

# Sound-on-Film Recording

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**T**HE *Recordgraph*, like most inventions, was mothered by necessity. Suppose you were faced with any one of the following problems:

(a) You are charged, say, with the responsibility of apprehending a ship believed to be engaged in smuggling. The extent of the smugglers investment in ship and cargo makes you reasonably certain he will not risk a landing without communicating with his land accomplices to lay carefully timed plans for landing, unloading and disposing of the goods, and probably to get reports on the whereabouts of any known law enforcement officers. You set up radio equipment to scan the airways on all suspected wave lengths. You cannot personally remain at the radio dials day and night, and must therefore trust to the cooperation of assistants, not all of whom are equally skilled in languages, signs, codes, etc., so you resort to *recording* all radio audio signals in order that they may be studied deliberately and in detail. But to keep a complete record of all possible communications you find you are recording for days and weeks on numerous frequency bands, piling up hundreds of useless records at great expense in material and labor in order to get those few terse sentences you are looking for.

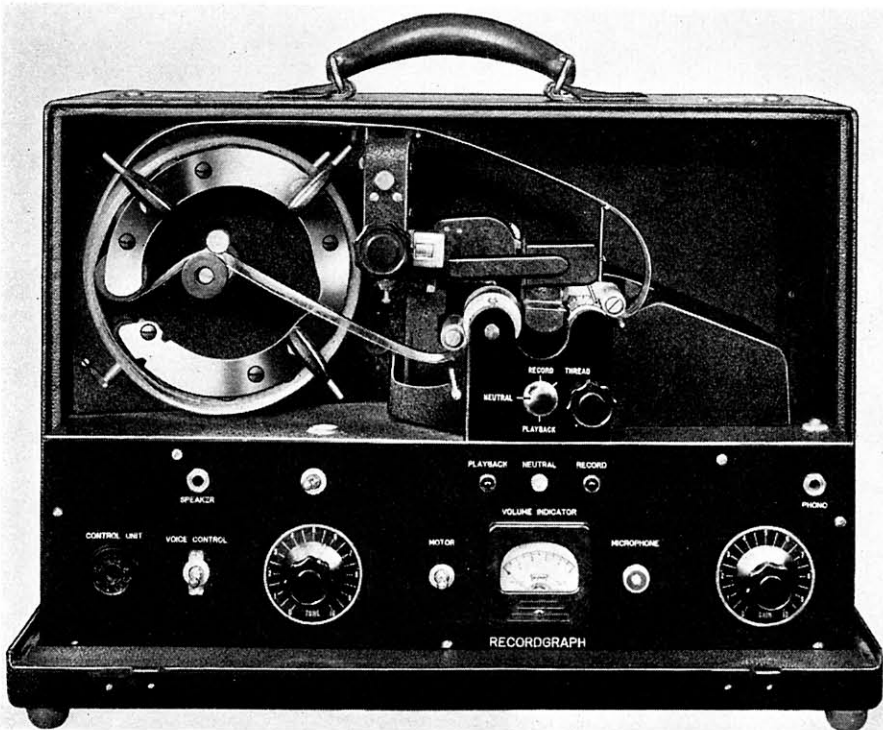
You need a recorder that is always ready, that goes into action automatically when the signal starts; stops when the signal disappears, and makes a faithful record of the signal received, whether or not the attendant was alert at the moment of its coming.

(b) Or you may be the engineer in charge of traffic control at a large city airport such as LaGuardia Field, New York City. In order to place responsibility and to make both pilot and control tower operators extremely careful, you install recording machines to record all messages between incoming pilots and the control tower. To do this you are compelled to cover some 16 radio frequency bands. The cost of keeping men available three shifts per day seven days per week to change records is prohibitive; nor do you wish a machine which runs all the time, but runs only when a signal is to be recorded in order to save expense on record materials. Again you need a recording machine which starts automatically with the incoming signal and stops when the signal disappears.

(c) Your problem may be that of the manager of a large power plant in which you record all orders to and replies from the dispatching room where an error of judgment or execution may prove very costly.

