

Instruction Manual



Tandberg
RADIO

Covering
Model 3B
Model 2-T
Model 3B-F, 2-TF and 4-F
Model 4 Stereo Quadruple
Model 5 Stereo Quadruple

TANDBERG TAPE RECORDER

T A N D B E R G T A P E R E C O R D E R

is available in the following models:

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TANDBERG TAPE RECORDER MODEL 3B

Technical Data

Operating Voltage: 110, 125, 145, 200, 220 and 245 volts AC, 50 or 60 cycles.

Power Requirements: 55 watts.

Tape Speeds: $7\frac{1}{2}$ in/sec, $3\frac{3}{4}$ in/sec, $1\frac{7}{8}$ in/sec. Change of speed also possible while the Tape Recorder is running.

Speed Tolerance: $\pm 1\%$ for all speeds.

Frequency Response: At $1\frac{7}{8}$ in/sec — 50 to 4 000 c/s.
At $3\frac{3}{4}$ in/sec — 40 to 8 000 c/s.
At $7\frac{1}{2}$ in/sec — 30 to 16 000 c/s.

When using standard tape, the frequency response will, at all recorded frequencies, be within ± 2 dB.

Bass Switch: During playback the bass may be increased (12 dB at 70 c/s) by means of a special Bass Switch.

Recording Time: Twin track and 1200 ft of tape give:

At $1\frac{7}{8}$ in/sec — 2×128 mins.
At $3\frac{3}{4}$ in/sec — 2×64 mins.
At $7\frac{1}{2}$ in/sec — 2×32 mins.

Thinner tape is available with 1800 ft and 2400 ft on a normal 7 in. spool. The recording time is increased correspondingly.

Automatic End Stop: When a tape is used which has a metal foil at either end, the tape will stop automatically before it leaves the left spool. An extra contact device has been incorporated to ensure positive automatic stopping of the Tape Recorder even when used for rapid forward winding and rewinding.

Heads: .00025 inches record-playback gap, separate erase, dual track. The tape moves from left to right. The heads are positioned with the gaps facing the front. Recording takes place on the upper half of the tape — International Standard.

Flutter and Wow: At $7\frac{1}{2}$ in/sec better than 0,15%. This corresponds to 0,4% peak to peak frequency deviation.

At $3\frac{3}{4}$ in/sec, 0,2% (0,6% peak to peak). At $1\frac{7}{8}$ in/sec, 0,3% (0,8% peak to peak).

Distortion: The tape recorded to the maximum level by a 400 c/s signal will give less than 4% distortion when played back.

A recording level 10 dB below the saturation level results in less than 1% distortion of the 400 c/s signal when played back.

Signal to Noise Ratio: 55 dB below highest recording level (4% distortion) measured with a straight output meter. This implies that the hum is almost completely eliminated, obtained by DC heating and mu-metal shielding of the first tube and by means of static shielding of the amplifier.

Recording Level Indicator: Electronic-Eye tube EM71. At maximum recording level the tuning eye just closes. The indications of the eye have a sluggish return.

Impedance and Voltage Levels at the Input Terminals: Microphone input jack: 5 megohms and 50 mV max. Input voltage of 1,5—2 mV gives max. recording level at 1000 c/s, the volume control set to max.

The input terminals marked INPUT on the terminal strip: 0,5 megohm and 5 volts max. input voltage. Input voltage of 100 to 200 mV gives max. recording level at 1000 c/s, the volume control set to max.

Output Impedance and Voltage Level: The output on the terminal strip marked OUTPUT: Max. power output is 3 watts or 3,5 volts across 4 ohms. The output terminals may also be unloaded and fed directly into a high impedance amplifier.

Loudspeaker: The Tape Recorder has built-in monitoring loudspeaker. There are terminals for separate loudspeaker or earphones, and also terminals for direct connection to a radio receiver for recording and playback. There is a separate loudspeaker switch.

Mixing: It is possible to mix a radio program with speech or music picked up by a microphone.

Public Address: The Tape Recorder may be used as a microphone- and loudspeaker amplifier at concerts, lectures etc.

Frequency Response: ± 2 dB 30 to 20 000 c/s

Fast Forward Winding and Rewinding: Two minutes in either direction for 1200 ft tape with no wear on either recording head or erase head.

Programing Counter: Built-in dial.

Tubes: EF804, ECC83, EL84, EM71 and Selenium Rectifier.

Measurements: 15 in. length, $11\frac{5}{8}$ in. width, $6\frac{5}{8}$ in. height.

Weight: 24 lbs.

Choice of Tape Speed.

The difference in reproduction quality for the three speeds lies only in the upper register. See Technical Data, page 1.

Changing speed is done by turning the Speed Change Switch to left, 1 $\frac{7}{8}$ in/sec, to middle, 3 $\frac{3}{4}$ in/sec, and to right, 7 $\frac{1}{2}$ in/sec.

Change of speed can take place during recording and playback.

Recording.

Plug the microphone cord into the jack located in the left corner at the top. Placing the microphone is dealt with in detail under «Hints and Suggestions» on page 30.

With the Function Selector in the neutral position the right hand side of the Mode Selector Switch should point to RECORD and should be held there while the Function Selector is placed in position →.

The Electronic-Eye operates only during recording and the indications vary in accordance with the intensity of the sound. It shows the correct recording level.

Adjust the Volume Control until the darker green sector just barely disappears during the loudest sound passages. More volume will produce a distorted sound while a too low volume will give hiss and hum.

The correct recording level can be set before the recording starts, by holding the Mode Selector Switch in the RECORD position while the Function Selector is still in the neutral position.

The recording stops when the Function Selector is pushed to the neutral position.

Fast Forward Winding and Rewinding.

When a recording is finished, the tape must be rewound to the point where the recording started, before the recorded program can be played back.

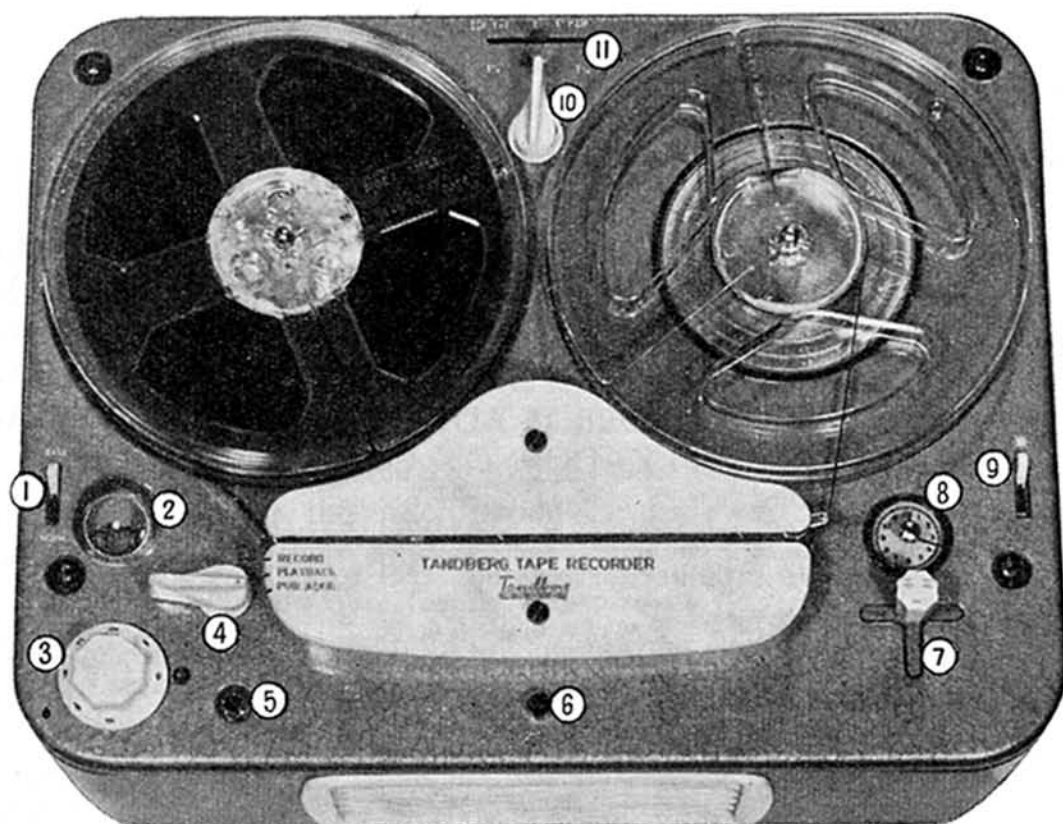
Rewind (to the left): Push the Function Selector all the way to the left, to position ⇐.

If it is desired to play a program which starts further in along the tape, forward winding can be done at high speed:

Fast Forward Winding (left to right): Push the Function Selector all the way to the right, to position ⇒.

Playback.

If the built-in loudspeaker is to be used, the Loudspeaker Switch is set to position 1. The Mode Selector Switch should be in position PLAYBACK.



Operating Controls

Fig 1.

