


MATSUSHITA ELECTRIC
JAPAN


TAPE RECORDER TECHNICAL TERMS



PANASONIC

**TAPE
RECORDER
TECHNICAL TERMS**

MAY, 1969

Dear PANASONIC Friends,

Many thanks for your fine work promoting the sales and service of PANASONIC Tape Recorders.

The Tape Recorder business has expanded remarkably during these past several years and, in particular, Cassette Tape Recorders have become very popular.

At the same time, technical improvement has been remarkable while the number of models has increased and their structure has become complicated.

Service work, therefore, requires high technical skill.

For these reasons, we are going to issue a series of handbooks in the hope of improving the service skills for PANASONIC Tape Recorders.

At the first volume, we are sending you "Tape Recorder Technical Terms", in which technical terms connected with Tape Recorders are explained.

We hope you will make use of it in your sales activities as well as in servicing work.

Sincerely yours



Masao Matsumoto
Director

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KADOMA, OSAKA, JAPAN**

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ABS Resin

An acrylonitrile butadiene styrene terpolymer resin.

Butadiene and acrylonitrile are polymerized with polystyrene to provide a plastic stronger and with greater shock resistance and better heat stability than polystyrene. The mechanical and electrical properties of the styrene resin are unchanged.

ABS accepts a metallic plating that provides a beautifully smooth metallic appearing finish. It seldom scars, is highly resistant to oil, and has a pleasant feel.

ABS is used in Tape Recorder cases, knobs, etc.

AC

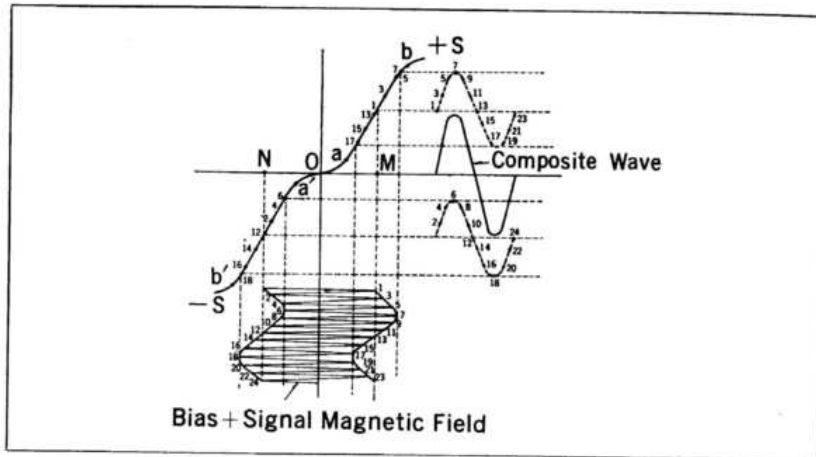
Alternating current, or voltage, which changes in direction and amplitude over a period of time.

AC Adaptor



A device used to provide economical power from an AC source at home for battery powered Tape Recorders, radios, etc. Outputs of 6.0, 7.5 and 9.0 volts DC are commonly available. Low power adaptors convert AC into DC by rectifiers while higher capacity AC adaptors stabilize output voltage by use of transistors.

AC Bias



When the signal to record sound on the tape is fed as such to the Record Head, much distortion is recorded due to magnetic hysteresis. Therefore, a superimposed current consisting of recording signal and high frequency AC is fed to the Record Head. This is called AC Bias.

As shown in the above figure, the recording is shifted rapidly for every half cycle of positive or negative bias (30~100 KHz).

Therefore, the curved part of the initial magnetization curve is hidden by the bias, and the positive linear line and the negative linear line can both be utilized. In other words, the linear part can be considered to have been extended twice as much.

Since this method is the same principle as the AC erasing method, there is no residual magnetic field on the Tape when there is no signal current. Therefore, noise is extremely low.

Today this AC bias method is used for almost all tape recorders.

Acetate Cellulose

One of the base materials for magnetic tape. It is mostly used for Standard Tape.

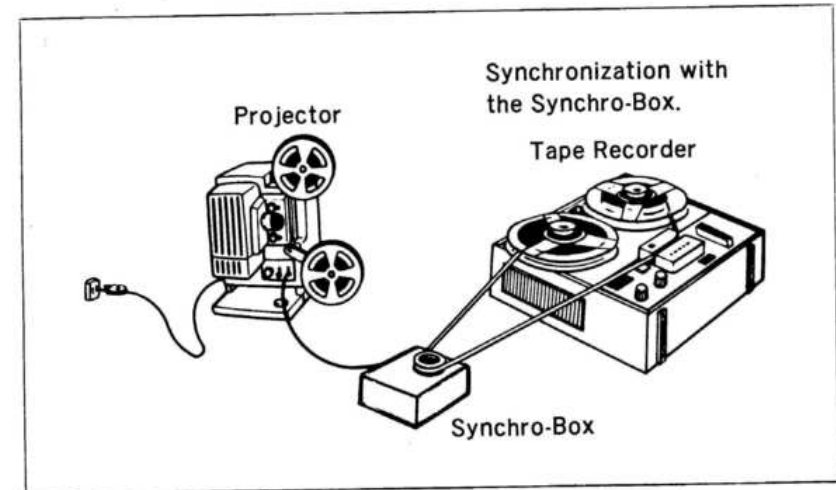
Acoustic Feedback

Refer to "Howling".

AC Erasing

Refer to "Zero Erasing".

After Recording

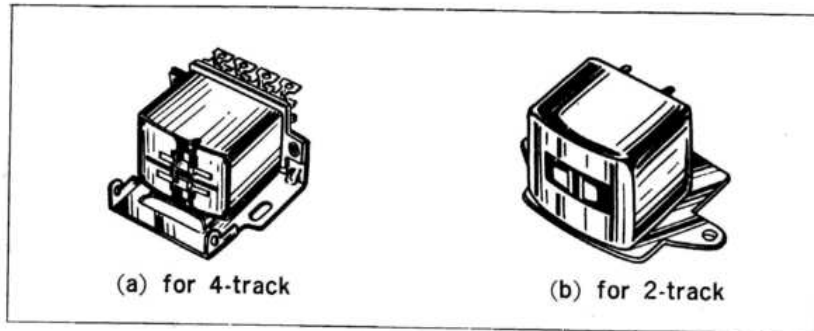


A method to synchronize sound and picture for 8mm or 16mm sound movies. Provides the same starting point of tape and film and maintains and adjusts speed of both to provide proper synchronization.

