

# Embossing Sound on Film

By  
**STANLEY KEMPNER**

**F**ROM the War Crimes Trial in Nuremberg, Germany, from airports dotting the United States, from radio testing stations of famous railroads and from remote Navy radio stations around the world, reports have been coming in of post-war applications of instantaneous recording on film by embossing, requiring no processing. A few of the multitude of current uses of these film recorders which made history throughout the war, are to be found in police and fire departments, public utilities, Federal bureaus, newspapers, control centers and other spots where recording speech and sound is essential. The many unusual features of this instrument are proving themselves in these installations.

During the war the film recorders brought brilliant word pictures and the actual sounds of battle from Normandy, Holland, robot launching bases in France, from Paris, Guam, Saipan, Peleliu, the Philippines, Japan, and elsewhere, to radio listeners throughout the world.

Undoubtedly the most publicized and probably the best-on-the-spot reporting during the invasion of France on D-Day was the recording on film made by George Hicks, Blue Network announcer. Throughout the blaze of the anti-aircraft batteries and the heavy firing from both ships and planes, the correspondent kept up a running commentary on the action. From the deck of an Allied warship, the flagship of a U.S. naval task force, Hicks described the action along the coast and the attack on the convoy by JU-88 bombers.

Gun 42, a 40 mm. twin-barrel anti-aircraft gun beside the microphones, succeeded in downing one of the Junkers. The recording caught not only the sound of the firing but the plane

falling into the Channel, and also the cheers and shouts of the men at the gun positions as they gloated over their first "kill."

All four major networks played the recording back at least six times and individual radio stations rebroadcast it innumerable times. One station played it 17 times. The British Broadcasting Company included the Hicks recording in its home report and short-wave and armed-forces broadcasts. The Canadian Broadcasting Company also put it on the air.

The machine used by Hicks was the *Recordgraph*, a film recorder which operates on the same principle as the familiar record or transcription machine except that its recording needle embosses grooves in parallel lines on a 50-foot film belt instead of on a disc. The film itself becomes the record and, without processing, can be played

back, as on a dictaphone or phonograph, by running a pickup needle along the embossed groove. One film belt can record about 97 minutes (one hour and thirty-seven minutes) of sound at 60' per minute on a single side.

Use of a film recorder for combat purposes was no accident. Through earlier tests, the navy had found that film recorders, rather than disc or wire machines, would be best suited for the invasion operation.

Recording machines were borrowed by the networks from the Navy, and technicians thoroughly drilled in the use of the sets by the Naval engineers.

A few days before D-Day, correspondents and technicians were called with full equipment and put through final rehearsal. Just before the push-off they were sealed in ships with the troops. Each network team carried

Nelson Wells, engineer, explains to Russell Maguire, president of Maguire Industries, operation of the recorder unit included in a radio installation for Reading Railroad.



***This war-proven recorder employing 35 mm. cellulose acetate film will find many peace-time applications.***

two recording kits weighing 50 pounds, about the size of a portable typewriter. Spare parts were supplied by the Navy.

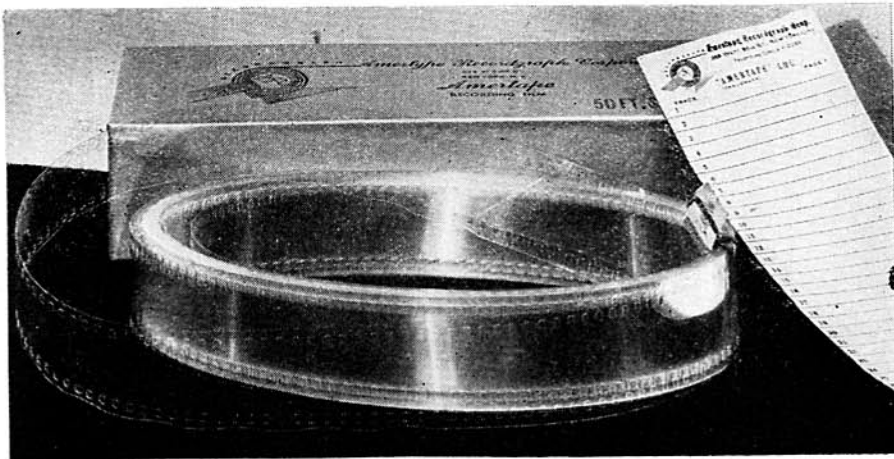
In contrast to the mechanical process of recording sound on film as used in the *Recordgraph*, recording on wire is done with an outfit that translates sound waves into fluctuations of a magnetic field and records the fluctuations in the form of altered molecular patterns in a fine wire passed through the field.