1. BASS SWITCH. Position NORM.: Normal bass, flat frequency response. Position BASS: Bass boost at playback.
2. ELECTRONIC-EYE indicates correct recording level.
3. VOLUME CONTROL for recording and playback.
4. MODE SELECTOR SWITCH.
Position RECORD: Recording, provided the Function Selector (7) is pushed to position →.
Position PLAYBACK: Playback.
Position PUB.ADDR.: The Tape Recorder used as a complete amplifying unit between microphone and loudspeaker.
5. MICROPHONE to be plugged in here.
6. PILOT LAMP to indicate that the power is on.
7. FUNCTION SELECTOR
Position left ←: Rewinding the tape.
« right →: Fast forward winding.
« →: Playback.
« →: Recording, provided the Mode Selector Switch has first been turned to position RECORD.
8. PROGRAMING COUNTER. The hands can be reset to the starting position by the small knob at the top.
9. POWER SWITCH. The red pilot lamp glows when the power is on.
10. SPEED CHANGE SWITCH
1 7/8 in/sec: turn to left
3 3/4 in/sec: turn to middle
7 1/2 in/sec: turn to right
11. LOADSPEAKER SWITCH
Position 1, right: Playback through built-in speaker.
Position 2, middle: Playback through external hi-fi speaker, earphones or radio.
Position 1 + 2, left: Playback through both built-in and external speaker.

Power Supply.

The power transformer has tappings for 110, 125, 145, 200, 220 and 245 AC at either 50 or 60 cycles, depending on the motor pulley used. Changing of the voltage is done by means of the Voltage Selector located on the rear side of the Tape Recorder. It is shielded by a little metal plate and is accessible by loosening the screw in the metal plate. Pull the Voltage Selector, turn to the correct voltage and push back. **BEFORE USING A NEW TAPE RECORDER ALWAYS MAKE SURE THAT THE RECORDER IS ADJUSTED TO THE VOLTAGE OF THE POWER SUPPLY. DO NOT CONNECT TO DC!**

Inserting the Tape.

Cut off adhesive tape at start of new reel to avoid gumming up the recording heads.

Place a full reel of tape on the left turntable. Unwind some tape and insert into tape slot while you hold it stretched out between both hands.

Make sure that the tape is not reversed or twisted. The shiny side of the recording tape should point towards you, whereas the *matte* side of the leader tape should point towards you, in order that one may put notes on it with a pencil. Pull out a little more tape so that you get a loop at the right. Slide the tape into the slot of the reel and turn the reel until the tape tightens. During recording and playback the tape always moves from left to right.

Hold end of tape with finger here

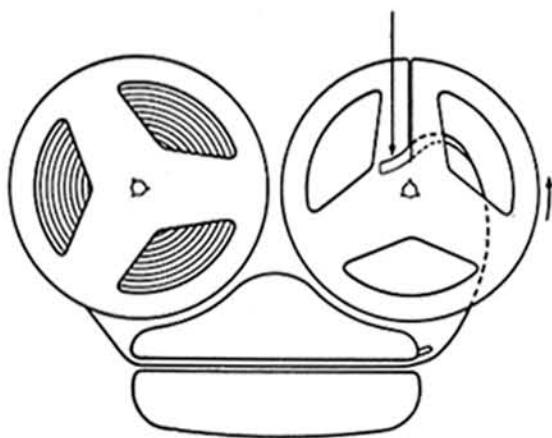


Fig. 2.

Automatic End Stop.

When the metal foil at each end of the tape passes a special contact device in the Tape Recorder, the motor is shut off and the tape stops. The automatic stop functions both for rapid forward winding and rewinding and also for recording and playback.

When a full spool is placed on the machine it is therefore necessary to wind over the leader tape so that the metal foil passes the stop contact before starting or one may start twice.

When using tape with metal foil on the whole length of the leader tape, it is only necessary to turn the right hand reel until the tape tightens, before starting.

Because only the motor is shut off by the automatic end stop, always remember to turn off the Power Switch and set the Function Selector in the neutral position.

TANDBERG TAPE RECORDER MODEL 2-T

Technical Data

Power Supply: Available for 100—120 volts AC 60 cycles, or 100—120 volts AC 50 cycles, or 200—240 volts AC 50 cycles.

Power Requirements: 55 watts.

Tape Speeds: $3\frac{3}{4}$ in/sec and $1\frac{7}{8}$ in/sec. Change of speed also possible while the Tape Recorder is running.

Speed Tolerance: $\pm 2\%$ for all speeds.

Frequency Response: At $1\frac{7}{8}$ in/sec: ± 2 dB 50 to 4 000 c/s.
At $3\frac{3}{4}$ in/sec: ± 2 dB 40 to 8 000 c/s.

Bass Switch: During playback the bass may be increased (12 dB at 70 c/s) by means of a special Bass Switch.

Recording Time: Twin track and 1200 ft of tape give: At $1\frac{7}{8}$ in/sec: 2×128 mins. At $3\frac{3}{4}$ in/sec: 2×64 mins.

Thinner tape is available with 1800 ft and 2400 ft on a normal 7 in. spool. The recording time is increased correspondingly.

Heads: .00025 inches record-playback gap, separate erase, dual track. The tape moves from left to right. The heads are positioned with the gaps facing the front. Recording takes place on the upper half of the tape — International Standard.

Flutter and Wow: Better than 0,2% at $3\frac{3}{4}$ in/sec tape speed. This corresponds to 0,6% peak to peak frequency deviation.

Distortion: The tape recorded to the maximum level by a 400 c/s signal will give less than 4% distortion when played back. A recording level 10 dB below the saturation level results in less than 1% distortion of the 400 c/s signal when played back.

Signal to Noise Ratio: 50 dB below maximum recording level.

Recording Level Indicator: Electronic-Eye tube EM71. At maximum recording level the tuning eye just closes. The indications of the eye have a sluggish return.

Impedance and Voltage Levels at the Input Terminals: Microphone input jack: 5 megohms and 50 mV max. Input voltage of 1,5—2

TANDBERG TAPE RECORDER MODEL 2-T

Technical Data

Power Supply: Available for 100—120 volts AC 60 cycles, or 100—120 volts AC 50 cycles, or 200—240 volts AC 50 cycles.

Power Requirements: 55 watts.

Tape Speeds: $3\frac{3}{4}$ in/sec and $1\frac{7}{8}$ in/sec. Change of speed also possible while the Tape Recorder is running.

Speed Tolerance: $\pm 2\%$ for all speeds.

Frequency Response: At $1\frac{7}{8}$ in/sec: ± 2 dB 50 to 4 000 c/s.
At $3\frac{3}{4}$ in/sec: ± 2 dB 40 to 8 000 c/s.

Bass Switch: During playback the bass may be increased (12 dB at 70 c/s) by means of a special Bass Switch.

Recording Time: Twin track and 1200 ft of tape give: At $1\frac{7}{8}$ in/sec: 2×128 mins. At $3\frac{3}{4}$ in/sec: 2×64 mins.

Thinner tape is available with 1800 ft and 2400 ft on a normal 7 in. spool. The recording time is increased correspondingly.

Heads: .00025 inches record-playback gap, separate erase, dual track. The tape moves from left to right. The heads are positioned with the gaps facing the front. Recording takes place on the upper half of the tape — International Standard.

Flutter and Wow: Better than 0,2% at $3\frac{3}{4}$ in/sec tape speed. This corresponds to 0,6% peak to peak frequency deviation.

Distortion: The tape recorded to the maximum level by a 400 c/s signal will give less than 4% distortion when played back. A recording level 10 dB below the saturation level results in less than 1% distortion of the 400 c/s signal when played back.

Signal to Noise Ratio: 50 dB below maximum recording level.

Recording Level Indicator: Electronic-Eye tube EM71. At maximum recording level the tuning eye just closes. The indications of the eye have a sluggish return.

Impedance and Voltage Levels at the Input Terminals: Microphone input jack: 5 megohms and 50 mV max. Input voltage of 1,5—2

mV gives max. recording level at 1000 c/s, the volume control set to max. The input terminals marked INPUT (RECORD) on the terminal strip: 0,5 megohm and 5 volts max. input voltage. Input voltage of 100 to 200 mV gives max. recording level at 1000 c/s, the volume control set to max.

Output Impedance and Voltage Level: The output on the terminal strip marked OUTPUT (PLAYBACK): Max. power output is 3 watts or 3,5 volts across 4 ohms. The output terminals may also be unloaded and fed directly into a high impedance amplifier.

Loudspeaker: The Tape Recorder has built-in monitoring loudspeaker. There are terminals for separate loudspeaker or earphones, and also terminals for direct connection to a radio receiver for recording and playback. There is a separate loudspeaker switch.

Mixing: It is possible to mix a radio program with speech or music picked up by a microphone.

Public Address: The Tape Recorder may be used as a microphone- and loudspeaker amplifier at concerts, lectures etc.

Frequency Response: ± 2 dB 30—20 000 c/s.