AGC

Refer to "Easy Matic".

All-in-one Head



A single tape head to provide erase, record and playback functions. The new PANASONIC development permits one head to perform the three functions for a two-track monaural and six functions for a four-track stereo head.

Ampere

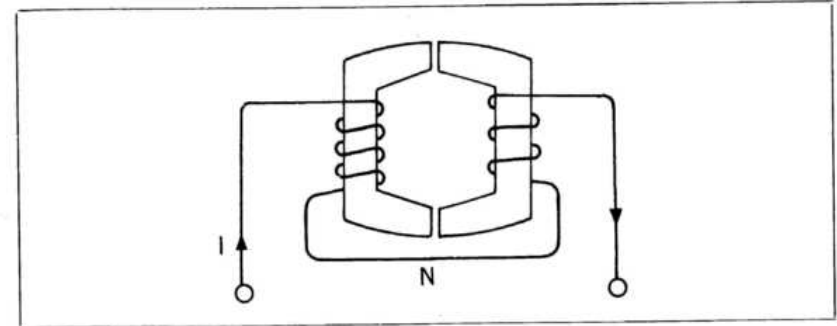
A unit of electric current, usually abbreviated "A".

One ampere is the amount of current that produces a potential difference of 1 volt at both ends of 1 ohm of resistance.

In the MKS unit system, 1 ampere is the volume of a certain current which passes 2 infinitely long straight conductors having an infinitely small round section placed in parallel at 1 meter intervals in a vacuum, respectively, and which provide each other with 2×10^{-7} (N) of power for every 1 m of the conductors.

Ampere Turns

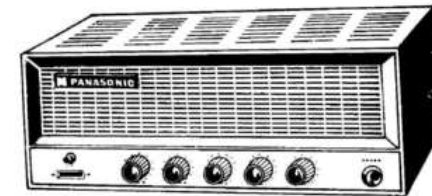
Represents the Magnetomotive Force of a Magnetic Circuit such as a Transformer, Record Head, etc. Magnetomotive Force corresponds to the Electromotive Force of an Electric Circuit.



When, as shown in the figure above, the "current flowing in the Magnetic Circuit" is represented by I and the "number of Coils" by N , the "Ampere Turns" is $N \times I$.

Magnetomotive Force required for an Erase Head is 20~30 Ampere Turns.

Amplifier

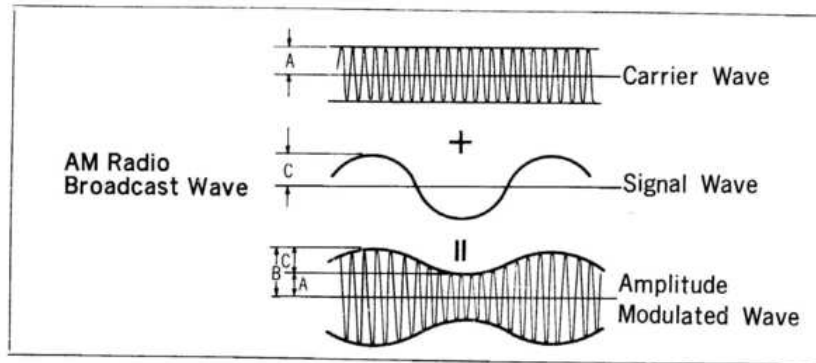


A device to amplify AC electrical voltages or currents. Voltage amplifiers, such as Pre-amplifiers, provide signal voltage variations, while Power Amplifiers provide the electrical power required to drive loudspeakers.

A combination of a Pre-amplifier and a Power Amplifier is used in Hi-Fi Amplifiers. Self-contained Tape Recorders have Pre-amplifiers for recording and playback and Power Amplifiers to provide audio power to the speaker. In addition, a built-in Oscillator provides AC bias and erase currents.

Tape decks do not have Power Amplifiers but have Pre-amplifiers and an Oscillator.

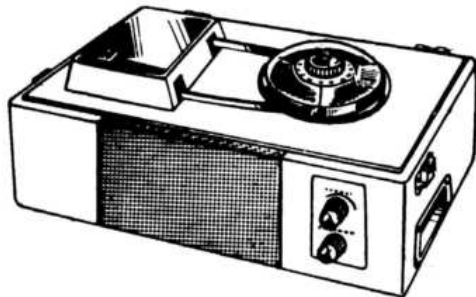
Amplitude Modulation



The system used for broadcasting in AM radio. The carrier is varied in amplitude in accordance with the signal (audio) frequency. As the audio frequency amplitude increases, the amplitude of the carrier increases and vice versa. The width of modulation is expressed in a percentage called Modulation Ratio (M).

$$M = \frac{B - A}{A} \times 100 \text{ or } \frac{C}{A} \times 100 (\%)$$

Announcement Machine



Uses an endless loop of tape to play pre-recorded time announcements, telephone messages, guide announcements, etc.

Is started or stopped by remote control or by certain signals.

Armature

The general term for an Iron Core with a Main Coil,* and this Coil in a dynamo or electric motor.

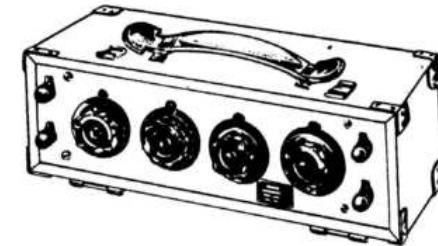
In AC machines, most Armatures are stators, although Rotors can also be used as Armatures; while in DC machines Rotors are used as armatures because rectification is required.

* The Main Coil in a dynamo is a coil which generates electromotive force; and that in an electric motor, counter electromotive force.

A.R.C. (Automatic Recording Level Control)

Refer to "Easy Matic".

Attenuator



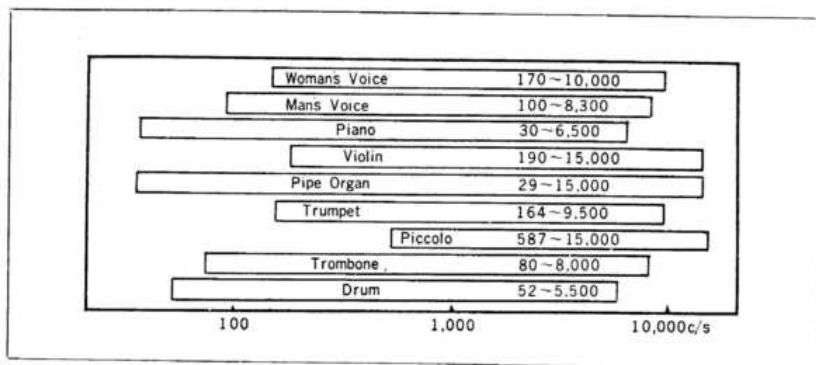
A device to lower the voltage by use of resistors.

