

## TWENTY YEARS OF MAGNETIC RECORDING

To the much-heralded under-25 generation, a world without tape recording would be hard to visualize.

Hi-fi music, school language laboratories, television's familiar "instant replay," the clicking reels of computer transports, the recorded heartbeat of an astronaut and weather reports from Venus are a few of the commonplaces of 1967 made possible by magnetic recording.

They were the stuff of science fiction 20 years ago when the first practical tape recorder was born.

On October 1, 1947, engineers of a 14-man company called Ampex pushed the "play" button on a cabinet size recorder they called the Model 200 before an audience of broadcasters in Hollywood, California. The result was the purest recorded sound the audience had ever heard. It was the sound of a multi-billion dollar industry being born.

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Sales of magnetic recording equipment and tape in 1947 were virtually non-existent. This year worldwide sales of tape recorders and tapes of all varieties, makes and models will exceed an estimated \$2.1 billion.

#### MAGNETIC RECORDING HISTORY

The technique of magnetic recording is much older than 1947. It was discovered by Danish scientist Valdemar Poulsen in the 1890s. Lack of electronic developments for amplifying recorded sound kept it in the laboratory for decades thereafter.

Accelerating developments in magnetic recording took place in the 1930s and early 1940s, particularly in Germany where a handful of engineering models were successfully used for propaganda broadcasting by the Nazi government.

It remained for Ampex to produce the first machine with the necessary reliability and performance for serious regular use.

It didn't take long for the Model 200 to find serious regular use. Seven months after its unveiling, American Broadcasting Company radio stations across the nation put the machines into daily use for time delay of network programming. The muffled sound of the old "electrically transcribed" radio program soon was replaced by the live quality of tape recorded broadcasts.

Rapidly, phonograph record companies discarded their wax mastering machines for Ampex tape recorders. Coupled with development of the microgroove record, this gave birth to the high fidelity era in home entertainment.

Before the Model 200, many industrialists doubted that magnetic recording would ever be more than an interesting toy. Such doubts were rapidly dispelled by the Model 200. Approximately 90 percent of the recorders bearing that historic number are still in regular use 20 years later.

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One key figure who did not doubt the future of magnetic recording was Alexander M. Poniatoff, a Russian-born engineer who in 1944 formed a small company in San Carlos, California, to produce electric motors and generators for airborne radar systems. The company name was composed of his initials, AMP, plus EX for excellence. AMPEX.

In 1946, Ampex contracts for airborne radar components came to an end. Mr. Poniatoff set about looking for a postwar product to use the considerable talents of his team of skilled engineers and technicians. Witnessing a demonstration of one of the German prototypes, he concluded that magnetic recording represented the future for Ampex and set to work on the Model 200.

Bing Crosby also played a key role in the launching of magnetic recording. In 1947, Bing was at the zenith of his radio career. He badly needed a way to record his weekly coast-to-coast radio show with sound comparable to that of a live broadcast. He not only purchased the first Model 200 but the first 20 and sold them in turn to ABC. Bing Crosby Enterprises subsequently sold hundreds of Ampex recorders as the company's first distributor.

The professional audio recording field to which magnetic tape recording was first applied today represents one of the smaller segments of the total industry. Consumer recorders, videotape recording equipment, computer tape systems and instrumentation recording apparatus all outstrip professional audio recorders in annual sales.

#### INSTRUMENTATION RECORDING

First of these new fields to develop was instrumentation recording. Early in the 1950s, scientists began experimenting with Ampex audio recorders as a means of capturing and storing scientific information. This began at airplane flight test centers and rocket ranges; where recording and analyzing thousands of test measurements were required with each flight or launching.

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In response to such needs, recorders were engineered to new levels of precision. From the 15,000-cycle-per-second range where high fidelity sound is recorded, they quickly moved up to 100,000 cycles to permit recording of vibration, temperature change, stress, speed changes and literally hundreds of other phenomena.

Ampex produced the first recorder specifically designed for recording instrument measurements in 1951. Today, instrumentation recorders record frequencies from zero (D.C.) to 6,000,000 cycles per second and play vital roles in space exploration, defense, industry and medical science.