Fast Forward Winding and Rewinding: Three minutes in either direction for 1200 ft tape, with no wear on either recording head or erase head.

Programing-Counter: Built-in dial.

Tubes: EF804, ECC83, EL84, EM71 and Selenium Rectifier.

Measurements: 15 in. length, 11 $\frac{5}{8}$ in. width, 6 $\frac{5}{8}$ in. height.

Weight: 21 lbs.

Operating Controls

The Tandberg Tape Recorder Model 2-T has the same operating controls as the Model 3B (see page 3) except for the Speed Selector:

1 $\frac{7}{8}$ in/sec: turn to right and press down.

3 $\frac{3}{4}$ in/sec: turn to right and lift.

Change of speed can take place during recording and playback.

You will find the instructions for *Inserting the Tape, Recording, Fast Forward Winding and Rewinding, Playback, The Loudspeaker Switch and Loudspeaker* on pages 4, 5 and 6.

TANDBERG TAPE RECORDER MODEL 3B-F, 2-TF AND 4-F

These models are exactly similar to Model 3B, 2-T and 4 except for the remote control relays for start, stop and rewind. Push button or pedal control is possible over short and long distance.

The pedal cord is plugged into the terminal on the back of the Tape Recorder. The plug has a guide pin which ensures correct connection.

If the pedal plug is removed, the Tape Recorder is operated in the normal manner.

Playback.

After the pedal plug has been connected to the Tape Recorder, the Power Switch is switched on and the Function Selector set to the playback position →.

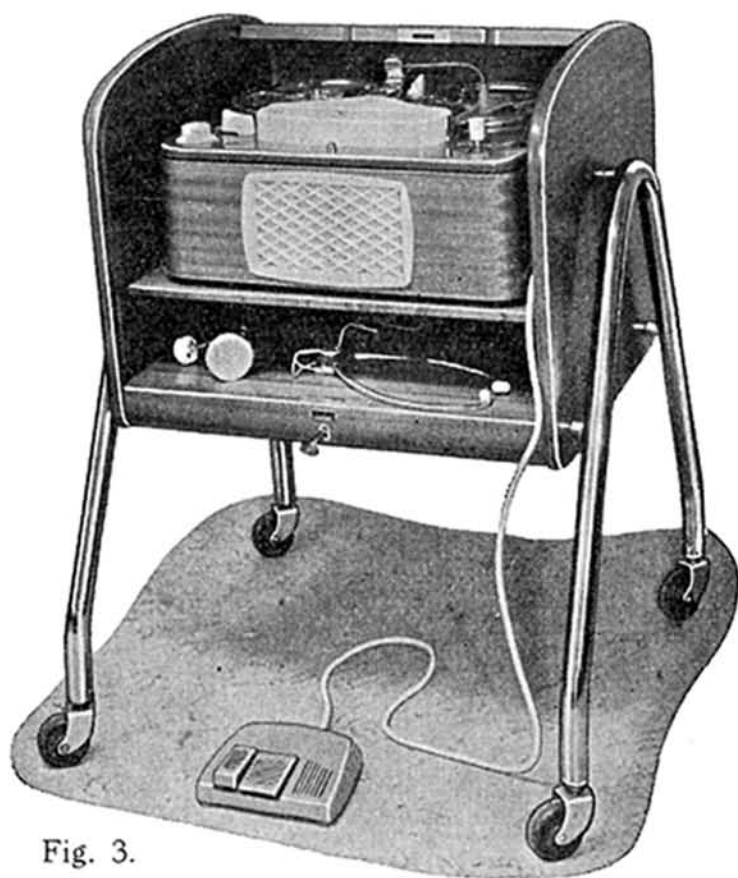


Fig. 3.

Start — stop: right pedal.

Press down the right hand pedal and the tape starts running. The tape stops when the pedal is released. Starting and stopping occur instantaneously. It is quite possible to cut a word in two.

Rewinding: left pedal.

Press down the left pedal. For longer rewinding the Function Selector should be used (position ←).

For fast forward winding always use the Function Selector.

Recording.

The Remote Control may also be used for recording. First the Mode Selector Switch and the Function Selector should be set to the recording position.

If it is desired to rewind in order to hear what has been recorded, the Function Selector should first be set to the playback position, otherwise the recorded matter will be erased during the rewinding.

The Electronic-Eye will not function before the right hand pedal is pressed down. The correct recording level can be set *before* the recording starts, by holding the Mode Selector Switch in the RECORD position while the Function Selector is still in the neutral position.

NOTE. The Function Selector should always be set to the normal position when the recorder is not in use.

Stetaset Earphones.

For monitoring during recording and playback (when one does not wish to disturb others) earphones can be used by connection to the terminals marked OUTPUT (PLAYBACK). The earphones can be adjusted so that they hang lightly in the ears without pressure or discomfort. The name plate should be out, not against your chest, in order to give the earphones the correct and most comfortable position in the ears.

Trunnion Cabinet. (Fig. 3.)

This cabinet is a very practical and useful accessory. Mounted on trunnions it can easily be moved from one room to another. The cabinet is especially suited for offices and schools where it is desirable to have the Tape Recorder ready for immediate use at all times. The Tape Recorder is simply placed on the shelf of the cabinet, while there is room underneath for the microphone, pedal, spools of tape, etc. The roll top cover can be locked. The cabinet is finished in polished mahogany and measures: Height: 27.5 inches. Width: 21.3 inches. Depth: 20 inches. The cabinet weighs 22 lbs.

TANDBERG TAPE RECORDER MODEL 4

STEREO QUADRUPLE

Technical Data.

Operating Voltage: 110, 125, 145, 200, 220, 245 volts AC, 50 or 60 cycles.

Power Requirements: 60 watts.

Tubes: EF804, ECC83, ECC83, EL84, EM71 and Selenium Rectifier 75 mA, 250 volts, 2 low voltage Selenium Rectifiers.

Tape Speeds: $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ in/sec. Speed may be changed while the Tape Recorder is running.

Speed tolerance: $\pm 1\%$ for all speeds.

Heads: Record-playback head: Special made in line stereo quadruple. Head gap: .00016 inch. Quadruple erase head.

The recorder will play back four track and two track stereo and monaural tapes as well as tapes recorded according to the former European Standard. The co-linear alignment of the heads is so good that when playing fulltrack tape, one may use both head halves. The recorder can record four track and two track monaural, and also two track according to the former European Standard.

The tape moves from left to right. The heads are positioned with the gaps facing the front. Recording takes place on track 1 or track 3.

Playing Time: Four track and 1200 ft. of tape give:

	Monaural	Stereo
$7\frac{1}{2}$ in/sec:	4 × 32 mins.	2 × 32 mins.
$3\frac{3}{4}$ in/sec:	4 × 64 mins.	2 × 64 mins.
$1\frac{7}{8}$ in/sec:	4 × 128 mins.	2 × 128 mins.

Fast Forward Winding and Rewinding: Takes about 2 min. in either direction, without wearing the heads.

Frequency Response at Record-Playback: Flat within ± 2 dB from 30 to 16 000 c/s, from 40 to 10 000 c/s and from 70 to 5 000 c/s for the $7\frac{1}{2}$ ips, $3\frac{3}{4}$ ips and $1\frac{7}{8}$ ips speeds respectively.

Distortion and Noise Level: The tape recorded to the maximum level by a 400 c/s signal will give less than 5% distortion when played back. A recording level 10 dB below the maximum level results in less than 1% distortion of the 400 c/s signal when played back. The noise level is 55 dB below the signal level when the tape is driven to the maximum level.

Wow: Better than 0,15% at 7 1/2 ips tape speed.

Better than 0,2% at 3 3/4 ips tape speed.

Better than 0,3% at 1 7/8 ips tape speed.

Wow is defined as the r.m.s. value of frequency deviation to one side in percent of the signal frequency, when a constant signal frequency is recorded and played back. The peak to peak value is 2,8 times greater.

Input: Microphone: 5 Megohms and 100 mV max. Because of the high impedance input, the loss due to the input impedance is below 3 dB at 30 cycles when using the Tandberg TM2 microphone. Sensitivity of mike input: 1.5 millivolt, for maximum recording level at 1000 cycles.

Phone or radio input: .5 Megohm. Phono or radio sensitivity: 75 millivolts.

Record Amplifier. Recording Level Indicator: Distortion at maximum recording level — below 1%. The electronic eye tube maintains its sensitivity corresponding to recording current to 10 000 cycles (with selenium rectifier and damped backward movement). Electronic eye tube range is 26 dB, plus overload.

Playback Amplifiers, Frequency Response: The playback amplifiers are matched to the heads to give a frequency response when playing back a standard tape within ± 2 dB at all recorded frequencies.

Playback Amplifier Gain: The gain of the main amplifier is controlled by the potentiometer. The gain of the preamplifier for lower track is fixed and the output voltage is .5 — .6 volt when the tape is recorded to 5% distortion.