For instance, since the output of a Playback Head or Microphone is so small that it is measured in milli volts, it is necessary to have a signal of the same output as the former, in order to measure the Pre-amplifier which receives them.

It is, therefore, necessary to lower the oscillator output. Since it is troublesome to adjust the voltage each time, this Attenuator is used so that the desired voltage may be obtained immediately at any time.

A variation of 100 dB (1/100,000) suffices for measurement of the Pre-amplifier of a tape recorder.

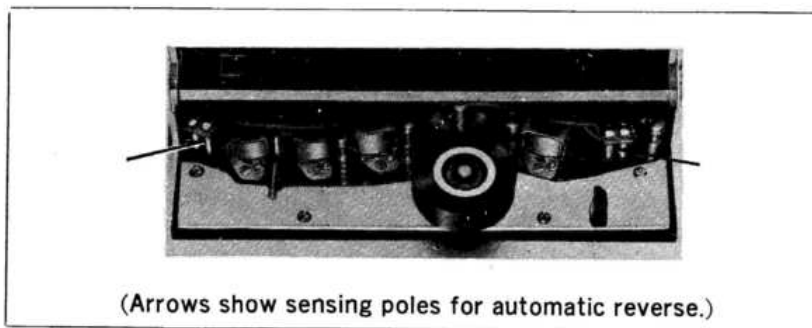
Audio Frequency



An arbitrarily designated range of sound variations (20 Hz to 20,000 Hz) that can be heard by a person with normally sensitive ears. All frequencies, however, cannot be heard equally well. Loudness of the sound also determines the amount heard. Series of curves indicating normal hearing response with changes of frequency and at varying volume levels are known as Fletcher Munson's Curve.

The figure shows the audio frequencies developed by various sound producing devices. The most common range is between 1 KHz ~ 3 KHz with most sound vibrations below 5 KHz.

Automatic Reverse



A method to automatically change the direction of tape travel at the end of the reel.

The most commonly used method is to apply a sensing foil at the end of the tape, or at any point where reversing is desired. When the foil passes a sensing pole, during playback or recording, a short-circuit operates a relay. The relay switches the recorder to "Reverse".

Refer to "Mechanical Reverse" for function and features of the Reverse Mechanism.

Automatic Shut Off

Refer to "Automatic Stop".

Automatic Stop

Automatically switches off the Tape Recorder when the end of the tape is reached or the tape breaks.

The following methods are used for automatic stop:

1. Interlocking the Power Switch to the Tension Arm.

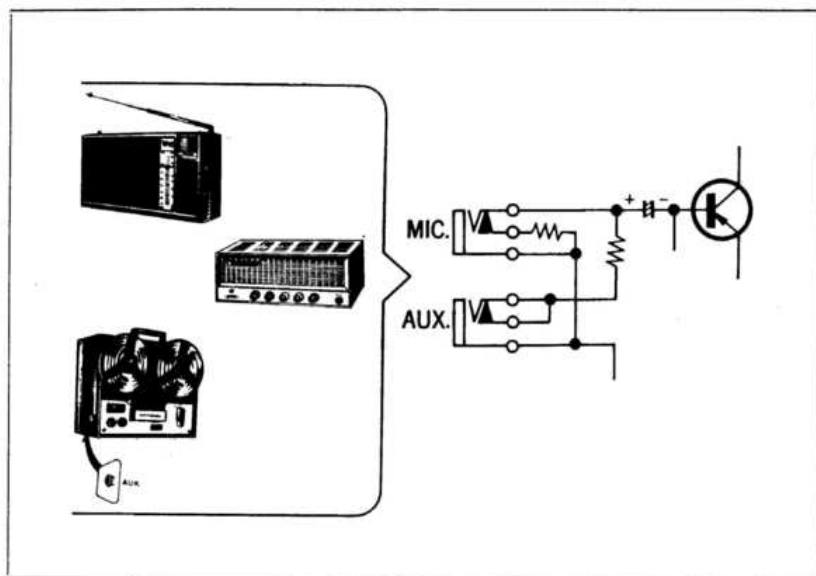
This is the method most generally used today. For high-quality 3-motor tape recorders, when the tape ends, or breaks, the release of the Tension Arm switches off the power source. The tape mechanism is released, in the same way as when the recorder is placed in the STOP mode.

2. Utilization of Sensing Foil

Sensing foil is attached to the end of the tape. When the foil passes the Sensing Pole, a short circuit energizes a relay that switches off the power source.

Except for the high quality recorders, the drive mechanism is not released although the power to drive the motor is off. This leaves the recorder in the Playback position. Care should be taken to switch to off, since wow and flutter will develop if the set remains in Playback for any length of time.

Aux. Input (Auxiliary Input)



An input connection used to apply audio signals from another tape recorder, AM or FM radio, television sound or a stereo channel to a tape recorder. The sound is usually attenuated (reduced) within the recorder by the use of a resistor to prevent overloading (distortion).

The Aux. Input is used for high input level signals, generally from -20 dB (0.1 V AC) to $+10$ dB (3.0 V AC) and at impedances greater than 100 K Ω .

Azimuth Adjustment

Refer to "Head Adjustment".

Background Music (BGM)

Quiet music played in offices, plants, stores, homes to improve working efficiency and to provide pleasant surroundings.

Also refers to music played in the background of movies, TV broadcasts, radio plays to set a mood.

Background Noise

Noise produced during playback with no connection to the sound recorded on the tape.

Noise heard even when tape is not being played back includes amplifier hum, transistor noise, oscillation noise, etc. There are also noises produced when the Magnetic Head is induced by the Motor Power Transformer, etc.

As for noises recorded on the tape, there are Bulkhausen-noise, noise caused by incomplete erasing, noise caused by incomplete coating of magnetism due to inferior tape quality, noise due to magnetization of the Head, etc.

The Signal-to-Noise Ratio shows the degree of noise, and is expressed in terms of dB.