Still different is the process of making the sound track on motion picture film, in which the sound waves are transformed electrically into light rays and photographed and reproduced by photoelectric cells. This means costly photographic development methods and time delay.

*Recordgraph* film recorders operate on 110-volt a.c. When this is not available, transformers, generators, or batteries may be used. Use of recorders to cover fighting on land was thus somewhat restricted since it would be difficult to lug the power supply from foxhole to foxhole. In Normandy when the recording machines were taken from the boats to the beaches, mobile generators supplied the power.

The combat recorders proved they were sturdy enough to stand the strain imposed upon them. Charles Collingwood, of the Columbia Broadcasting System, carried his apparatus from an LST to an LCP and went right up on the beach. During the journey the recorder was doused repeatedly with spray and salt water. The announcer was certain it would not work. In fact, in this recording he stated that "it looks like we owe the Navy Department one recorder."

Other correspondents reported that the recording sets jumped as high as six inches off the deck during gunfire while crossing the channel from England. One commentator took the film recorder on a bombing mission in a B-26 Marauder and made one of his



Fifty foot roll of 35 mm. cellulose acetate film on which sound is embossed.

best broadcasts. Some sets were caked with dust when used to cover landings. Yet all the sets came out of the operation in good condition.

Censoring was done by running off the original film and re-recording its contents on copy, or dub, film. The copy which is just as good as the original is used for actual broadcasting. When a censorable word, sentence or phrase is noted, monitors simply switch off the dub machine until the objectionable content is passed. So precise is the process that words and sometimes infinitives can be split.

The *Recordgraphs* are the result of more than eight years of intensive research and development, together with a comprehensive study of the widely varying requirements of the many governmental and civilian agencies.

The portable unit is a compact completely self-contained unit with no extraneous equipment and weighs 50 pounds. It is furnished in a valise-like case, making it relatively easy to handle and transport. Its over-all size is 18½" x 13½" x 9½".

This machine records in any position and recordings can be made even though the machine may be upside

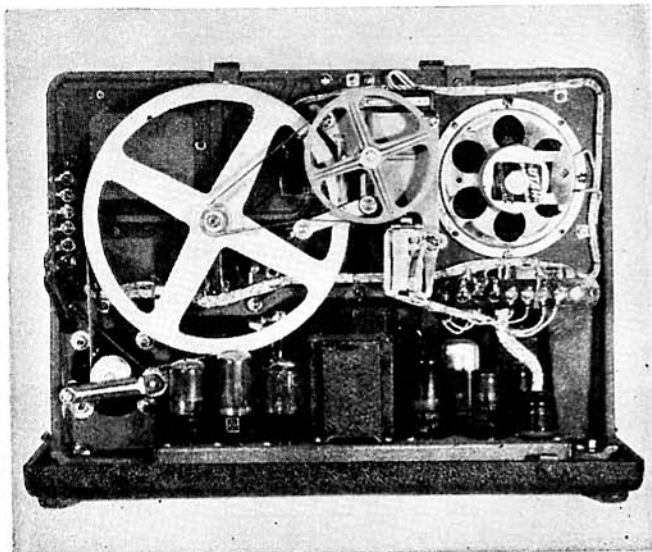
down or subjected to extreme vibration. Upon completion of any recording, the same machine immediately plays back.

Either manual or automatic control of the machine may be selected at will. The automatic device for starting and stopping is called Audio-trol. When using this, the voice or sound signal is used to "trigger off" the starting clutch. This is accomplished by having the output of the amplifier operate a thyatron tube (2050) which in turn energizes the clutch relay. Delay time to start is 1/10 second and the hold over time is from 4 to 6 seconds. Thus the loss of sound is negligible.