Playback Amplifiers Output & Distortion:

The main amplifier:

At 1000 cycles:

1.5 watts	Distortion below 1%
3.0 watts	Distortion below 5%

At 50 cycles:

1 watt (2 volts)	Distortion below 1%
1.5 watts (2.5 volts)	Distortion below 5%

Effective source impedance of main playback amplifier is less than 1 ohm, negative feedback about 15 dB. (Matched load impedance 3—4 ohms).

Because of the low output impedance and high degree of negative feedback with corresponding low distortion, the playback can be fed into any Hi-Fi amplifier, regardless of input impedance, with no loss in frequency response or quality.

Frequency response when used as PA amplifier: ± 2 dB, 30 to 20 000 cycles.

The preamplifier:

At 1000 cycles:

1 volt	Distortion below 1 %
0.5 volt	Distortion below 0.5 %

Effective source impedance of preamplifier for lower track approx. 50 kohms. To avoid frequency response distortion, the preamplifier for lower track should not be connected to a power amplifier with an input impedance below 2 Megohm.

Monitor Speaker: 4 in \times 7 in.

Output Switch: Left position: (Seen from the front of the recorder). Main amplifier connected to output terminals marked «Upper track» and loudspeaker. Preamplifier for lower track connected to output terminals marked «Lower track».

Mid. position: Main amplifier connected to output terminals marked «Upper track». Loudspeaker disconnected. Preamplifier for lower track connected to output terminals marked «Lower track».

Right position: Main amplifier connected to output terminals marked «Lower track». Preamplifier and loudspeaker disconnected.

Mixing: It is possible to mix a radio program with speech or music picked up by the microphone.

Clock-Counter: (Similar to an ordinary clock dial). Each hour (by hour-hand) shows 150 revolutions of tape reel, each minute (by minute-hand) shows 2 1/2 revolutions. Location and length of recording is designated as time on a clock (e. g. 2:12 to 3:15).

Automatic Stop: Possible on tape which has the necessary metal coating at beginning and end of the reel.

Dimensions: Fine grain mahogany cabinet, 15" long, 11 5/8" wide, 6 5/8" high.

Weight: Instrument alone 27 lbs., with carrying case 32 lbs.

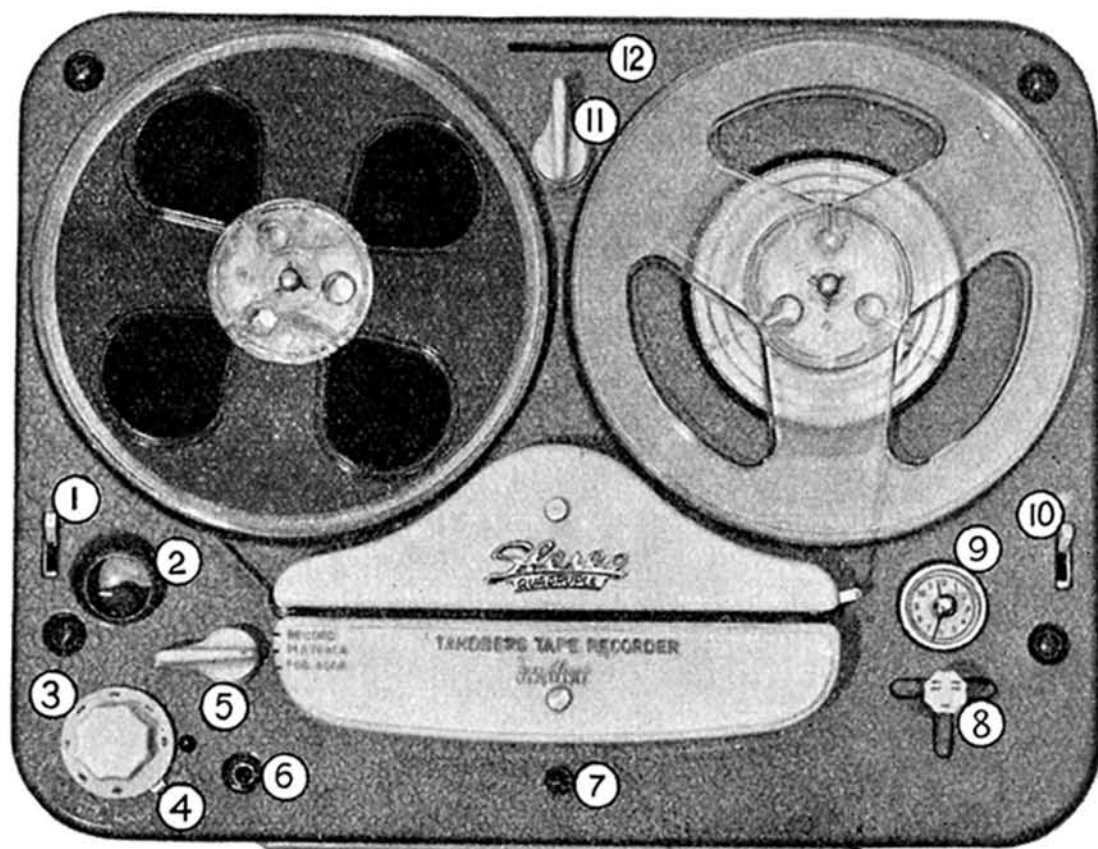


Fig. 4.

Operating Controls

1. **BASS SWITCH.** Position NORM.: Normal bass, flat frequency response. Position BASS: Bass boost at playback.
2. **ELECTRONIC-EYE** indicates correct recording level.
3. **VOLUME CONTROL** for recording and playback.
4. **STEREO-MONAUURAL SWITCH**
5. **MODE SELECTOR SWITCH**
 Position RECORD: Recording on the upper track, provided the Function Selector (8) is pushed to position →.
 Position PLAYBACK: Playback.
 Position PUB.ADDR.: The Tape Recorder used as a complete amplifying unit between microphone and loudspeaker.
6. **MICROPHONE** to be plugged in here.
7. **PILOT LAMP** to indicate that the power is on.
8. **FUNCTION SELECTOR**
 Position left Rewinding the tape.
 « right Fast forward winding.
 « →: Playback.
 « →: Recording, provided the Mode Selector Switch has first been turned to position RECORD.
9. **PROGRAMING COUNTER.** The hands can be reset to the starting position by the small knob at the top.
10. **POWER SWITCH.** The red pilot lamp glows when the power is on.
11. **SPEED CHANGE SWITCH**
 1 $\frac{7}{8}$ in/sec: turn to left
 3 $\frac{3}{4}$ in/sec: turn to middle
 7 $\frac{1}{2}$ in/sec: turn to right
12. **OUTPUT SWITCH**

Power Supply, Inserting the Tape, Automatic End Stop, Choice of Tape Speed, Recording, Fast Forward Winding and Rewinding, Playback and Bass Switch are the same as for Model 3B, described on pages 4, 5 and 6.

In addition the Model 4 Stereo offers the following possibilities:

Stereo Monaural Switch.

1. Mode switch in pos. RECORD.

- a) Pos. STEREO: The amplifier for the upper track operates as a normal recording amplifier, and gives record current to the upper head. The preamplifier for lower track is muted. The erase head gets erase current on both head halves and will erase track 1 and 3 (or 4 and 2) simultaneously. This combination of switch positions should therefore be avoided.
- b) Pos. MONAUR: The amplifier for the upper track operates as a normal recording amplifier for track 1 (or 4). The gain is controlled by the potentiometer. The preamplifier for the lower track is muted.
- c) Pos. EXTRA: The amplifier for the upper track operates as a normal recording amplifier for track 3 (or 2). The gain is controlled by the potentiometer. The preamplifier for the lower track is muted.

2. Mode switch in pos. PLAYBACK:

- a) Pos. STEREO: Each amplifier is connected to the individual two headhalves, ready for playing back stereo tape, two tracks or quadruple. The potentiometer controls the gain of the amplifier for upper track. The preamplifier for lower track has a fixed amplification, and gives approx. .5—.6 volts across the output terminals when the tape is recorded to 5% distortion.
- b) Pos. MONAUR. The main amplifier is coupled to track 1 (or 4) and the gain of the amplifier is controlled by the potentiometer. The preamplifier for lower track is muted.
- c) Pos. EXTRA: The main amplifier is coupled to track 3 (or 2) and the gain of the amplifier is controlled by the potentiometer. The preamplifier for lower track is muted.

3. Mode switch in pos. PUB.ADDR.:

- a) Pos. STEREO: The main amplifier is connected to the ordinary inputs. The gain is controlled by the potentiometer. The preamplifier acts as preamplifier for the lower track.
- b and c) Pos. MONAUR. and EXTRA: The main amplifier is connected to the ordinary inputs and the gain of the amplifier is controlled by the potentiometer. The preamplifier is muted.

Output Switch.

Left position 1 + 2: (Seen from the front of the recorder). Main amplifier connected to output terminals marked upper track and loudspeaker. Preamplifier for lower track connected to output terminals marked lower track.

Mid. position 2: Main amplifier connected to output terminals marked upper track. Loudspeaker disconnected. Preamplifier for lower track connected to output terminals marked lower track.