Back Spacing

The tape is automatically rewound a small amount to playback a short section. This applies to Tape Recorders used as office dictating machines and permits the secretary typing the contents of the tape to repeat a small passage that she may have missed or wishes to have repeated.

Refer to "Dictation Machines".

Back Tension

B

The tension applied constantly to the Supply Reel in order to eliminate skipping and wow when starting the tape.

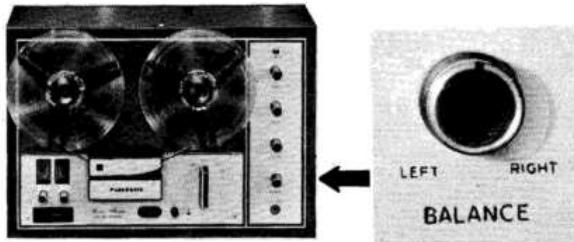
If tape is started without back tension, the Reel rotates by inertia at a higher speed than the tape speed. This causes loosening or abnormal tension on the tape.

In a system in which tape is brought into contact with the Head by back tension only, without a Tape Pad to keep the tape in close contact with the Head, back tension is particularly important because uneven tension immediately causes wow.

The following methods are used to apply back tension.

1. By Self-weight of Tape
2. By Spring
3. By Induction Motor

Balance Control

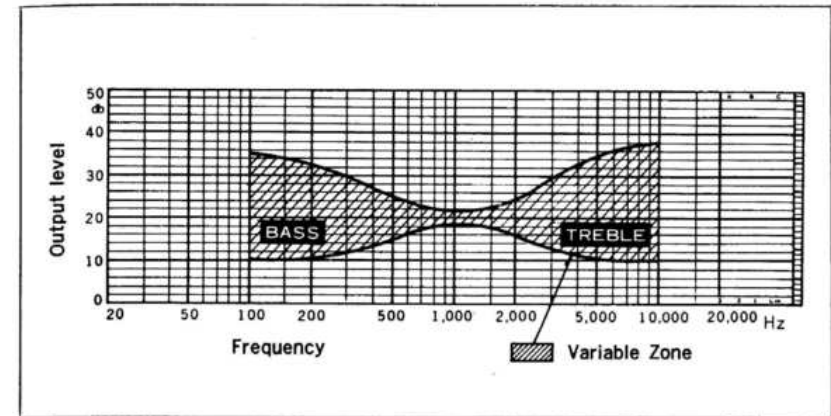


Used to equalize the volume of both channels during stereo playback to suit the listener. Clockwise rotation of the balance control increases the right channel output and reduces the left channel output, and vice versa.

The same effect can be obtained by adjusting the right and left channel volume controls, respectively.

Bass-Treble Control

B



Also called tone control. Provides increases and decreases in the volume of bass or treble.

A high quality amplifier has separate bass and treble controls that can increase or decrease output level of either bass or treble threefold (about 10 dB) or sixfold (about 15 dB) in comparison with the standard 1 KHz signal as shown in the figure.

More common systems permit reducing treble only or permit increase in bass and decrease in treble only.

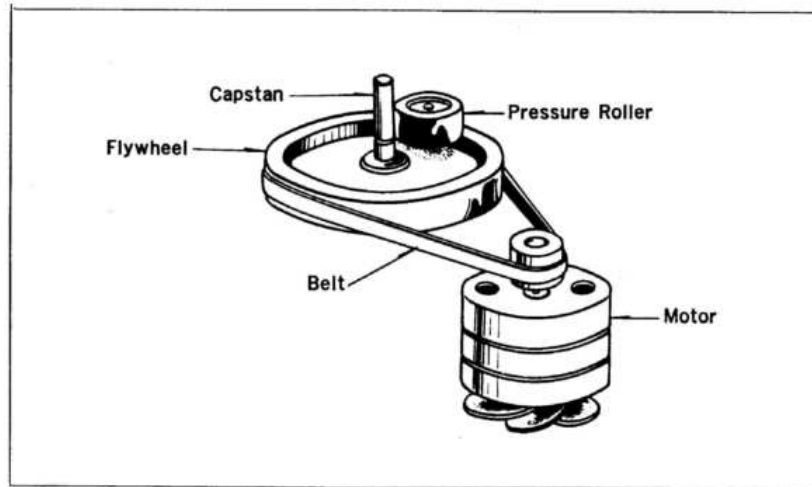
Beat

When two or more frequencies are superimposed, other frequency which corresponds to the difference of the two is generated.

In a Tape Recorder, a disturbing sound can be heard as a difference beat between the bias frequency of the recorder and a record sound signal (or its higher harmonic). This condition can be eliminated by designing the bias frequency to be 4 to 5 times as high as the highest sound frequency to be recorded. Therefore, the bias frequency should be between 30 KHz and 100 KHz.

In addition, audible disturbances may be produced by beats between the Radio Oscillator circuits and the higher harmonics of the tape recorder Bias Oscillator, or between the 19 KHz harmonic of the FM pilot signal and the bias frequency while recording an FM stereo broadcast. Either condition can be eliminated by changing the bias frequency of the Tape Recorder by a small amount.

Belt Drive System



One method to deliver motor torque to the Capstan. The belt interconnects the motor pulley and the capstan flywheel.

Advantages of the Belt Drive System are as follows:

1. Motor vibrations are not transmitted to the capstan.
2. Construction is simple.
3. The position of the motor can be selected easily.

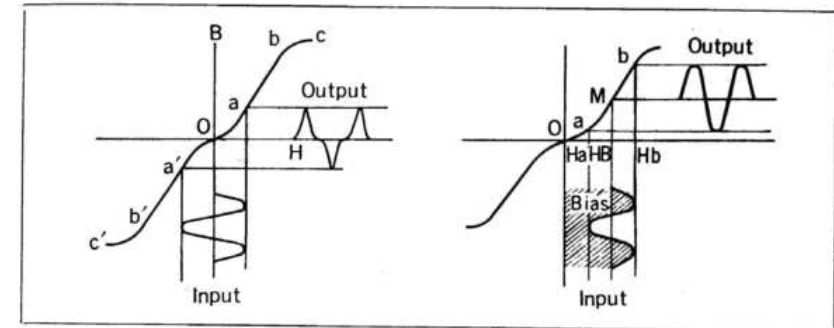
Belt Drive Systems are best suited for use with Reversing Mechanisms.