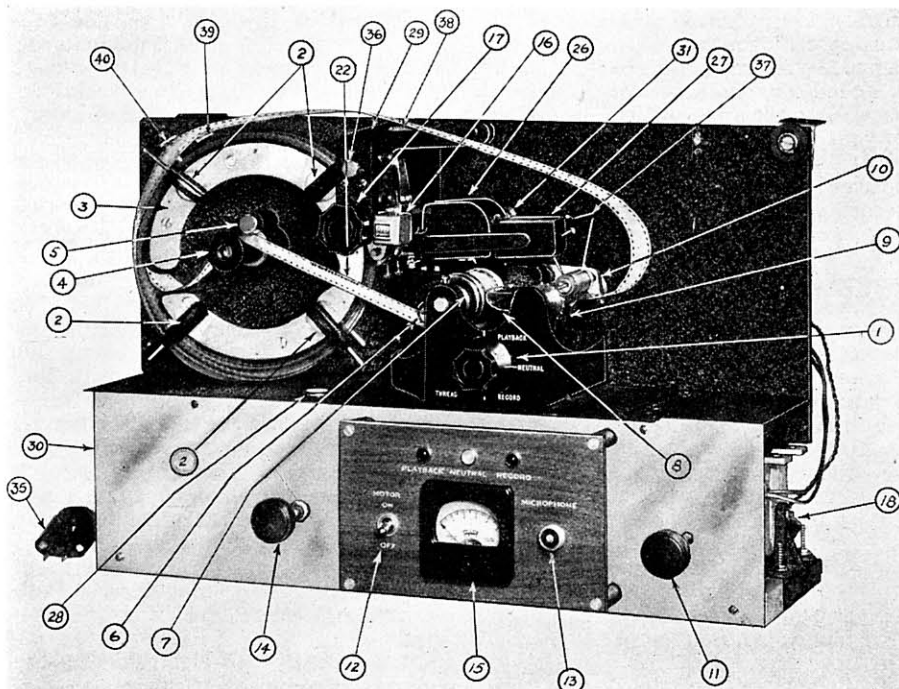
(d) Or your problem may be that of a postal inspector, a narcotic officer, a member of the F.B.I. or member of the state or city police force whose job it is to detect crime. With

***Longer playing time at lower cost are but two of many features found in sound-on-film recording.***



A portable model film recorder, ready for service at a moment's notice.

Fig. 1. Identifying numbers on the parts are fully explained in the text.