Right position Δ : Main amplifier connected to output terminals marked lower track. Preamplifier and loudspeaker disconnected.

Monaural Recording and Playback.

4-track. By monaural recording and playback the stereo monaural lever should be in position MONAURAL until side 1 is finished as well as side 2 on the recording tape. Then the lever is placed in position EXTRA, and both sides of the tape are used once more in the same way, thus giving double playing time. In playing monaural tapes, by operating the stereo monaural lever (MONAURAL — EXTRA) instant change between two different programs is possible.

2-track. To record programs for playback on 2-track standard, use the position MONAURAL (or EXTRA) and turn the tape only once.

Stereo Playback.

This model is capable of playing back prerecorded stereo tapes (half track or quarter track tapes). A high quality radio set or Hi-Fi amplifier with matched speaker has to be used for the lower track channel. For interconnection between the tape recorder and a radio set, see story p. 25. The only difference that the red plug has to be connected to the Lower Track output on the terminal strip.

An external speaker (preferably a Hi-Fi speaker) is connected to the Upper Track output on the terminal strip. This speaker should be placed at the left hand side of the radio set, 5—10 feet apart from the set. Check polarity of speakers, see p. 22. Set radio for phonograph reproduction and connect the tape recorder to phono input. Set Monitor speaker switch in pos. 2, and the Stereo-Monaural switch in pos. Stereo. The frequency range should be equally adjusted for the two channels. The bass boost switch is operative for the upper track channel only, and the bass and treble controls of the radio set for the lower track channel. Adjust the volume controls of tape recorder and the radio to obtain balanced output for both channels.

Recording and Playback via Radio Set.

Interconnection between tape recorder and radio as described above. Red plug connected to the Lower Track output terminal. The tape

recorder will then record radio programs. If single track playback through the radio set's speaker, is wanted, the Output Switch has to be set to pos. triangle and Upper Track amplifier of the tape recorder is thereby connected to the phono of the radio set. Set Stereo-Monaural switch to pos. Monaural or Extra. See also p. 26.

For playback through the external speaker only, set the Output Switch to pos. 2. The radio set may then simultaneously be used for ordinary reception. When red plug is connected to the upper track output terminal the Output Switch should be in pos. 2 or 1 + 2 for playback via the radio set.

TANDBERG TAPE RECORDER MODEL 5

STEREO QUADRUPLE

Technical Data.

Operating Voltages: 110, 125, 145, 200, 220 and 245 volts AC, 50 or 60 cycles.

Power Requirements: 75 watts.

Tubes: EF804, EF804, ECC83, ECC83, EL84, EL84, EM71 and three Selenium Rectifiers.

Recording Level Indicator: Electronic-Eye tube EM71. At maximum recording level the tuning eye just closes. The indications of the eye have a sluggish return.

Amplifiers: Two built-in separate amplifiers, one of which is switchable for recording and playback, the volume of both amplifiers may be adjusted individually or jointly.

Tape Speeds: 7 1/2 in/sec., 3 3/4 in/sec., 1 7/8 in/sec. Speed may be changed while the Tape Recorder is running.

Speed Tolerance: $\pm 1\%$ for all speeds.

Flutter and Wow: At 7 1/2 in/sec. better than 0,15%. This corresponds to 0,4% peak to peak frequency deviation.

At 3 3/4 in/sec., 0,2% (0,6% peak to peak). At 1 7/8 in/sec., 0,3% (0,8% peak to peak).

Recording Time: Four track and 1200 ft. of tape give:

	Monaural	Stereo
7 1/2 in/sec:	4 × 32 mins.	2 × 32 mins.
3 3/4 in/sec:	4 × 64 mins.	2 × 64 mins.
1 7/8 in/sec:	4 × 128 mins.	2 × 128 mins.

Thinner tape is available with 1800 ft. and 2400 ft. on a normal 7 in spool. The recording time is increased correspondingly.

Fast Forward Winding and Rewinding: Two minutes in either direction for 1200 ft. tape, with no wear on either recording or erase heads.

Timing Counter: Built-in dial.

Automatic End Stop: When a tape metal foil at each end is used, the tape will automatically stop before leaving the left hand spool. An extra contact device has been incorporated to ensure positive automatic stopping of the Tape Recorder even when used for rapid forward winding or rewinding.

Heads: Record-playback head: Special made in line stereo quadruple. Head gap: .00016 inch. Quadruple erase head.

Cross-talk between the two head halves better than 60 dB. Because of the high cross-talk quality, the Recorder will record and play back normal single half-track tape without any reduction of quality. The co-linear alignment is so good that a full-track tape may be played back using both head halves. The recorder will play back four-track stereo and monaural as well as two-track stereo and monaural tape.

The tape moves from left to right. The heads are positioned with the slits towards the front. Recording takes place on track 1 or track 3, or on tracks 1 and 3 simultaneously for stereo.

Frequency Response: At 7 1/2 in/sec. — 30 to 16 000 c/s.

At 3 3/4 in/sec. — 40 to 10 000 c/s.

At 1 7/8 in/sec. — 70 to 5 000 c/s.

When using standard tape, the frequency response will, at all recorded frequencies, be within ± 2 dB.

Bass Switch: When playing through the speaker of the Recorder or through a separate loudspeaker the bass may be increased (12 dB at 70 c/s) by means of a special Bass Switch.

Distortion: The tape recorded to the maximum level by a 400 c/s signal will give less than 4% distortion when played back. A recording level 10 dB below the saturation level results in less than 1% distortion of the 400 c/s signal when played back.

Signal to Noise Ratio: 55 dB below highest recording level (4% distortion) measured with a straight output meter. This implies that the hum is almost completely eliminated, obtained by DC heating and mu-metal screening of the first tube in both amplifiers and by help of static screening of the amplifiers.

A switch short-circuits the heads when the Tape Recorder is placed in position playback with the operating lever in position neutral or in position fast forward winding or rewinding. The loudspeakers for each channel then become quite mute.

Impedance and Voltage Level at the Input Terminals: Microphone input over jack: 5 megohms and 50 mV max. Input voltage of 1,5—2 mV gives max. recording level at 1000 c/s, the volume control set to max.

Output Impedance and Voltage Level: Two amplifiers. Max. power output on each amplifier is 3 watts or 3,5 volts across 4 ohms. When playing back monaural, both amplifiers can be connected to one track, thus the output power will be 2×3 watts. The output cannot be coupled in parallel. If one therefore want to make use of the increased power, two loudspeakers should be used.

Loudspeaker: The built-in monitoring speaker may by means of the Monitor Speaker Switch be connected to the amplifier for the upper track, for the lower track, or disconnected.

There are terminals for separate loudspeakers or earphones, and also terminals for direct connection to a radio receiver for recording and playback.

Mixing: It is possible to mix a radio program with speech or music picked up by the microphone.

Public Address: The Tape Recorder may be used as a microphone or phonograph amplifier.

Frequency Response: ± 2 dB 30 to 20 000 c/s. Power output: 2×3 watts.

Stereo Disc Amplifier: Both amplifiers have extra terminals marked Stereo Amplifier Input, making it possible to use the Recorder as a complete amplifier for a stereo phonograph.

Input Impedance: .5 megohm. Sensitivity: 15 mV for full power output (2×3 watts). Order special plug.

Stereo Recording: As the Recorder has an output for connection to a separate Stereo Record Amplifier, first class stereophonic recordings may be made.

Measurements: 15 in. long, 11 $\frac{5}{8}$ in. wide, 6 $\frac{5}{8}$ in. high.

Weight: 28 lbs.

Stereo Record Amplifier.

Technical Data.

Power Supply: Terminals for connection to the Tape Recorder.

Tubes: EF804, ECC83, EM71 and Selenium Rectifier.

The amplifier has exactly the same technical specifications as the recording amplifier in the Tape Recorder.

Measurements: 9" long, 6 $\frac{3}{8}$ " wide, 2 $\frac{1}{4}$ " high.

Weight: 2,4 lbs.

Operating Controls.

The Tandberg Tape Recorder Model 5 Stereo has the same operating controls as Model 4 (see page 14) except for the volume control and the output switch:

The volume control has a double knob so that each track may be individually regulated when playing back stereo, or when the Recorder is used as an amplifier for stereo phonograph. Both knobs may, however, also be operated simultaneously, because they are coupled by friction. A dial shows the mutual setting and the normal position is clearly marked.

Monitor Speaker Switch for connecting the monitor speaker to the amplifier for the upper track, position left, to lower track position right, or disconnecting, position OFF.

Power Supply, Inserting the Tape, Automatic End Stop, Choice of Tape Speed, Recording, Fast Forward Winding and Rewinding, Playback and Bass Switch are the same as for Model 3B, described on pages 4, 5 and 6.

In addition the Model 5 Stereo offers the following possibilities:

Monaural Recording and Playback.

By monaural playback both power amplifiers are coupled to the same track. When using a loudspeaker for each amplifier the volume may be individually regulated for each speaker.