#### DATA PROCESSING

The precision which made possible instrumentation recording qualified the magnetic recorder as the basic storage medium for computers when the first giant data processors came into being. Today the data processing industry represents the largest single-user of magnetic recording equipment and tape.

Tape memories were incorporated with computers for the first time in the mid-1950s. Ampex introduced its first computer tape handlers in 1955. Today, tape is standard for large bulk storage of computer data, without which the computer would be limited to extremely small computations. Ampex is a leading independent producer of tape memories and systems for computers -- supplying major computer manufacturers and systems developers throughout the world.

For the most part, instrumentation recorders record scientific information as an electrical parallel or analogy of the original phenomenon. This is called analog recording.

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For computer work, however, information is translated into a code made up of the various combinations of 1 and 0. The information then is arrayed on the tape in the form of a regular series of digits. This is called digital recording.

#### VIDEOTAPE RECORDING

Perhaps the most dramatic development in the brief history of magnetic recording has been that of videotape recording. A videotape recorder records sound and black and white or color pictures on magnetic tape similar to that used with the audio recorder. Top frequency response of the videotape recorder is 5,000,000 cycles per second compared with 15,000 cycles per second for the audio recorder, and 100,000 cycles for early instrumentation recorders. This increase in frequency response was made possible by development of a rotary recording head which moves rapidly across the tape as the tape is moved past the head.

Ampex astonished the television broadcasting industry in 1956 with the introduction of the videotape recorder. The first coast-to-coast pretaped broadcast was "Doug Edwards and The News," November 30, 1956, over the CBS network. Thereafter, videotape recording quickly did for television what the original Ampex Model 200 audio recorder had done for radio. Programs produced in New York could now be held one to three hours for broadcast at comparable times across the country, with quality virtually undistinguishable from the live production.

Television shows and commercials could be produced on tape and edited precisely to remove errors which might take place in a live broadcast. Educators were quick to see the advantages of television tape recordings and the immediate playback of pictures. National Educational Television (NET), sometimes called the fourth network, came into being with stations all across the nation, relying in large part upon video taped programs for its format.

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Videotape recorders are now in daily service throughout the Free World. Sophisticated advances have made possible electronic editing of video taped material and generally made the machines more precise, versatile and reliable.

The development of high band color recording by Ampex in 1964 makes it possible to produce several generations of copies without losing "live" quality.

Recently the company introduced a 48-pound battery-powered portable broadcast videotape recorder and camera combination that allows one man to function as a video production unit. Thus professional video recording can move out of the studio to cover today's fast breaking news events wherever they happen.

Another unusual machine is a video recorder that stores pictures and sound on a magnetic disk instead of conventional tape reels. It is used for color and black and white playback in slow motion and stop action for sports broadcasting and research analysis.

#### CLOSED CIRCUIT TELEVISION

Compact, low cost (\$1,000 to \$3,500, compared to almost \$110,000 for studio recorders) portable closed circuit videotape recorders, introduced within the past few years, are bringing television's familiar "instant replay" into new fields every day. Its potential to solve production problems, multiply instructional effectiveness and, quite literally, to do a thousand things never done before constitutes a great training/communications resource.

Subjects as remote from each other as the ocean floor, surgery, a golfer, a hamburger chef and a rocket engine, an operatic soprano and a giant milling machine are today being eyed by tiny television cameras, then taped by a videotape recorder for a valuable second look.

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The revolutionary technique is rapidly moving into government, industry, medicine, sports, education and the performing arts. In the past year and a half, thousands of recorders in this price class have been sold - several times more than the number of videotape recorders sold in all previous years. Although only a small percentage of these recorders are in use in the home now, the technique's future as a home entertainment medium is most promising. Videotape recording is the fastest growing segment of the magnetic recording field today.

#### HOME STEREO

Home entertainment is another area in which magnetic recording has become an important factor. Prerecorded stereo tapes and the recorders on which they are played are treasured by hi-fi buffs and just plain listeners. Ampex alone manufactures more than 2,200 selections from 64 different labels. All kinds of music, from pop to folk to classical is available on tape, along with language lessons, dramatic readings and historical speeches.

Specialized versions of entertainment tapes have recently been marketed. These include 4 and 8-track cartridge tapes and players, primarily intended for automobile listening, and the newest form - cassettes. Cassettes, tiny plastic boxes which contain tape on two reels, protect the tape from wear, dirt and accidental spillage. These cassettes, and their record/playback systems are bringing tape recorded entertainment to many more people in convenient, low cost packages.

