

Surround sound patents

Will the future of surround sound depend on patent bargaining?

by Adrian Hope

The modern history of surround sound has been the subject of regular reports in these pages. Inevitably, less has been written on the past history of multi-channel sound, and the patent literature contains a number of surprising revelations. It is also fruitful at the same time to examine the more modern patent literature, because this helps put into perspective current claims, disputes and commercial alliances in the surround-sound field. Moreover an understanding of the patent situation, both ancient and modern, may also be of use to those involved in the production of surround sound equipment and interested either in patenting their own ideas or ensuring that they do not encroach on ideas covered by current patents.

A PATENT IS A BARGAIN struck between the inventor and whichever country grants him the patent. The inventor discloses full details of invention to the patent office of the country in question — virtually every industrial country has a patents system — and if the patent office adjudges the idea novel a temporary monopoly is granted to the inventor.

Then, for a limited period of time, the inventor has the opportunity of preventing others from using the same idea. But simultaneously, as part of the bargain, the patent office publishes the details of the patented invention to the public. The disclosure document or patent, is from the moment of publication, a free source of information to the public. (The Holborn Science Reference Library off Chancery Lane in London, has a full set of patents from most industrial countries, including, of course, the UK. Copies of these may be bought, at a price dependent on length, or at a flat fee of 95 pence if the patent is British.)

Once the patent has expired, either by reaching the end of the statutory period or by failure of the inventor to pay any renewal fees that are necessary, the invention as disclosed by the published document passes into the public domain. Under the new UK laws a British patent will last 20 years in conformity with many other countries. (The previous term was 16 years.) It is, therefore, a safe bet that any technical information contained in any patent over 20 years old will belong to the public. Generally speaking, that infor-

mation cannot then be re-patented by the inventor or anyone else. It is clear, from the patent records, that a surprising number of audio ideas applicable to surround sound are well and truly part of the public domain.

As early as 1878, October 22nd to be precise, Thomas Alva Edison completed the filing of an important patent application in Britain. This issued as BP1644/1878, and it contained, just ten months after the invention of recorded sound, a passage that pre-empted the idea of multi-channel recording. Edison sketched and described a cylinder recorder with four separate cutter heads, simultaneously tracking different parts of the same cylinder. "Four persons may speak simultaneously and have records made in separate, parallel lines upon one cylinder, and the phonogram will reproduce the sounds the same as though it contained the record of but one voice," said Edison. Who says four-channel recording is new?

In 1881, a system was demonstrated by Clement Ader at the Paris Electrical Exhibition which effectively anticipated much of the modern binaural and dummy-head stereo work. Eighty of the newly-invented Bell telephones were used to transmit the sound of music from the orchestra of the Grand Opera through to listeners at the Exhibition. According to a contemporary report, a "new acoustic effect" was discovered by accident. It was found that if the listener took two, rather than one, telephone earpieces, and put one to each ear, the sound heard took on a new dimension. A "special character of relief and localisation" was experienced, for the simple reason that the sound fed to the listener's left ear was originating from one microphone and the sound fed to the right ear was originating from another microphone, spaced from the first. Presumably the most realistic effects were heard by those listeners who had by pure chance picked telephones connected to a pair of microphones spaced apart by a distance comparable to that between the ears of the human head. Although there is no record of a patent filed on this process, it surely represents the first disclosure of binaural stereo, albeit by direct wire transmission.

Incidentally, at the turn of the century cylinder recordings were made by the simple expedient of putting the artist in a room, facing a bank of several dozen cylinder recording machines. That way, without recourse to duplica-

tion which for cylinders was then technically difficult, or dubbing which degraded quality, one recording could produce several dozen cylinders. American recording engineer Jerry Bruck has argued that at least some of those recording machines must inevitably have had their horns spaced apart by the ideal distance for a crossed-pair recording. All that remains now is to find the right pair of cylinders from the same recording session and dub them together onto tape as left and right-channel sound records of the original performance...