4-track. By monaural recording and playback the stereo monaural lever should be in position MONAURAL until side 1 is finished as well as side 2 on the recording tape. Then the lever is set to position EXTRA, and both sides of the tape are used once more in the same way, thus giving the double playing time. When playing monaural tapes, by operating the stereo monaural lever (MONAURAL — EXTRA), instant change between two different programs is possible.

2-track. To record programs for playback on 2-track standard, use the position MONAURAL and turn the tape only once.

Checking the Program during Monaural Recording.

The amplifier for the upper track is used as a normal recording amplifier. The amplifier for the lower track is connected as a power amplifier for the program which is being recorded. It is therefore possible to monitor the program through the speaker of the Tape Recorder, or it can be fed to a separate speaker connected to the terminals marked OUTPUT LOWER TRACK. When the Monitor Speaker Switch is set in position LOWER TRACK, the program will be heard both in the monitor speaker and in the separate speaker. In the OFF position the program will be heard only in the separate speaker. In order to avoid howling acoustic feedback, the monitor speaker and the microphone must be placed in separate rooms.

The volume in the monitor speaker must be adjusted by the smaller knob on the volume controller, the larger to be hold firm.

As the stereo monaural lever on this model is also used when recording, check that it is in the correct position in order not to erase a program accidentally.

Stereo Playback.

A separate Hi-Fi loudspeaker is connected to each of the terminals marked UPPER TRACK and LOWER TRACK. Most stereophonic tapes are recorded in such a way that the left hand loudspeaker (as seen when facing the front of the speakers) should be connected to UPPER TRACK. The best position of the two speakers in the room had to be tried out. A distance of 5 to 10 feet ($1\frac{1}{2}$ to 3 m) between speakers will normally be the best. Both speakers should be placed at equal heights above the floor, approximately 3 to 6 feet (1 to 2 m).

Switch on the power. Place the tape on the recorder. Select the correct speed. Put the Monitor Speaker Switch in the OFF position, the Stereo-Monaural Switch in position STEREO and the Function Selector in the position →. The volume may be individually adjusted for each speaker. The Bass Switch can be set to the NORM. or BASS position as desired.

In playback of 4-track stereo programs, the tape is turned after one side has been used and is continued on side two. The stereo monaural lever should all the times remain in position STEREO.

Correct Polarity.

The diaphragm of a speaker moves to and fro in accordance with the electrical impulses. If two loudspeakers are connected to one pair of terminals, it would be possible for the diaphragm of one speaker to move forwards while, simultaneously, the diaphragm of the other speaker is moving backwards in response to the same impulse. If the loudspeakers are placed close to each other, this will be especially detrimental to bass notes which will be severely reduced in volume. If, therefore, the two wires going to one speaker are reversed, both diaphragms will «pump» in the same direction and the reproduction will become correct. When two speakers are connected for stereophonic reproduction one should therefore find out whether the polarity is correct. The speakers are placed close together and the Stereo-Monaural Switch is put in the position MONAURAL, so that the same program is heard from both speakers. By reversing the connections of the wires to one of the speakers, one will be able to hear when the polarity is correct. All Tandberg speakers have symmetrical terminals so that identical connections give correct polarity.

The Tape Recorder used as Microphone or Phonograph Amplifier.

When the recorder is to be used as a monaural amplifier the stereo monaural lever should be placed in position MONAURAL and the mode selector switch in position PUB.ADDR. Both amplifiers function, and the volume may be individually regulated.

The Tape Recorder used as 2-track Amplifier for Stereo Phonograph.

Both channels for stereo pickup are connected to the jack marked Input Stereo Amplifier. The stereo monaural lever is placed in position STEREO and the mode selector in position PUB.ADDR. The volume of both channels may be regulated individually.

Stereo Recording.

The Stereo Record Amplifier is placed along the left side of the Recorder. The power supply lead from the Recorder is plugged into the rear of the amplifier. The lead from the amplifier is plugged in a jack in the rear bakelite cover on top of the Recorder. One microphone is plugged to the Stereo Record Amplifier and another to the Recorder. To obtain correct frequency response the switch for the three different

speeds on the amplifier should be placed in the same position as the corresponding switch on the Recorder.

The volume of the one microphone is adjusted by the volume controller of the Recorder (the large knob, the smaller is now out of function). The volume of the other microphone must be adjusted by the volume controller of the amplifier. Stereophonic tape is standardized so that the left hand microphone (facing the orchestra) and the left hand loudspeaker during playback are connected to the upper track, whereas the right hand microphone and the right hand loudspeaker are connected to the lower track, (during recording to the Stereo Record Amplifier).

NB. The lead from the amplifier to the rear bakelite cover on the Recorder should only be connected during stereo recording. (It should always be disconnected during recording and playback of monaural programs).

Stereo Recording from Stereo Phonograph or another Stereo Tape Recorder.

One of the channels is connected to the terminal marked INPUT on the Recorder, and the other channel to the terminal marked INPUT LOWER TRACK on the Stereo Record Amplifier.

SPECIAL USE

The Tape Recorder Used as a Complete Amplifying Unit between Microphone and Loudspeaker.

The Tape Recorder can be used as an ordinary amplifier at concerts, lectures, speeches etc. when the Mode Selector Switch is set to PUB. ADDR. The recording part is then inactive. Reproduction should take place from one or more separate loudspeakers connected to the terminals marked OUTPUT (PLAYBACK).

If the microphone and the loudspeaker are arranged in the same room, the Volume Control must not be advanced too much, as otherwise acoustic feedback will result in the familiar singing and howling. A higher volume of sound can then only be obtained by placing the microphone closer to the sound source or by moving the loudspeakers away from the microphone.

If you attach the microphone to a string loop around your neck, the microphone will be quite close to your mouth, and a good result is achieved.

For Model 5 Stereo, see page 21.

Recording Telephone Conversations with the Tandberg Telephone Pickup.

The Telephone Pickup consists of a coil in which voltages are induced by the magnetic field of the transformer in the telephone set.

The Telephone Pickup is fastened quite simply, by means of a suction cup on the outside of the telephone set. No wire connections are necessary. The suction cup should be moistened with water before it is pressed in position.

In order to obtain the strongest possible signal input to the Tape Recorder, the Telephone Pickup should be placed in a definite position in relation to the transformer inside the telephone set.

The most favorable position will generally depend upon the type of telephone set and should be found by trial.

The cable from the Telephone Pickup should be plugged into the microphone jack of the Tape Recorder. The Tape Recorder is set in position for recording, the Volume Control being adjusted to about 3 or 4. During a telephone conversation the Telephone Pickup is moved around the outside of the telephone set while you watch the Tuning Eye of the Tape Recorder. Attach the Telephone Pickup to the telephone in the position which gives the strongest indication.

In the case of automatic telephones, the dialing tone, which has the advantage of constant signal strength, may be used to find the best position of the Telephone Pickup.

Hum from the motor and transformer of the Tape Recorder or other electrical equipment, such as radio receiver and business machines, may also be induced in the Telephone Pickup, unless the telephone is placed three to four feet away from such equipment.

The Telephone Pickup cannot transmit a recorded program from the Tape Recorder to the telephone line.

THE TAPE RECORDER USED IN CONNECTION WITH A RADIO RECEIVER

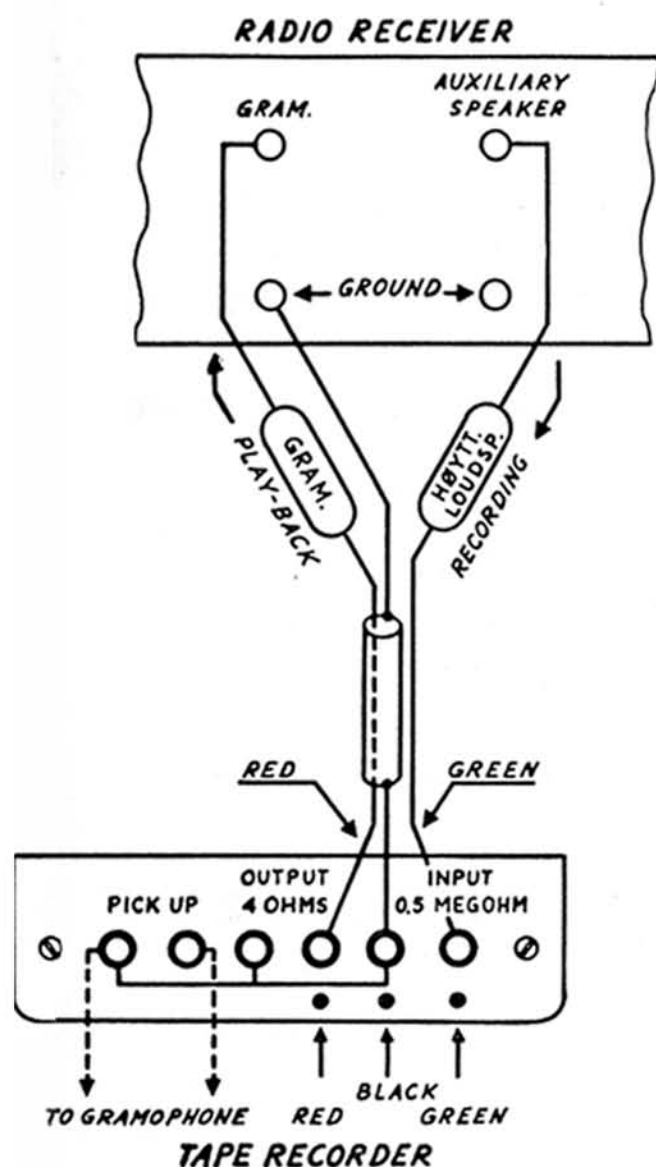
The Tape Recorder can be used with any radio receiver which is furnished with terminals for pickup and separate loudspeaker. A good radio receiver should, however, be used, as the quality of the recording will be no better than that given by the radio itself. See section «Hints and Suggestions» on page 32.