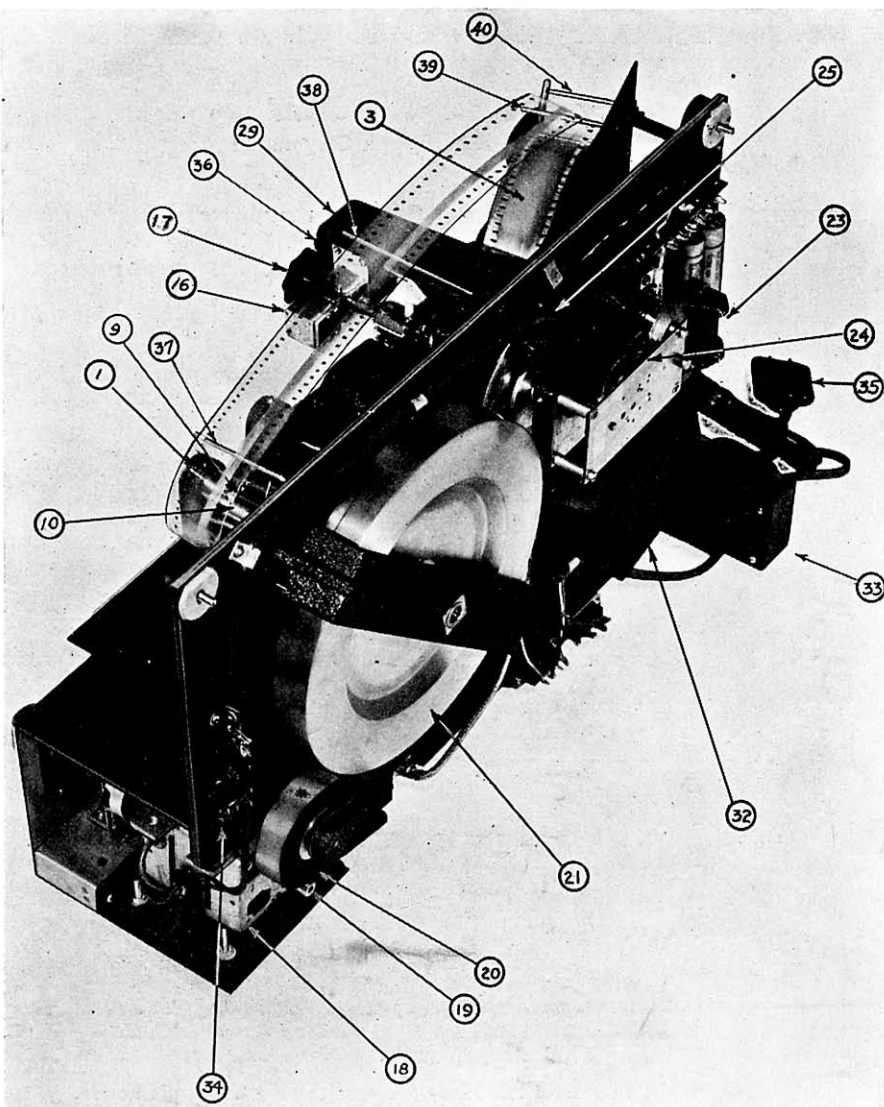


Figure 2. Back view shows heavy flywheel, used to stabilize speed. The assembly is very compact, in spite of the many parts required.

microphones planted and concealed in strategic hideouts or with telephones tapped, you may wait days for the watched-for signal. You require a recording machine which, regardless of your presence, will flash into action, recording every message and stand-by between messages without wasting recording material.

To solve such problems the *Record-graph* recording machine has been developed. It records on 35 mm. safety cellulose acetate unemulsified film. It starts automatically with the incoming of an audio signal; it stops automatically when the signal decays. It records with a permanent stylus which requires no sharpening or replacement and plays back with a similar stylus. The recorded message may be reproduced immediately after the recording is completed or if desired it may be reproduced while the recording is being made. The recorded signal may be amplified for loud speaker listening or it may be listened to by headphones without amplification. A film roll of sufficient size to last for 8 to 12 hours of actual recording can

be placed on the film magazine at a single loading. For intermittent recording this may prove to be enough film to last for one to two weeks, depending upon the duration and frequency of occurrence of the incoming signals. Recording may be made on both sides of the film without removing it from the machine or without any interruption to change the recording from one side to the other. At a film speed of 20 feet per minute and recording on both sides, only 6¼ feet of film are consumed per hour of continuous recording, there being 100 sound tracks available on each film. A Compressor in the amplifier tends to record weak signals with adequate volume without over recording the strong signals. The needle scratch level is very low. Frequency response, though less than that of high fidelity recording, is better than telephone quality and far superior to that of current dictating machines. Both speech and music are of a pleasing quality.

Mechanically and electronically the instrument consists of devices to per-

form the following functions:

- (1) Means for propelling the film.
- (2) Means for supporting and controlling the film.
- (3) Means for effecting intermittent action of the film.
- (4) Means for recording and reproducing.
- (5) Means for moving the recording head and pick-up laterally of the film in order to advance from track to track.

#### **Means for Propelling the Film**

(See Figs. 1 and 2)

The film is propelled by a sprocket wheel (9) mounted on the same spindle with the fly wheel (21). The fly wheel is driven by a motor (18) provided with a pulley (19) which drives the rubber idler (20) thus rotating the fly wheel (21) and driving the sprocket (9) which propels the film.

#### **Means for Supporting and Controlling the Film**

(Fig. 1)

The film is retained in the form of a roll on a magazine (3). A loop of film takes off the inside of the magazine between rollers 4 and 5, passes under the recording drum idler (6), over the recording drum (7), under the safety switch bracket (8), over the sprocket (9), under the sprocket idler (10) and back over film guides (37, 38, 39 and 40), to the outside of the film roll on the magazine.