B-H Curve

A curve which shows the magnetic characteristic (the amount of magnetic reaction to the magnetic field) of a magnetizable material. A recording tape has such a magnetic characteristic as shown by its B-H curve.

Refer to "Hysteresis Loop".

Bias Current



Since magnetic properties are not recorded on the tape in proportion to the variation of the magnetic field which follows the sound variation, it is necessary to apply a bias magnetic field (in addition to the magnetic field) by sound current. The current to apply this bias magnetic field is called Bias Current.

Binaural Effect

Sound heard by two ears produces a Binaural, or frequently called Stereo effect.

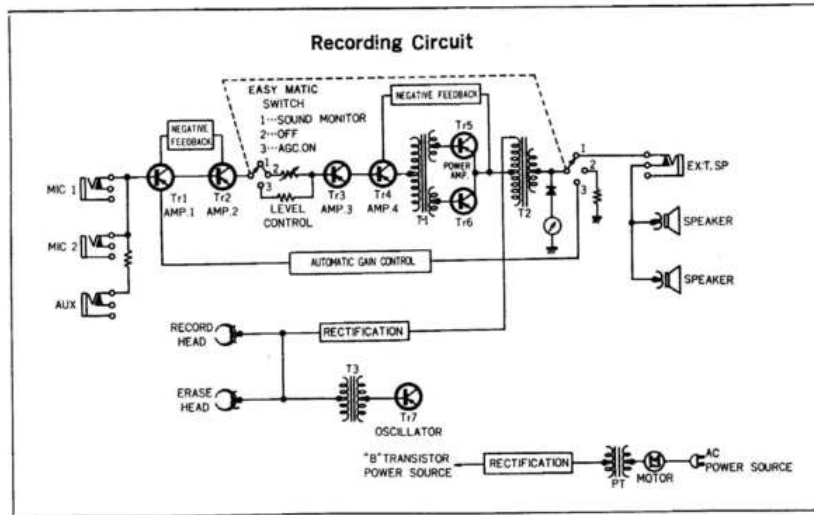
Sensing the direction of the heard sound is the most common phenomenon of the binaural effect. The difference in loudness, and the slight time lag (phase difference) of the sound heard in each ear gives the perception of direction.



If sound is heard by one ear only, all sounds are received. But, when both ears are used, extraneous sounds are not noticed. As a result stereo sound systems produce good natural sound, not obtained even by the best monaural systems.

Binaural effect also produces a masking effect, whereby a sound being heard weakens the ears' perception of the preceding sound.

Block Diagram



Shows the function of each stage of the amplifier.

For a tape recorder, the block diagram explains:

1. Structures of amplifiers for recording and playback, respectively.
2. How Negative Feed Back and equalization are applied.
3. Relation between input and output, each control, VU meter, etc.

BS

BS stands for British Standard.

Although safety specifications are not specifically outlined in England, BS415 is applied to radios and other similar electronic appliances.

BS415 is applied to appliances as a whole. From the viewpoint of safety as well as fire prevention, it regulates the requirements to protect the user from electric shock, fire, explosion of cathode ray tube, X-ray exposure, etc.

Bulk Eraser



Erases entire contents of a reel of tape in approximately 5 seconds. Tape can be erased by running it through the recorder in the Record mode with the Volume at zero, while a 7-inch reel (1,200 ft tape) at 7-1/2 ips takes one hour both ways.

Butadiene Rubber

B One of the materials for belts used in tape recorders; also known as Stereo Rubber.

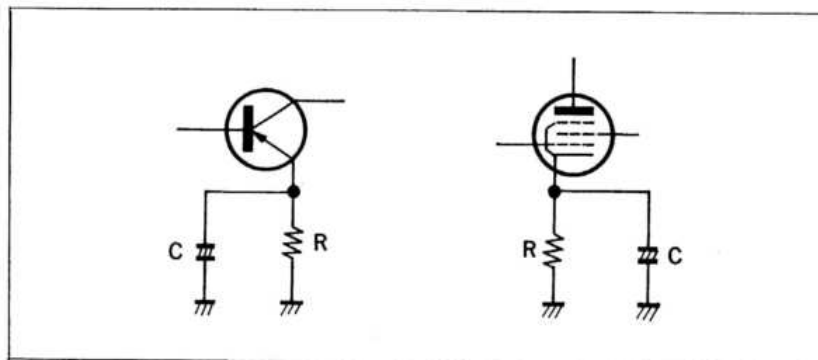
Features:

1. High abrasion resistance.
2. High repulsion elasticity.
3. Low internal (dynamic) heat generation.
4. Excellent low temperature properties.

For tape recorders, butadiene rubber is used in sections where heavy driving occurs or for belts which directly contact crucial parts of the unit.

Examples: Capstan Belt, Rewind Belt.

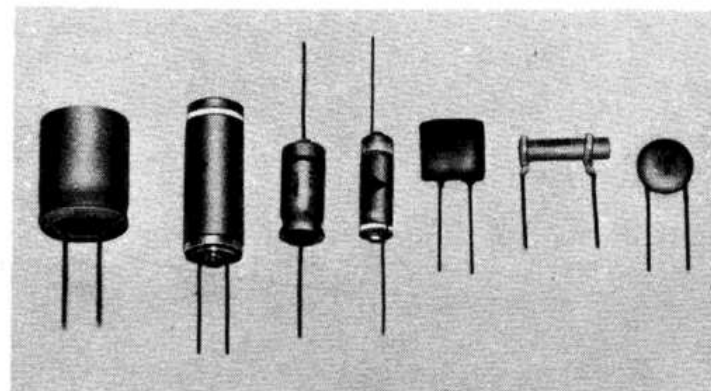
Bypass Condenser (Capacitor)



For applying direct current to only the load in circuits where AC and DC are superposed.

For example, when only DC is required for Load R in relation to transistors or vacuum tubes in the figure above, both ends of R are short-circuited in terms of AC if Condenser C is inserted in parallel to R. This C is called the Bypass Condenser.

Capacitor



Provides electrostatic capacity between two conductors.

Capacity is shown by symbol C, and is expressed in the unit of farad (F). The unit is very large, and practical values used in tape recorders are expressed in one-millionth of a farad (μF) or one-millionth of a μF (the picofarad (PF)).