Connections.

A shielded twin lead is supplied with the Tape Recorder for connection to the radio receiver. The shield is used as a ground connection. The diagram, Fig. 5, shows the connections. No changes of the connections are necessary in order to utilize the Tape Recorder or the radio receiver independently of each other.

Recording takes place directly from the auxiliary loudspeaker terminals of the radio receiver.

Modern radio receivers (f. inst. our HULDRA Model 5) have separate diode output for recording, so that the signals are received independent of the audio amplifier and its operating controls.



TAPE RECORDER

Model 3B and 2 TF

Fig. 5.

Playback is done in the same manner as when a record changer is used; by connecting the Tape Recorder to the pickup terminals of the radio receiver.

If the terminals of the radio receiver for pickup and auxiliary loudspeaker are placed horizontally it must be ascertained that the plugs marked GRAM and LOUDSP. (HØYTT.) are plugged into the proper (not to ground) terminals.

For Model 4, see page 16.

Recording of Radio Programs.

- 1) Pull out the microphone plug. If this is left in the jack, the program will also come from the microphone and besides, all sound in the room will be recorded.
- 2) For some receivers it may be necessary to turn the Loudspeaker Switch over to position "1" to avoid howling. (Model 3B and 2-T).
- 3) Tune the radio receiver to the desired station. The reception should preferably be very good, so that the selectivity and bass controls of the radio receiver can be set in the normal position giving high quality reproduction.
- 4) Adjust the Volume Control of the radio receiver to slightly above listening level. If the output voltage from the radio receiver is too low, hiss and hum will be present in the recording.
- 5) Set the Tape Recorder to the recording position and adjust the Volume Control of the Tape Recorder to the correct level, both as described before.

Playback, Using the Audio Amplifier and Loudspeaker of the Radio Receiver.

- 1) Set the Loudspeaker Switch in the position "2". (Model 5 Stereo, pos. OFF and Model 4 Stereo pos. "2" or "Δ".)
- 2) The radio receiver is switched to the position for playing phonograph records.
- 3) Adjust the Volume Control of the Tape Recorder to pos. 3.
- 4) Playback starts when the Function Selector is pushed to →.
- 5) The listening level is adjusted by the Volume Control of the radio receiver. The Bass and Treble Controls of the radio receiver can be used to adjust the frequency response.

Recording from Microphone while the Radio Receiver is Connected.

When the Tape Recorder is connected to the radio receiver and this is switched to "phonograph" (i.e. for reproduction from the Tape Recorder), it is necessary to turn the Volume Control of the radio receiver to zero or to set the Loudspeaker Switch to "1", in order to avoid howling when recording by microphone. During recording, the loudspeaker in the Tape Recorder is automatically disconnected.

Receiver.

Alternate Use of Tape Recorder (Model 3B and 2-T) and a Record Player for Playing back through the Audio Amplifier of the Radio

Alternative use of the Tape Recorder and the record changer in connection with the radio receiver is possible without interchanging plugs every time. The phono pickup is connected to the Tape Recorder as shown in Fig. 5 and it is only necessary to turn the Loudspeaker Switch over to position. P.UP when it is desired to play records through the radio receiver.

The Model 4 and 5 Stereo has no terminal for phonograph, but modern radio receivers (f.inst. Tandberg Huldra Model 5) have two inputs for the low frequency amplifier, one for the Tape Recorder and one for the phonograph.

Recording your Favorite Records on Tape.

Records can be recorded on tape via a radio receiver or by direct connection to the Tape Recorder.

A. Via a radio receiver.

- 1) The connections are shown in Fig. 5.
- 2) The Loudspeaker Switch is set to position marked P.UP (Model 3B and 2-T).
- 3) Switch the radio receiver to position shown for phonograph.
- 4) Adjust the Volume Control of the radio receiver to somewhat more than usual volume. Use the Bass and Treble Controls to modify the reproduction as desired.
- 5) Set the Tape Recorder in position for recording and start the record changer.

B. Direct connection from Pickup to Tape Recorder.

Connect the pickup to the Tape Recorder using the terminals marked INPUT (RECORD). This gives no possibility of modifying the bass and treble reproduction. The program can be monitored during recording if earphones are connected to the terminals marked OUTPUT (PLAYBACK) and with the Loudspeaker Switch in position "2".

For Model 5 Stereo, see page 21.

EDITING AND FILING

Twin Track Recording and Playback.

Recording takes place on half of the tape width only. (Model 3B and 2-T). When the whole length of the tape has run through the machine and the left hand reel is empty, the reels can be interchanged so that the tape reels are turned up-side-down. See fig. 6. A full reel is again on the left turntable, and the machine is ready for recording or playback.

For Model 4 Stereo, see page 16 and Model 5 Stereo, see page 21.

The reels are clearly marked 1 and 2 on each side respectively. If you take a reel from your files and wish to play side 2 first, the reel is placed on the right turntable with 2 up. All the tape is then wound on to an empty reel placed on the left turntable. The tape is then ready for playing.

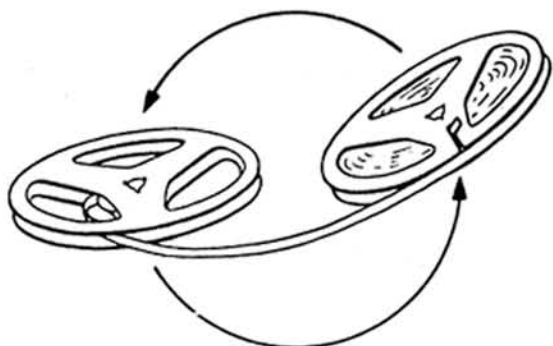


Fig 6

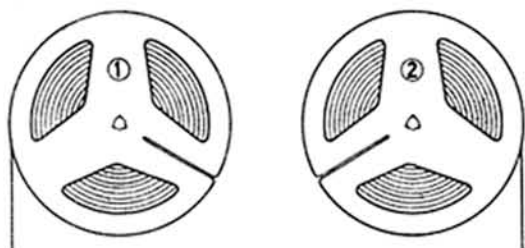


Fig 7

Programming Counter.

When a new tape is placed on the Tape Recorder the pointers are set to the zero, or 12 o'clock position, by means of the screw at the top. The hands will indicate the length of tape used, both for recording and for playback and also for fast forward winding and rewinding. When a new program is to be recorded or played back, the position of the hands is noted in order that one may later rapidly wind the tape to exactly the same position.

One «hour» corresponds to 150 turns and each «minute» represents $2\frac{1}{2}$ turns. A twelve hundred foot tape will run until approximately "7 o'clock" and an eighteen hundred foot tape will run approximately until 10³⁰.

Erasing a Program.

Previous recordings are automatically erased when a new program is recorded. Before recording, one should therefore make sure that the tape does not contain a program which one wants to keep.

The tape is guarded against unwanted erasure when using the other positions of the Function Selector because when this is moved back from the recording position, the Mode Selector Switch is released. If desired, the tape may be erased without recording a new program. This can be done by setting the controls as for recording, only the Volume Control set to zero.

Filing Recorded Material.

If it is desired to edit several different recordings this can be done by re-recording or by cutting the tape and splicing the selected parts. These may also be wound on smaller, empty reels. Remember that in cutting the tape the program recorded on the other half-track is cut at the same time.

During the editing it is a good idea to put small bits of paper between the tape windings as markers.

If best quality sound tape is used, the recorded matter can be stored for years without reduction in sound quality.

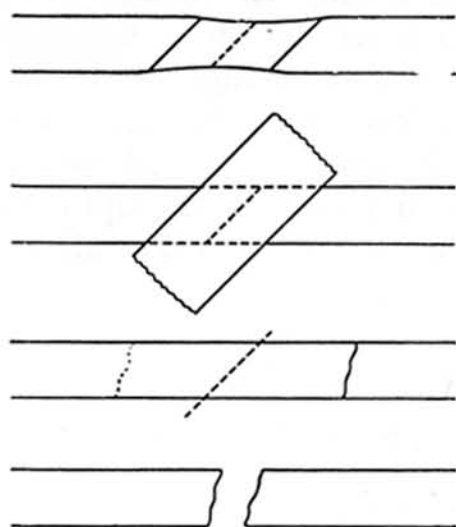


Fig 8

Splicing the Tape.