#### **Means for Effecting Intermittent Action of the Film**

The spindle, which is co-axial with the sprocket (9) and the fly wheel (21) is in two pieces, the two pieces being also co-axial. It will thus be seen that the fly wheel may rotate without causing rotation of the sprocket. The two abutting ends of the spindle are equipped with a toothed clutch which is normally open. With the incoming of an audio signal, however, a portion of the output of the audio amplifier is used to energize a relay which in turn causes the toothed clutch to close. When closed, both ends of the spindle are caused to rotate together, the fly wheel thus driving the sprocket. With the decay of the incoming signal the clutch opens, the fly wheel continues to rotate, but the sprocket is idle, thus when no signal is being impressed on the amplifier the sprocket does not rotate and no film is consumed. With the incoming of a signal, however, the sprocket goes into immediate action and the signal is recorded. The time required for the clutch to close is about 1/200 of a second.

#### **Means for Recording and Reproducing**

By means of a single knob (1) the instrument is set in any of its four positions, namely, Record, Neutral, Playback and Thread. Cams on a shaft which is turned by knob (1) (see Fig. 1 and drawing 132) perform all the necessary functions to convert the instrument into the above four positions.

When the arrow on the knob is turned to the "Record" position, the Recording Head (26) is lowered with

its stylus on the film by means of the Recorder Lifter Arm and the Record Cam. The Pick-up (27) is lifted by the Phono Lifter Arm and Phono Cam in order that its stylus clear the film. The incoming audio signal which is fed to the amplifier through a shielded plug (13) and may originate in a microphone, telephone, a radio tuner or a phonograph, is connected to the input of the amplifier by means of a 3-position four segment switch rotated by a U-shaped member M which is rotated by a pin N attached to a gear wheel L which in turn is rotated by gear K attached to the shaft which is rotated by knob (1). The output terminals of the amplifier are connected to the coil of the Recording Head and the toothed clutch is operated as above described which sets the film in motion thus recording the incoming signal.

When the knob (1) is turned so that the arrow points to "Neutral" as shown in Fig. 1, the Record Cam raises the Recording Head clearing the stylus from the film by means of the Recorder Lifter Arm and the rotation of the shaft rotating gears K and L by means of pin N, rotates the U-shaped member M, thus setting the four segments of the three position switch to a new position in which the Recording Head is disconnected from the output of the amplifier and the loud speaker is connected in its place, thus converting the instrument into a public address system.

When the knob (1) is turned to the "Playback" position, the Phono Cam permits the right hand end of the rocker arm beneath it to rise, thus causing the left hand end to fall and with it the Phono Lifter Arm is lowered, permitting the pick-up stylus to rest on the film and in the groove formerly made by the Recording Head. The rotation of the shaft at the same time sets the four segment three position switch in a position which disconnects the microphone from the input circuit of the amplifier and connects the pick-up thereto, thus connecting the signal from the pick-up to the amplifier and out through the loud speaker.

By turning knob (1) to the "Thread" position, the Thread Cams A and B raise rollers 6 and 10, thus permitting the operator to remove the loop of film from the sprocket and recording drum. By turning the four film magazine knobs (2) through 90 degrees, the roll of film may be removed from the magazine.

#### **Moving the Recording Head and Pickup Laterally from Track-to-Track**

Recording film is provided for in the *Recordgraph* in the form of a continuous loop. As above stated, the loop is wound into a roll of several turns which fit over the magazine (3) leaving a portion of the loop to be threaded over the recording drum and sprocket, and back to the roll. An ingenious splice connects the two ends of the film to make a continuous loop.



The stationary model is ideally suited to Governmental Agencies, Schools, and Radio Listening Posts. It is equipped with monitor-playback speaker.

The splice has the same thickness and sound-characteristics as the parent film so that no unusual sound is made when the needle passes over the splice. The film is also provided with a number of small metal contacts (22).

Each time the film makes a complete round these metal contacts pass between rollers 4 and 5 thus closing a circuit which energizes relay (32) which in turn closes a contact and energizes the carriage motor (23). The carriage motor (23) drives a train of reduction gears (24). A spindle of the last gear of (24), with its speed greatly reduced, drives a disc (25) through a friction clutch which may be seen on Fig. 2.