Probably the earliest disclosure of, and patent on, a multi-channel recording is to be found in BP23620 of 1911. This patent, granted to Augustus Rosenberg of High Holborn, London, proposed a cinema sound recording and reproduction system which enabled "two synchronous sound-records (to) be obtained, one from each end of the front of the stage, or scene of the incidents to be recorded". The sound records were to be "produced photographically side by side upon a single strip" with reproduction through "sound reproducing devices placed at or near each end of the screen", to produce sound from the screen "in accordance with the movements of the apparent source of sound from side to side of the picture". Particularly important is the suggestion in this 1911 document that "the number of sound records employed is not limited to two".

It is interesting here to digress forward in time and note that Fred and Ralph Walker of New York patented the Cinerama film and sound system as long ago as 1937 (BP518905) with the object of "increasing the illusion of being in and surrounded by an environment by producing binaural sound effects".

In USA patent 1855149 of 1927, W. Bartlett Jones of Chicago described in some detail the now well-known effect of binaural sound, and suggested that the two channels of sound necessary could be either separately transmitted by using two radio wavelengths, or by adoption of multiplex techniques "so that a single wavelength may be used to broadcast two effects". Bartlett Jones then went on to suggest that the two channels of sound could be recorded using either a film record, or a disc with one effect on each side or a double or side-by-side groove. Alternatively, and most important, he went further to suggest that the disadvantages of recording separate channels in separate

grooves "may be avoided by providing the two effects in one groove. Two types of sound groove are now employed, one varying vertically and one varying horizontally. A groove may be made which varies vertically for one effect and which varies laterally for the other effect."

Thus by 1927 the notion of recording surround sound using binaural techniques and the vertical-horizontal modulation of a single groove was already old. Indeed, the notion of recording two channels of sound in a single groove modulated both laterally and vertically was already old in 1920. In July of that year, Samuel Waters of Washington filed USA patent 1520378, which claimed an acoustic gramophone using a pick-up with orthogonally related components, to track a groove modulated by orthogonally related vibrations. But again, Waters was interested only in vertical-lateral modulations and, like Bartlett Jones seven years later, was interested in keeping the two channels of sound separate. Incidentally, Waters was concerned with improving signal to noise ratio, rather than reproducing sound in three dimensions.

IT WAS IN 1931 that Alan Blumlein filed BP394325, which disclosed the principle of 45:45 modulation and while not claiming surround sound, as such, laid the foundation to modern surround-sound matrixing. Blumlein was the first to think of two channels as a means of transmitting or recording a composite of information for subsequent reconstruction into a usable format. Although concerned mainly with two-microphone recording and two-loudspeaker reproduction, Blumlein did suggest in passing the possibility of using "four or more loudspeakers" in a vertical pattern and microphones arranged "one above the other ... to provide significance of vertical as well as horizontal movement of the sound source".

Contrary to popular misconception, Blumlein did not describe quadraphonics or four loudspeakers in a quadrangle. What he did was reveal, and take advantage of, the psycho-acoustic phenomenon whereby the human ear/brain combination will hear a phantom spread of sound when facing two loudspeakers reproducing two channels of information containing amplitude variations to provide directional clues. Ironically although it is on Blumlein's patented approach to signal matrixing that modern surround-sound encoding is based, it is the illogical extension of Blumlein's pair-blend loudspeaker stereo ideas to a quadrilateral that has led so many surround sound designers into blind alleys. As Blumlein surely well knew, pair-blending works properly only when the listener faces the loudspeaker pair, and in a quadraphonic set-up only one loudspeaker pair can be faced at a time.

Even before Blumlein filed his patent application, Arthur Keller of Bell Labs in New York had filed an application which issued as USA Patent 1910254. This document, dated 1929, discloses an alternative approach to multi-channel signal recording and transmission and has subsequently been developed and adopted by JVC and Nippon Columbia.