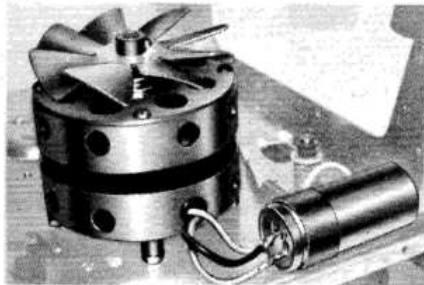
Common capacitors are composed of an insulating material between two conducting electrodes. The following are the common capacitors found in Tape Recorders. Each name is taken from the type of the insulator used:

1. Paper capacitor: The oldest kind of capacitor with a wide range of applications.
2. Metalized paper capacitor: Compact, non-inductive and is self-restoring, if electrically punctured.
3. Polyester capacitor: Compact with high heat stability and very reliable.
4. Polystyrene capacitor: High precision capacity, high insulation resistance, constant temperature coefficient, small loss, high quality, extremely small dielectric absorption and other favorable features. Widely used in high-frequency circuits, resistor compensation, circuits, etc.

5. Electrolytic Capacitor: High capacity. Used to eliminate ripple in rectifier circuits.
6. Ceramic capacitor: Compact and thin with good thermal characteristics. Unlike other capacitors, it can be used at high frequencies.

C

Capacitor Motor

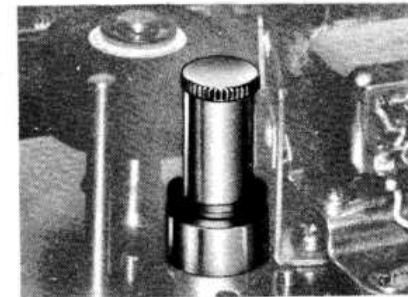


A single-phase induction motor, using a capacitor as the starting device. With the capacitor in series with the auxiliary coil, a phase difference is produced between the magnetic flux of the main coil and that of the auxiliary coil, which becomes a revolving magnetic field to start the motor.

While the motor rotates, the Capacitor functions to improve the Power Factor.

The Capacitor Motor features high power factor, high efficiency and very low vibration and noise.

Capstan



C

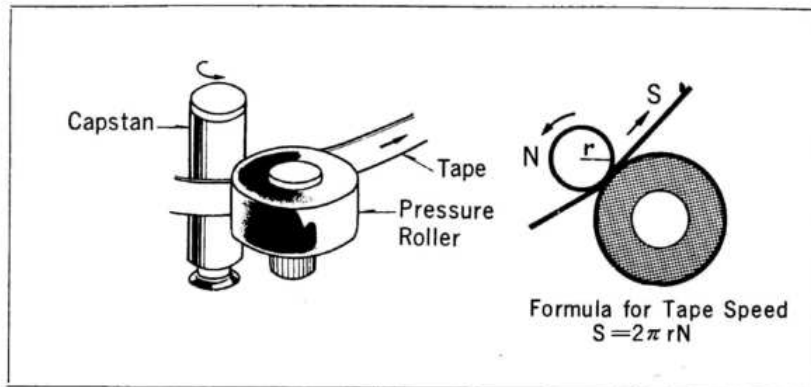
An indispensable component to drive the tape at a constant speed. Usually, the Capstan is made of stainless steel or brass, which do not easily become magnetized. It is made with utmost care to prevent an eccentric core or shaft vibration which would cause deviation of tape speed or uneven rotation.

Ordinarily the Capstan is directly connected to a large Flywheel to assure smooth rotation. For portable and compact AC-type tape recorders, a system to change tape speed with this type of Capstan is often used.

Because the circumference speed of the Capstan determines the tape speed, a Sleeve which has a length of double that diameter is attached to (or removed from) the Shaft, and two different tape speeds are obtained. This easy speed change is an advantage of the Capstan.

Capstan Drive System

Used to drive the tape at a constant speed. The Pressure Roller forces and holds the tape in contact with the Capstan. Capstan rotation forces the tape in the direction of rotation. Tape speed is equal to the circumferential speed of the Capstan and is constant if the motor speed remains constant.



As shown in the figure, the tape speed (S) depends upon the radius of the Capstan (r) and the number of revolutions per second of the Capstan (N) is expressed as follows:

$$S = 2\pi rN$$

Refer to "Reel Drive System".

Carbon Tetrachloride

A chemical solvent which is used to clean the head surface.

Cardioid Microphone

Refer to "Uni-Directional Microphone".

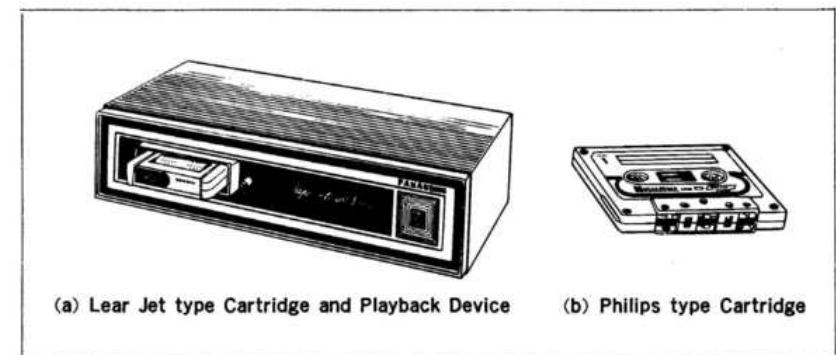
Car Stereo

A stereo tape player installed in an automobile to provide enjoyment of stereo music and sound of the listener's choice. Eliminates the need to change radio stations when signal strength changes. There are three car stereo systems currently in use:



1. Fidelipac type (Conlay type): 4-track endless tape
 2. Lear Jet type: 8-track endless tape
 3. Compact Cassette type: 4-track (2-track monaural) reel-to-reel
- Refer to each system.

Cartridge Tape



Tape housed in a package.

In 1958, RCA introduced a cartridge containing approximately 600 feet of 1/4 inch tape and established the basis of 4-track stereo systems. Other tape systems, utilizing the 1/4 inch width, have since been introduced.

They are:

1. Reel-to-reel types; RCA, R3M, Philips, DC International.
2. Endless tape types; Fidelipac, Lear Jet, MGM Play Tape.

The cartridge provides a single convenient pack that is adaptable to automated methods of tape play. Cartridge tape is very promising as a trend in tape recorder development in the future. Since a special mechanism is required for each cartridge, world standardization is desirable to select a single method.