Place one tape end over the other, so that they overlap and cut both at once, using scissors, at an angle of about 60 degrees. Place the ends together so that they touch and apply splicing tape, at an angle, to the shiny side of the tape. Cut away the excess splicing tape on both sides. To make sure that the splice is not wider than the tape itself, cut a little into the tape as shown. A too wide splice will make the tape stick in the mechanism and snap off.

Re-recording.

By using two Tape Recorders, a full tape may be re-recorded or a number of different recordings may be recorded on a special storage tape. The program may be taken direct from one Tape Recorder to the other by using a two wire cable connected to the terminals marked OUTPUT (PLAYBACK) on one machine and to the terminals marked INPUT (RECORD) on the other machine. One may use the red and the black wires of the connecting cable which comes with every Tandberg Tape Recorder.

The Volume Control of the Tape Recorder used for playback should be set to position 2.5 to 3. The Volume Control of the Tape Recorder

used for recording should be adjusted to the correct volume according to the tuning eye. The Speaker Switch of the Tape Recorder for playback must be in position 2, or 1 + 2 if one wishes to monitor the program. The program can also be monitored with ear phones plugged into the sockets marked OUTPUT (PLAYBACK) on the Tape Recorder used for recording.

When using the Model 5 Stereo to either recording or playback, the program may be monitored by setting the Stereo-Monaural Switch in position MONAUR. and the Loudspeaker Switch in position LOWER TRACK.

When it is only desired to re-record certain parts of a program, one should use instantaneous start and stop (see page 30) in intervals between the various parts of the program. Otherwise one should start with the Volume Control in the zero position and then turn up the volume to the correct level. Before the recording is stopped, the level should be reduced to zero.

If it is desired to retain the same sound quality in the new recording, the same tape speed must be used on both Tape Recorders. Otherwise it is entirely possible to re-record to a lower speed, for instance from $7\frac{1}{2}$ in/sec. down to $3\frac{3}{4}$ in/sec. or even $1\frac{7}{8}$ in/sec. Nothing, however, can be gained by re-recording from a lower speed to a higher one.

If it is desired to make many re-recordings from one tape, one should always use the original tape for playback, because the sound quality may be somewhat reduced by re-recording from a re-recorded tape. The latter technique is, however, used when one man alone plays all the instruments of a whole orchestra.

HINTS AND SUGGESTIONS

Instantaneous Start for Recording or Playback.

Recording and playback should usually start with the Volume Control set to zero. The Volume Control is turned up after the tape has started running. If instantaneous tape start is desired, the Function Selector can be pulled in to the half-way position. After a few seconds when the flywheel has accelerated, the lever is pulled all the way in.

Recording from a Microphone.

Three things must be considered carefully when making indoor microphone recordings:

Reverberation in the room, noise in the room and the position of the microphone.

A small room with bare, hard walls will give an annoying echo and some parts of the tonal range will be unduly accentuated. If, in addition,

the recording is played back in the same room, the reverberation will be doubled and the quality will suffer accordingly.

The reverberation can be reduced by placing the microphone closer to the source of sound.

Even if it seems quiet, there is generally more noise in the room than one is conscious of. This is because the human ear possesses the property of filtering out noise and unwanted sounds, concentrating on the desired sound. The microphone, however, registers everything over a certain minimum sound level, and when all the sound is reproduced from one point i.e. the loudspeaker, the noise and the extraneous sounds become highly disturbing.

Placing the microphone nearer to the source of sound helps in this case too. The microphone should also be placed on a soft and springy support (a rubber sponge, a cushion, etc.) which will prevent direct transmission of noise and shocks. Keep the microphone cable as quiet as possible. If it is rubbed, a disturbing sound will result in the recording.

The best distance between the microphone and the source of sound is about $\frac{1}{2}$ meter, i.e. about two feet. When reverberation and noise are strong the microphone can be held close to the mouth or suspended by a string or ribbon around the neck of the speaker. The front grill of the microphone should be turned toward the speaker, otherwise the reproduced speech will be tubby. If several people in a group are to speak or sing, the microphone should lie flat with the grill up in the middle of the group. When music is recorded the best location of the microphone should be found by trial to give the best reproduction of all the instruments. If the instrument is a single one with a wide dynamic range, i.e. piano music, the microphone should be placed at some distance in order to avoid overloading the microphone, as this will result in distortion of strong passages. As a general rule it can be said that the distance should be increased if the Volume Control has to be set lower than 1 to 2, in order not to overload the Tuning Eye.

If a long microphone cable is to be used and when the sound is weak so that the Volume Control has to be turned up, there is a risk of getting hum in the recording. This can be avoided by fitting a good ground connection just as one would connect a radio receiver to ground.

The ground connection plugs into one of the sockets on the Tape Recorder between which a line is engraved. The ground wire is fixed to a water pipe or similar grounded object.

When the Tape Recorder is connected to a radio receiver this will usually take care of the ground connection automatically.

Microphone TM 2.

This microphone is designed especially for use with the Tandberg Tape Recorders. It is a crystal microphone with a frequency response

curve which is flat between 30 and 13 000 cps. Because of the small size, it receives sound nearly equally well from all directions. Foam plastic has been used both inside and outside to provide elastic shock absorbing suspension. Therefore the microphone is insensitive to handling and vibration. The microphone may be laid with the plastic sponge down on a table and it will then pick up the sound with equal intensity from persons grouped around it. The microphone can be suspended from a string or cord tied around the groove.

Diameter $1\frac{3}{4}$ " , thickness $\frac{7}{8}$ " , weight 1 ounce. Supplied with 12 feet of cable and plug.

Recording a Radio Program.

The first requirement for a good recording is that one uses a high class radio receiver whose audio output shows a linear frequency response. Any irregularity in the frequency response characteristic will come in twice, when recording and when playing back. This may result in overloading, distortion and poor reproduction.

The second requirement for good reproduction is that the radio signal is strong and free from noise and interference. Reception should preferably be so good that the Selectivity and Bass Controls of the radio can be set in their normal positions.

The Volume Control should be set to slightly more than usual volume. If a recording starts or ends in the middle of a program, the Volume Control of the Tape Recorder should be turned up from zero when starting, and down when ending the recording. Otherwise a "plop" will be heard when the recording starts and stops.

Hi-Fi Recording.

With the $7\frac{1}{2}$ ips. it is possible to make recordings with completely natural reproduction. In order to reduce the chances of destroying the life-like original sound quality there should be as few links as possible in the chain from the microphone to the loudspeaker.

The finest results are therefore obtained if a recording is made with the TM 2 microphone direct from the original performance of singer, chorus or orchestra, whereupon the recorded program is played via a Hi-Fi loudspeaker, f. inst. Tandberg Hi-Fi Corner Speaker or Hi-Fi System.

Hi-Fi recordings can also be made from non-recorded radio programs coming direct from the transmitter studio of a frequency modulated radio station capable of reproducing all tones up to 16 000 cps. with a linear response curve.

Monitoring the Program being Recorded.

The program being recorded can be monitored by means of the earphones which are plugged into the terminals marked OUTPUT (PLAYBACK). The Loudspeaker Switch should then be in position 2.

When the Tape Recorder is connected to a radio receiver, the program can be monitored via the radio loudspeaker. In that case the microphone and the radio receiver must, however, be placed in separate rooms to avoid acoustic feedback.

For Model 5 Stereo, see page 21.

Mixing.

Acoustic mixing. It is possible to speak or sing to music by playing the music (from a radio, a record player or from another tape recorder) through the loudspeaker of the radio and use the Volume Control of the radio receiver to adjust the volume up or down. The Volume Control on the Tape Recorder should be adjusted for the correct recording volume from the microphone.

The sound quality of the music from a radio receiver will, however, be better if electrical mixing is used.

Electrical mixing: During recording, the program from the microphone input will be mixed with any program coming into the terminals marked INPUT (RECORD). The Tape Recorder should then be connected to the radio receiver as described on page 25. The radio receiver speaker must be disconnected.

The person who is going to sing along with the radio program (or program from tape recorder or phonograph) is given an earphone which is plugged into the separate speaker sockets on the radio receiver.

The person who is going to do the mixing and adjust the correct ratio of the two volumes, is given another earphone, plugged into the Tape Recorder sockets marked OUTPUT (PLAYBACK). (Model 4, upper track, and Model 5, lower track.) The Volume Control of the Tape Recorder must be adjusted to the correct recording volume as indicated by the tuning eye.

By using the volume control of the radio receiver it is then possible to adjust the relative volumes of the two programs. In certain cases one may also vary the distance to the microphone, and the person who is talking or singing into the microphone can raise or lower his voice. Several trials should be made before the final recording is made. In the same manner it is possible to have music accompaniment to speech or singing when the Tape Recorder is used as a microphone or loudspeaker amplifier.