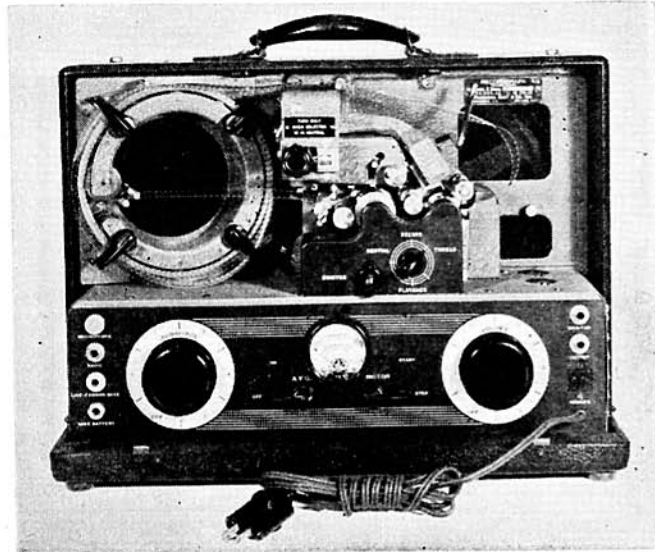
The *Recordgraph* film is a 50 foot continuous belt with a recording capacity of 5750 feet on one side. If desired, both sides of the film may be used in which event, the footage is doubled. For recording at a 40 foot per minute film speed a continuous (one side) recording of 2½ hours may be had, while at 20 foot speed, using both sides, 9½ hours recording of a satisfactory monitoring or reference quality may be obtained. With the

(Continued on page 106)

Rear view of the portable recording instrument.



Front view shows path of film through Recordgraph.



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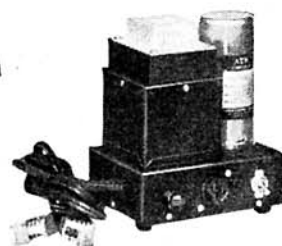
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## Embossing Sound on Film

(Continued from page 37)

Audiotrol feature operating, this recording time is further extended to many hours or even days of intermittent recording on one 50 foot film.

The sound is permanently embossed on 35 mm. cellulose acetate film which is manufactured to specification by the Eastman Kodak Company. The base material is fire resistant, free of abrasive, tough and good for a surprising number of playbacks. It sells for \$1.50 per roll which brings the recording cost down to 15.6¢ per hour for 9½ hours. No processing of the film is necessary by the user. The film is supplied in a box 10" x 3" x 2" and is usually returned to the box after use for safe storage. It should be noted that permanent storage of the record therefore, presents a simple problem.

The machine has the following structural features:

1. Selection: flip of the switch selection of public address, recording, playback or threading.

2. Continuous recording with automatic track over from groove to groove in the film as required. 115 tracks are permissible on one side of the film.

3. A means is provided for the recording and also the locating of a particular track when desired for playback.

4. A 114 db. gain high quality amplifier is used. Frequency response is 2 db. from 300 cycles to 10,000 cycles. Various input circuits automatically give desirable gains for intended uses. Output impedance 6 ohms. The input and output circuits are listed below.

Input circuits—(not simultaneous) are as follows:

- (a) Microphone—½ megohm impedance, 114 db. gain.
- (b) Radio—½ megohm impedance, 85 db. gain.
- (c) Line Input—1000 ohms impedance, 90 db. gain (d.c. impedance infinity).
- (d) Carbon Microphone—1000 ohms impedance (for 100 or 200 ohm carbon microphones) with self contained batteries.

Output Circuits—

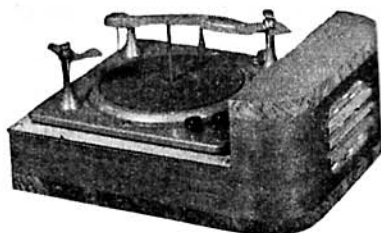
- (a) Self-contained 5 inch permanent magnet speaker.
- (b) 6 ohm jack (interrupting signal to speaker).
- (c) Monitor—Direct connection from playback head.

Volume meter is provided for easy adjustment to correct recording level. Automatic volume control is optional by flip switch and is designed to accommodate 30 db. input signal variation.

The Audiotrol, described above, has a sensitivity control permitting operation on an input signal from 0 to -13 db. based on the required average recording level. This means that the

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5CP1	803	1201	VR150-30
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signal to noise ratio of the incoming signal should be 20 db. for really good operation.

5. Frequency Response—input-to-recording-to-output-on-playback 300 to 4500 cycles on the standard machine. 5000 cycle and other special machines have been produced to order.

6. Recording Head—balanced magnetic type, sealed against dirt, having an impedance of 9000 ohms at 1000 cycles-per-second.