The Philips (compact cassette) has become the most popular reel-to-reel method and the Lear Jet type has been the most popular endless tape method.

Cassette

Refer to "Compact Cassette".

Cassette Recorder

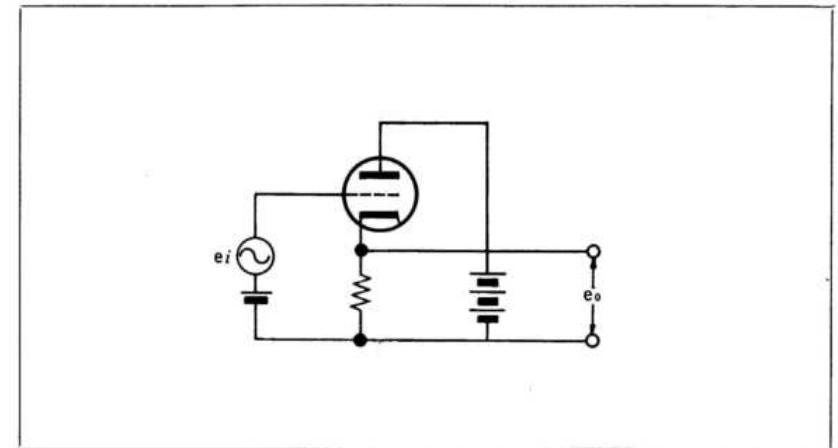


Uses a small cartridge of the reel-to-reel type. The most popular and the one currently used by most manufacturers is the compact cassette developed by Philips of Holland in 1963.

Features:

1. Cassette is so small that it can be put in a shirt pocket. As a result, the tape recorder itself is also compact, and portability is remarkably improved.
2. Records and plays back for 60~120 minutes by use of the 2-track 2-way system.
3. Records and plays back in the same way as an ordinary reel-to-reel tape recorder.
4. Performs fast forward and rewind satisfactorily.
5. Equipped with an accidental erasure prevention device.
6. Also used as a tape player for automobiles.
7. 4-track stereo and 2-track monaural compatibility.

Cathode Follower



Used to provide low distortion matching of high input impedance to low output impedance. Commonly used in the output stage of the Pre-amplifiers or in the input stage of the Power Amplifier.

Features :

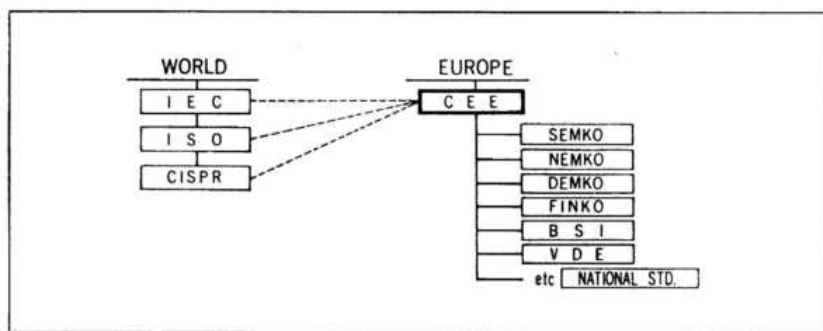
1. Amplification is less than, but almost 1.
2. Input and output signal phases are the same.
3. High input impedance.
4. Low output impedance.
5. Low distortion.

The Cathode Follower is also called a Plate Earth. The same circuit using transistors is called an Emitter Follower.

CCIR

Comité Consultatif International des Radio Communication.

Regarding Tape Recorders, the CCIR specifies the international technical standard for tape recording for broadcasts.

CEE

International Commission on Rules for Approval of Electric Equipment.

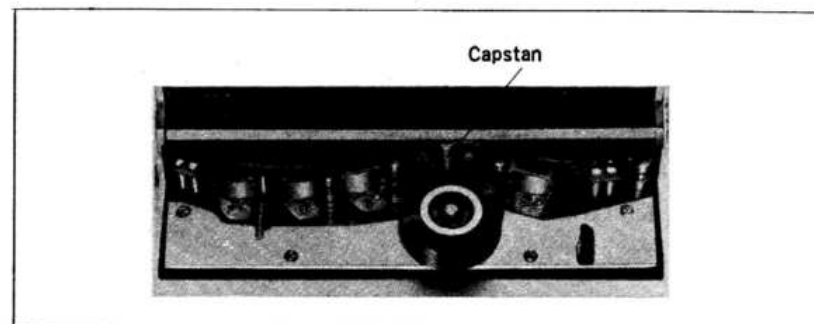
Organized in 1926 as the IFK and renamed CEE after the war, it now represents 16 European nations.

CEE is closely connected with IEC, ISO, and CISPR, which mainly decide standards of materials, etc. CEE, on the other hand, decides the specifications of domestic appliances and recommends products to related countries.

In the CEE specifications, prevention of shock hazard is emphasized, and inspection is based on use of the finished product per se rather than on the material structure, etc.

Cellulose Acetate

Refer to "Acetate Cellulose".

Center Capstan System

Used as a Reversing Mechanism. As shown in the figure, the Capstan is located between the Tape Head that operates during forward motion and the Tape Head that operates during reversing.

The two heads are installed in parallel to provide a Symmetrical System. Thus, the same performance is obtained in both reverse and forward. Panasonic does not use an Asymmetrical System because of the following characteristics of the Asymmetrical System:

1. The reversing tape passes in front of the Head after being sent out from the Capstan. Although the speed from the Capstan is constant, the takeup tension is uneven causing wow and flutter.

2. Both Heads for forwarding and reversing are positioned after the tape is sent out from the Capstan when reversing. In order to take up the tape a greater tension must be applied to the tape.
3. Either forwarding or reversing merit in respect to tape speed accuracy and tape speed fluctuations (wow) must be sacrificed.

Channel

The longitudinal designation of the section of the tape recorded. The usual types are:

1. 2-track, 1-channel monaural: This is most often used for a 2-track monaural system.
2. 2-track, 2-channel monaural: Recordings can be made on the two tracks separately in one direction of tape movement.
3. 4-track, 1-channel monaural: By switching the head, recording and playback of each track is accomplished separately.
4. 4-track, 2-channel monaural: The Head for 2-track, 2-channel monaural is designed for 4-track use.
5. 4-track, 2-channel stereo: Two stereo channels are recorded or played back simultaneously. This system is generally called All-in-one Stereo.