The disc (25) consists of 3 concentric discs, the central disc serving only to space the two outside discs slightly apart. Each of the outer discs, known as the Indexing disc and Locking disc, respectively, is provided with 15 notches, the notches of the two discs

being cut in the opposite direction. In the "Record" position, a locking cam on the shaft turned by knob (1) permits a Lock Index Arm to engage the notch of the Locking Disc (25) which prevents the operator from inadvertently moving the recording head laterally of the film by means of knob (17) and the mechanism hereinafter described. In any other position than the recording position, the Locking

Here's the film compared to a pen.





Cam removes the Locking Index Arm from the notch in the Locking Disc.

The Release Cam removes the Track Index Arm from meshing with the Indexing Disc when the instrument is set in the "Neutral" position, but in all other positions the Track Index Arm is meshed with the Index Disc. Through the center of the three concentric discs and co-axial therewith and at right angles thereto, passes a worm which terminates at its rear end in the discs and at its front end in knob (17). It will be apparent that the turning of knob (17) turns the Index and Locking discs. Also geared to the worm is a counter (16) so geared to the worm that one complete turn of the worm causes the counter to increase by 15 numbers. Since there are 15 notches on the Index Disc it will be apparent that as the Index Disc is rotated through the angle from one notch to the next (24 degrees) the counter will show an increase or decrease of one number depending on which direction the knob (17), the worm and the index disc are turned.

When the knob (17) is turned counter clock-wise (view from the front),

the counter decreases; when it is turned clock-wise, the counter increases. It will be apparent that the knob (17) is locked against turning clock-wise by the Track Index Arm in all positions except the Neutral position. It will also be apparent that the knob (17) is locked against turning counter clock-wise when the instrument is in the "Record" position. Geared to the worm by a nut is a carriage which supports the Pick-up and Recording Head. When the carriage motor (23) is energized it rotates the Index Disc clock-wise (viewed from the front), rotates the worm and knob (17) clock-wise and moves the Pick-up and Recording Head laterally of the film toward the front of the instrument.

When, by means of knob (17), the worm is rotated counter clock-wise the Pick-up and Recording Head move laterally of the film away from the front of the instrument. When the metal contacts (22) carried by the film pass between the rollers 4 and 5, energizing relay (32), the relay pulls the left hand end of the track index arm out of the notch and closes a

switch not shown which energizes the carriage motor. With the Track Index Arm removed from the index disc notch, the disc is free to rotate under the propelling influence of the carriage motor until the next succeeding notch reaches the pawl of the Track Index Arm, at which time the pawl fits into the next succeeding notch and opens the contact to the carriage motor, thus de-energizing it.

The motor is permitted to drift to a stop by a slippage of the friction clutch but the Index disc and therefore the Recording Head and Pick-up are brought to a fixed and sudden stop by the pawl and notch thus accurately positioning the stylus into the next succeeding track on the film. It will be apparent that the track number is always indicated by the counter and that by making an index as the recording is made, the operator may by means of knob (17) turn the counter to any track desired, at which point he may drop the Pick-up and play back any track selected. The distances between perforations on the film is adequate to support 100 recording tracks.

By means of a lever (46) (drawing 132), the Phono Lifter Arm may be dropped while knob (1) is in "Record" position, thus permitting the operator to monitor while recording.

By the above described method there has finally been realized the age old dream of engineers to record sound with a stylus on safety film, with its allurements lying in the two fold fact that the method is the simplest form of recording known and its medium the most economical. The recording leaves no residue and no shavings; there is no processing, no developing, no record changing and no changing of the needle. The instrument performs automatically when there is a signal to record and ceases operation automatically when the signal disappears. Weak signals are recorded with high gain and strong signals with proportionately less. Monitoring may be done concurrently with recording which means volumes to the experienced engineer who has returned from his recording expeditions to find his recordings a failure. Hours, days or weeks of noise free recordings may be concentrated on one loop and stored in a tiny box to be reproduced tomorrow, next week or years hence. And the whole instrument is sturdily mounted in a portable package no larger than a medium sized suitcase.

*Editor's Note: We would like to hear from our readers regarding articles on Sound-On-Film Recording. We know that there is a tremendous amount of interest shown on Recording subjects in general, and that this is the first comprehensive treatment on the subject of Film Recording to appear in RADIO NEWS. Your comments are invited.*