7. Playback Head—balanced magnetic type, sealed against dirt, having an impedance of 9000 ohms at 1000 cycles-per-second.

8. Stylus—both Playback and Recording styli are of special design and are of the permanent sapphire type.

9. Mechanical—design is such that permits of ready accessibility for replacement and service.

(a) Bearings—Oillite.

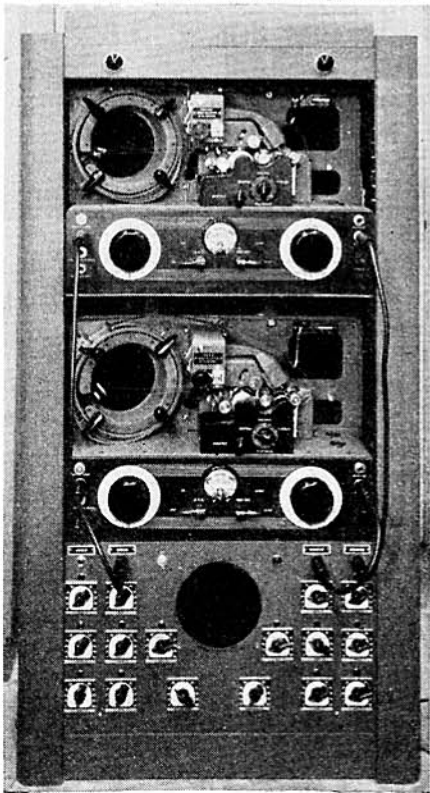
(b) Motor drive—self-aligning sleeve bearings, shaded pole induction motor with dynamically balanced rotor.

(c) Machine divided into three main parts, carrying case, mechanical frame and amplifier. Simple and easy to separate.

10. Monitor—the monitoring method in the *Recordgraph* is greatly appreciated by all professional recording men, for the actual recording as embossed in the film belt is played back as against the usual method of tapping directly across the recording head. Thus a true picture of the actual recording is had.

The recorder is currently being used for police communications recording,

Rack model with multiple mixer and dual *Recordgraph* units which will record continuously for 19 hours and intermittently for many days without supervision.



authorized telephone recordings, investigations, conferences, radio interception, sound analysis, training purposes, narration, at control centers, on ships, for mobile equipment, and wherever else permanent recording of sound, speech or code may be wanted.

—50—

### Photo-Electronic Organ

(Continued from page 27)

a rubber belt or endless V belt would also work. If a leather belt is used, the splice should be sewed with thread, as this will be found more satisfactory than a wire splice.

The octave assembly and keyboard slides into the cabinet along two supports and is held in place by tightening two bolts attached to wood clamps. See Figs. 2 and 5. This type of construction facilitates removal for service and adjustments.

Speakers were mounted in separate cases, but they could easily be mounted in the cabinet if desired. There is a disadvantage in mounting them in the cabinet; trouble may be experienced from feedback, and for this reason it is desirable to mount them separately. Most commercial installations of instruments of this type require separately mounted speakers.

Almost any high-gain amplifier with a power output of 15 watts or more may be used with the Photo-Electronic Organ. The connections from photocell to amplifier are standard practice and are shown in Fig. 3B. Voltage on the 868 or 918 phototube must be kept at 90 volts or below by means of a suitable voltage divider network which can usually be coupled to a screen voltage circuit. It is desirable to include provision for radio and phono pickup in case these are not already included in the mixer circuits of the amplifier used. Of course, a home constructed amplifier can be used, and perhaps some advantage gained, since the construction of a suitable amplifier presents no special problems. One thing to avoid in the amplifier is microphonics, and, to avoid the possibility, it is desirable to mount the entire amplifier on a piece of sponge rubber rather than to fasten it directly to the cabinet.

As will be noted by referring to the diagram, Fig. 3A, the power supply for the lights really consists of two separate supplies wired in series. In building this power supply, use power transformers and chokes that will carry the heavy current, as the output requirements are 250 ma. at 575 v.d.c. to light the five 25 w. 115 v. lamps. Using bakelite for the chassis base rather than metal will help to prevent shorts and unwanted grounds. Since one power supply is to be operated at a high potential from ground, it is also well to use caution in touching any of the parts when the current is turned on. Filtering, as shown, was found to be adequate to suppress hum,