ENGINEERING

Sound on the Record

New and improved methods, developed in recent years, will mean better recordings for longer periods of time and at lower cost after the war.

By ROBERT N. FARR

➤ RECORDING sound by new and improved methods, developed since the industry began to expand in recent years, will mean better recordings, for longer periods of time and at lower cost after the war.

Generally speaking, today's recording devices fall into three groups; those that record mechanically, like a phonograph record; those that record magnetically, like the magnetic wire recorder; and those that record photographically, like sound movies. Probably the most faithful reproduction of sound can be secured by the photographic method, since there is no mechanical distortion, but other types of equipment are being studied and improved, so that soon they may be equal to or better than photographic recording.

What are these new recording devices? How do they work? Will they play an important part in postwar business and entertainment? Well, here are some of the answers.

Those small, compact units which record on spools of cellulose tape, movie film or wire, are the latest developments in recording equipment. You can record voice, music, or any other sound for several hours with almost any of these devices at a cost of a few cents an hour. They are an improvement over recording on phonograph discs which limit recording time to 15 minutes or less, depending upon the diameter of the disc used.

One of these devices, the so-called "continuous sound recorder," records on either cellulose acetate or ethyl cellulose tape, the width of 8, 16, or 35 millimeter movie film. One to five hours of recording is possible with film recorders which emboss, side by side, as many as 15 sound tracks on the entire length of the film.

High Speeds

Using various types of microphones, sounds are picked up and converted to mechanical pulsations which cause a jewel needle to vibrate on the surface of the film which moves at speeds of 40, 60, or 90 feet a minute, leaving an embossed record of the sound in the film strip. High speed is necessary so that all tone variations will be recorded. By re-winding the film, which is spooled on reels like movie film, the sound can be reproduced through an amplifier, using a magnetic pickup fitted with a jeweled stylus similar to that found on the best electric phonographs.

Jewel-tipped needles are used because jewels such as diamonds, sapphires, and rubies are harder than steel and resist wear over a longer period of use. When a needle becomes worn, it develops ridges in its outer surface which leave an imperfect record of sound on the film or disc, and cause mechanical surface noise when the recording is played back.

Record Any Sounds

One continuous cellulose tape recorder now in wide use with the armed forces and by the government was developed by William Wolf and is called the Recordgraph. Another similar device was invented by J. C. Fonda, ex-Hollywood cameraman. Mounted in a single case, containing both recording and reproducing equipment, the units weigh less than 50 pounds. They can be used to record any sounds, operating on 110 volts, 60 cycle alternating current, or with adapters, any other type of current.

The Recordgraph, which embosses sound on film with a sapphire-tipped needle, was used to record a report of the Normandy Invasion and the first B-29 raid over Tokyo. These recordings were broadcast over the entire world.

You can start the Recordgraph by turning on the current and speaking into the microphone. An automatic switch starts the machine when sound begins to come over the microphone, and stops the recording when the sound stops. With this device it is possible to record under conditions of extreme vibration, and you can record with the machine in an upside-down position. A new-type volume control automatically prevents booming sounds, such as roaring gunfire or the zoom of planes, from drowning out other sounds. This is accomplished by compressing loud sounds with an electronic amplifier.

Still another similar recorder is known commercially as Millitape. A coating of black gelatin is put on standard eight-millimeter film, making it opaque. Millitape uses a sharp pointed recording needle which cuts through the coating, leaving a transparent sound track where the needle has passed. The recorded sound is reproduced by running the film between a beam of light and a photoelectric cell which converts the visible sound track into electric impulses, which are in turn amplified and reproduced through a loud speaker.

Recording on film by the mechanical methods described above is probably the most economical way to permit you to make permanent recordings that can be played back immediately. The big disadvantage is that duplicate copies cannot be made without re-recording on new tape, using the original film as a source of sound. Re-recording devices are expensive, costing from $600 to $1,500, yet, even at such high cost, they are less expensive than many other types of recording devices that give comparable quality of sound recording and reproduction.

USES WIRE—This portable pocket model of the magnetic recorder can be carried around with you to keep a permanent record of interviews, important events and even concerts.

RECORDS HISTORY—Important events are recorded vividly in the words of the men who make them by a cellulose tape recording device. One of many kinds of recorders to be available after the war, this instrument can record up to five hours without stopping on 35 millimeter film.