#### DOCUMENT FILING AND RETRIEVAL

Videotape recording took on an added dimension in 1964 with the introduction of the Ampex Videofile document filing and retrieval system.

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The Videofile system uses television techniques to reduce conventional files of paper to compact magnetic recordings on video tape. As many as 250,000 standard pages may be filed on a single 14-inch reel. Files may be located and viewed on television screens or reproduced as facsimile copies in seconds. Information may be retrieved electronically at several viewing/retrieving stations simultaneously, as the documents are never "out of file." Because of the unique properties of magnetic tape, documents may be added to existing tape files wherever desired. They may be erased, relocated, or replaced electronically within the file.

The first Videofile system, a \$1,081,000 project, was delivered to the National Aeronautics and Space Administration, Huntsville, Alabama, where it is being phased into operation. In 1967, a second major system will be delivered to the Southern Pacific Company to speed handling of freight waybills, and a \$2,000,000 system is being developed for Bell Telephone Laboratories to store and retrieve maintenance data. American National Insurance Company has ordered a Videofile system to speed handling of some 23 million insurance policy documents as part of a total management information system, and Sandia Laboratory has ordered a developmental system to handle various filing operations.

Ampex is the only company in the world producing both recording equipment and magnetic tape for every major application in sound recording, computer data storage and video and instrumentation recording. As a result, developments in tape take place in close coordination with parallel developments in recording equipment.

Ampex, which began this remarkable 20 years, has prospered with the industry it has led. Its 14 employees in 1947 have increased to approximately 12,000 worldwide. Its annual sales have grown from \$239,000 in 1947 to \$214 million in the fiscal year ended April 29, 1967.

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It may be difficult to view a \$2.1 billion industry as an adolescent, but most observers agree that the 20-year old magnetic recording industry has just begun its growth. By 1971, an annual industry volume in excess of \$3 billion is forecast.

Included in these forecasts are undisclosed new products and methods which will continue to bring the convenience and versatility of magnetic recording to ever-widening fields of human endeavor.

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PRINCIPLES OF MAGNETIC TAPE RECORDING

Magnetic tape recording is the process of storing and retrieving information of many types that has been converted to electrical signals. Modern electronic equipment allows almost every type of information to be so reduced with minimum of distortion and over a wide range of electrical frequencies.

Consequently, pictures, sound, vibration, acceleration, temperature, numerical and alphabetical information may all be recorded on magnetic tape for instantaneous replay without processing.

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In the recording process itself, a transducer is used to convert picture, sound or other physical phenomena to an electrical current. A microphone is one form of transducer, a television camera another. Magnetic tape, composed of a plastic base coated with minute particles of metallic oxide, is moved past heads which create fields around the tape and so align the particles in specific patterns. For replay, the tape again passes a head and the previously aligned patterns disturb the field of the head to cause electrical signals to be generated which result in the production of pictures, sound or whatever was recorded.

Magnetic heads are electrically energized magnets. A picture to be recorded, for instance, is transmitted to the head in the form of electric signals from a television camera. Variations in the signals cause the head magnet to vary the field it produces and align the iron oxide particles on the tape.

Magnetic tape recordings can be used many times or stored for long periods without significant degradation of the quality of the recording. Unwanted information can be erased by demagnetizing, and the tape can be reused repeatedly.

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MAGNETIC RECORDING INDUSTRY

		<u>Estimated 1967 Worldwide Sales</u>
1. Computer:	Tape transports	\$ 1,050,000,000
2. Audio:	Recorder/reproducers for broadcasting, mastering, duplicating, industrial use, home entertainment, cassettes and cartridges, microphones, accessories and speakers	550,000,000
3. Magnetic Tape:	For all applications - audio, video, computer, instrumentation, prerecorded stereo	300,000,000
4. Video:	Broadcast and closed circuit videotape recorders, receivers and systems	110,000,000
5. Instrumentation:	Recorders and systems for laboratory and mobile use	91,000,000
6. Videofile:	Document filing and retrieval systems	--
Total:		\$ <u>2,101,000,000</u>