on the floor of A.P. is completely untrue. As you can see from the sketch any leaking from the fixer container would go into the water bath.

Both Alan Lawson, the Baird camera man and Gordon Craig, who built the equipment, are still around. They feel it is highly unlikely that the camera was retrieved due to an unpaid bill.



Intermediate film process studios of Baird Television Ltd. The camera is arranged so that it can be swung round to cover action in three studios.



Left: The mechanical arrangement of the intermediate-film gear used for experimental purposes by Baird Television Ltd.

Right: The scanning gate and optical system of the intermediate-film transmitter.