Probably the most recent development in recording is the magnetic recording of sound on a spool of steel wire 0.003-inch thick, almost as fine as a human hair. The idea was based upon the invention of a Danish professor, Valdemar Poulsen, in the late 19th century, and has only recently been perfected and produced commercially.

The wire is drawn at a speed of 1.25 feet a second past the iron cores of a set of coils, and speech or sound current, passed on from the microphone, is converted into a magnetic pattern on the wire. When the wire is drawn past a set of reproducing coils, current induced by the magnetic pattern is picked up by the coils and converted into sound through an amplifier and loud speaker.

Sound can be wiped off the wire, so that it can be re-used almost indefinitely, by passing it through a magnetic field that neutralizes the magnetic pattern. Any part of the wire can be erased without harm to the sound recorded on adjacent parts. If the wire breaks, it can be "welded" together by tying the two ends and applying the heat of a cigarette.

The wire is unaffected, so far as sound is concerned, by temperatures and humidity conditions that might ruin cellulose tape or film. The unit is comparatively unaffected by external vibration and severe shock.

The unit is small, compact, and expensive. Some 15 commercial firms, including Armour Institute, General Electric, Stromberg Carlson, and Raytheon are experimenting with postwar applications of the device. One version is a three-pound battery-operated recording unit in a plastic case that can be carried around like a small camera. Using a lapel or hand-held microphone, up to one hour can be recorded on the 1,720 feet of wire on a reel in the unit. An automatic device prohibits further recording when the end of a spool is reached. Another magnetic wire recorder, called Soundex, employs two darning needles as the magnetic poles for setting up the sound pattern on the wire.

The main problem today with the magnetic wire recorder is that the wire has to move at a speed of about 225 feet a minute to pick up sound so that faith-

Do You Know?

There are 1,200 military uses for *lumber,* it is estimated.

Oklahoma leads the United States in the production of broomcorn.

Alcohol is being made from waste and surplus bananas in Jamaica.

Chemotherapy, the internal treatment with chemicals, is being used to combat Dutch elm disease in Connecticut.

Fifty different *enzymes,* all proteins, are known to be present in skeletal muscle.

The catch of *lobsters* on the coast of Maine last year was 14,500,000 pounds, the largest since 1892.

Turkey hens normally produce from 40 to 60 eggs during the spring months, and few if any during the other months.

ful reproduction will result. At present the wire moves at a speed of 75 feet a minute. At the higher speed for good recording, you would need 9,000 feet of wire for 40 minutes of sound. Even with very thin wire, such lengths make the spools bulky, and the cost of Swedish steel wire, needed for best results, is high.

The motion picture industry uses either the RCA Photophone or the Western Electric systems to record sound on film. These processes are entirely photographic and eliminate mechanical distortion caused by needles and surface noise.

A beam of light, passing through a slit made by two pieces of metal which vary in width depending upon the sound picked up by the microphone, flashes upon the film "dashes" of varying width. This is the Western Electric variable density method of recording sound photographically.

Variable Area System

The other method is called the variable area system, and is used by RCA Photophone. In this case the intensity of the beam of light, projected on an oscillating mirror, throws a solid blot of light on the film which varies in area depending on the sound current from the microphone.

In the sound motion picture projector, when the sound track printed beside the pictures is passed between a beam of light and the photoelectric cell, the variations in area or density are converted into electrical impulses which in turn create sound waves in loud speakers mounted behind the screen.

The photographic method of sound reproduction is not suitable for immediate play-back, since the film must be developed and printed like motion pictures before it can be reproduced.

Recording sound was done by Edison in 1876 on a cylinder, but the modern disc or platter was the idea of Emile Berliner. Today, about 90% of the recording done is on these record discs similar in shape to the phonograph records that you buy at music shops. The discs themselves are made of cellulose acetate or vinylite resin spread thinly over a disc of glass, aluminum alloy, or paper composition.

Aluminum alloy discs are also used for recording without any coating. Very sharp steel alloy or jewel-tipped needles cut into the surface of these records at recording, leaving a spiral sound track. Since they require no processing, disc recordings can be played back immediately.