Keller used a modulator to combine or multiplex the separate sound channels, by displacing them in the frequency scale "to form a progressive series of bands separated by suitable intervals". The multiplex approach was refined by William Livy of EMI, in BP612163, filed in 1946. Livy proposed a solution to the problems produced by speed fluctuation during reproduction of a multiplex disc. He proposed that a high frequency carrier be recorded on the disc along with the programme, and used on replay "to lock the oscillator in the reproducing apparatus in synchronism, so that if the speed of the record varies the frequency of the oscillator will likewise vary in the same ratio". In 1954, Kenneth Hammon of Ohio filed US patent 2849540, which developed the Livy idea further, to improve quality and frequency range, and relied on a 30kHz carrier.

Peter Scheiber of New York is generally acknowledged as the first to use a matrix technique of Blumlein descent to encode four signals into two channels. The Scheiber master patents BP1328141 and 1328142 are now under the CBS wing, and it is interesting to note that a computer error allowed them both to lapse for a while, due to inadvertent non-payment of renewal fees! In fact CBS holds an extensive string of patents and more are continually issuing. BP1347993 and 1347994 are conveniently representative of the basic SQ system, and BP1303021 is similarly representative of the basic QS system. The Tate signal-dependent decoder is described and patented in BP1514162 and USA patent 3944735, again under the CBS wing. BP1402320 covers the Variomatrix decoder which is, of course, Sansui's signal-dependent process. (The Sansui circuit has been used by the BBC to enhance Matrix H decoding.)

Other important patents applied for early in the 1970's included USA 3417203 and British patent 1356843, both in the name of David Hafler. The last-mentioned is particularly interesting because it disclosed the basics of the so-called Hafler system for producing four-speaker stereo with a loudspeaker matrix. But Hafler prior-published the substance of BP1356843 in *Hi-fi News*, and therefore invalidated this aspect of the patent.

MOVING UP TO DATE, the original Ambisonics patent was BP1369813, which contains subject matter similar to BP1411994. This latter patent claimed the BMX matrix developed by Duane Cooper in the USA and has for

several years been under the wing of Nippon Columbia. The BBC, incidentally, has patents on a BMX-style matrix eg. BP1414166. Something of a puzzle is British patent application 34839/74 by the BBC. Although secret, this has been publicised as containing a claim to the use of a Sansui Variomatrix decoder with a phase shifter of 60°. If the report is correct, here is a novel approach to patent novelty — like claiming patent monopoly on a well known flagpole tilted to 60°!

Patents continue to issue on matrix encoding, multiplex and combined matrix-multiplex techniques from a world-wide range of companies. Examples of patents for extra-channel radio transmission systems are BP1367429 from Siemens and BP1377138 from Matsushita. It is likely that the Siemens patent may prove the master patent on phase quadrature three-channel transmission. The stream of issuing patents continues still because there is a lag between application and publication, and we are still reaping the dubious benefits of research enthusiasms now several years old. Almost certainly it is the number of mutually conflicting patents now issued that has produced a more adult approach by the competitive companies. Such a tangled web of conflicting patent rights has developed that, as with radio in its infancy, a degree of patent pooling has become inevitable if progress in the field is to continue without the largely unnecessary expense and delay of litigation.

Recently for instance CBS has received patents in the UK on modifications of the SQ system which involve the transmission and recording of extra channels of information in "discrete" manner (BP1504391 and 1504392). This suggests an overlap of patent monopoly between CBS and the string of firms more traditionally associated with the multiplex approach to multi-channel recording and transmission. The original Ambisonics — NRDC British patent 1369813 has now been followed by BP's 1494751 and 1494752 which respectively protect the concept of frequency-dependent decoding for improved sound localization and variable decoding to match the performance of a system to the shape of the room and number of speakers used. The Calrec sound field microphone, now being used by both the BBC and IBA, is clearly based on another NRDC-Ambisonics patent, BP1512514. Other patents based on Michael Gerzon's work are believed to be in the pipeline to grant. The BBC, IBA, Nippon Columbia and NRDC are already informally pooling patent rights and with the rights of Scheiber and Tate aligned with the giant CBS and the interests and allegiances of Sansui and JVC currently ill-defined, the commercial future of surround sound must depend as much on patent politics as system performance. □