Modern recording equipment for "canning" sound on discs consists of a turntable like that on a phonograph, a recording needle mounted in a "recording head" and a pickup for playing back the recording. The recording head is connected to the microphone through an audio frequency channel, while the pickup is connected to a loudspeaker through an amplifier. The records you play on your home phonograph are usually 10 or 12 inches in diameter and run at a speed of 70 revolutions a minute.

There are two ways of cutting a sound track on a disc record, lateral or vertical. The vertical method was employed by Thomas Edison in the first recording machine which he built. The indentations of the cutting needle are impressed on the floor of a groove in the record so that the sound track resembles a continuous stretch of hills and valleys caused by varying impressions of the needle on the acetate.

The early disadvantage of vertical recording was that in playing back the record, the pickup needle would jump from the top of one hill to the crest of the next, skipping the valley. Recently, however, Western Electric has overcome this by suspending the playback needle arm so that the needle itself carries no weight, and follows the true pattern of the groove.

Emile Berliner developed the lateral method of recording. By his method the needle cuts into the side walls of the sound track so that *(Turn to page 366)*

From Page 364

instead of a vertical movement, the needle moves from side to side. On this type of record, microscopic examination shows that there are no hills and valleys as in the vertical record. All recording equipment in use today, except that made by Western Electric and Fairchild, uses lateral recording. Both types of recordings can be played back on any good reproducing machine.

Professional disc recorders are produced by Presto, Fairchild, and Speak-O-Phone and others in portable units mounted in suitcases. Many manufacturers, including RCA, Scully, and Presto make professional studio equipment for stationary permanent installation. Home recording devices are manufactured by Wilcox-Gay, RCA, Emerson and others.

One of the latest developments in disc recording and reproducing is a sound pickup device for playing back recordings that rides in the groove of the record, eliminating entirely the pickup arm which heretofore held the needle. It consists of an L-shaped metal weight with a felt pad to protect the record on one branch of the L, and the needle with an electrostatic pickup on the other branch. Wires run from the device to the detector and amplifier. In operation, the device is set in the outside groove of the record by hand and, riding the groove, it travels the spiral path toward the center of the record. Supported only by the record itself, it picks up mechanical impulses as it moves along, which it converts into electrical impulses and then to sound.

Another new device is the Soundscriber, designed for office use. Employing an eight-inch vinylite resin disc, it will record up to 30 minutes of voice at slow speed. It can be used to record dictation, important telephone conversations or conferences. The records are small and unbreakable, so that they may be conveniently filed in a correspondence file for further reference. The big disadvantage of this otherwise handy device is that it records so many sound tracks so close together on the small disc that while the words are understandable, the voices do not bear much resemblance to those of the speakers.

One of the most recent combination recording devices, called "Radiotone" commercially, has been developed for the use of schools, industrial plants and institutions. This unit combines a radio, recording device of the professional type, and a public address system. Built by the Robinson-Houchin Optical Company, it may be used to record programs off the air from its built-in radio, from the public address system, or in the regular manner.

A fourth development, recently patented, is a recording device that will answer your telephone while you are away from home, record any message that the caller leaves, and play to the caller a recording of any message you wish to leave for him. It consists of two or more turntables mounted close together. Any turntable may be used for recording or reproducing. When your telephone rings, the vibrations of the bell actuate a detector which connects the telephone to the apparatus. The reproducing pickup is lowered to the record you have recorded and your message is played for the caller. Then a gong rings, and the caller is instructed to begin giving the message he wishes to leave for you.

BOTANY

NATURE RAMBLINGS
by Frank Thone

Thorns and Thistles

➤ WEEDS have been recognized as the gardener's worst enemies ever since the first garden was dug. "Thorns also and thistles shall it bring forth to thee," was the heart of the curse imposed on Adam; cause enough that he should eat bread only "in the sweat of his face." And no gardener since that luckless arch-ancestor has been able to evade the burden of hoeing or pulling up weeds.

Wherever man has gone, his weeds have gone with him. We know little enough about the origin of our field and garden plants; most of them came into cultivation before the beginning of written history, so that records are in the very unsatisfactory state of having no beginning. And, naturally enough, we know even less about those illegitimate waifs, the weeds, than we do about the more favored children of our gardens.

We have been able, though, to get some idea of how adept weeds are at stealing rides into new territory from the way they travelled into the New World when our European ancestors came over here. They brought with them a large proportion of our common garden and field crops: lettuce and rad-