Channel Separation

The degree of sound separation between two stereo channels measured in dB. Lack of separation is characterized by crosstalk between the channels.

Crosstalk is usually caused by defects either in recording or playback equipment, although improper recording methods (for example, microphones too close together) can be responsible.

Chloroprene Rubber

The first synthetic rubber. It is also called Neoprene Rubber, and is made through emulsion polymerization.

There are various types of chloroprene rubber as classified below.

1. Sulfur modified type
2. Non-sulfur modified type
3. Special type

Features:

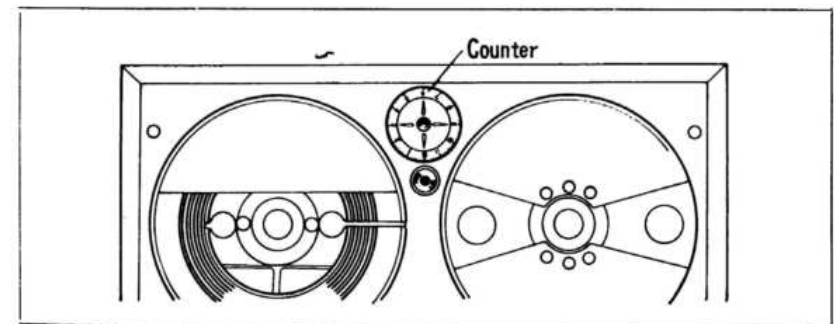
1. Excellent in resistance to oils such as lubricant, gasoline, animal oil, etc.
2. Relatively thermostable.
3. Since it contains CL radical, it has excellent weather and ozone resistance.

In most DC type tape recorders it is used for driving belts.

CKD

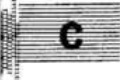
A system of supplying parts to a partner under a technical assistance agreement. All parts are shipped after being knocked down, viz., disassembled into pieces.

Clock Type Tape Counter



A round dial and hand which resemble a clock. The position of the recording tape is indicated by the hand.

Refer to "Digital Tape Counter".



Coil



Provides inductance (L) required in Tape Recorders, radios, and other communication devices. It is made by winding insulated wire around a bobbin or a magnetic core.

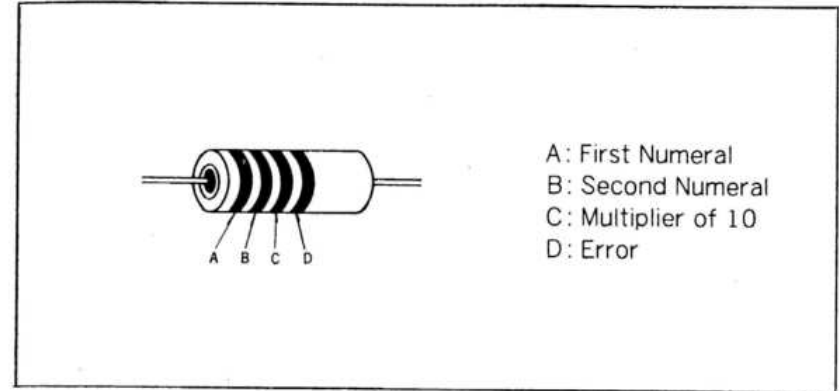
In principle, the inductance is effected by two parts, viz., Coil and Transformer.

1. The Coil is to utilize self induction of the electromagnetic sytem.
2. The Transformer is to utilize mutual induction of the electromag-netic system.

The coil may use a hollow core depending upon its use, but usually it is made with a solid core to improve its magnetic effect.

It has a wide range of applications such as chalk coils, oscillation coils, heads, speakers, microphones, etc..

Color Code



A method using different colors to identify resistance value or its allowance. The chart shows how to read the color code.

(Example)

- A: Green = 5
- B: Blue = 6
- C: Orange = 3
- D: Silver = ±10%

Resistance Value

$$56 \times 10^3 \Omega \pm 10\% = 56K\Omega \pm 10\%$$

Color	Mumeral	Error
Black	0	±20%
Brown	1	
Red	2	± 2%
Orange	3	
Yellow	4	
Green	5	
Blue	6	
Purple	7	
Grey	8	
White	9	
Gold	0.1	± 5%
Silver	0.01	±10%



Compact Cassette



A small plastic case (Cassette) for housing the recording tape without the trouble of threading the tape as in conventional reel-to-reel systems. Its dimensions are $4" \times 2\frac{1}{2}" \times 1\frac{1}{2}"$ ($100.4 \times 63 \times 12$ mm). Tape width for this Compact Cassette is $\frac{1}{8}"$ (one half that of ordinary tape).

Features:

1. Since it is a Reel-to-Reel System, the tape can be rewound, and fast forwarded. There is no inconvenience for recording and playback.
2. It is possible to record and playback both 2-Track Monaural and 4-Track Stereo.
3. Error erasing and error recording can be controlled automatically.
4. Being compact and light in weight, it can be operated easily.
5. Time of two-way recording is 60 minutes or 90 minutes. (Tape Speed: $1\frac{7}{8}$ ips)
6. It is being developed as a car stereo cassette.
7. No maintenance is required for the Tape and Housing.
8. It is easy to splice the Tape if broken.

Compatible

The ability to use several systems in one device. For example, monaural recorded tape can be played back on a stereo tape player as well as stereo recorded tapes.

In recorded discs, monaural discs are "compatible" with stereo players since the monaural disc can be played on a stereo player.

Present-day FM Stereo Broadcasting and Color Television systems are interchangeable between monaural and stereo, or between monochrome and color, and therefore can be regarded as "compatible".

Composite Type Speaker



A combination of two or more speakers with the best features of both large and small diameter speakers, since both speakers respectively have advantages and disadvantages in reproduction.

A 2-way Speaker is also a combination of a large diameter speaker (Woofer), which has good bass characteristics, and a small diameter speaker (Tweeter), which has good treble characteristics, using the merits of both speakers.

Mainly used for Hi-Fi reproduction.

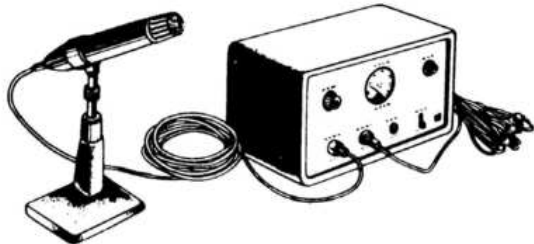
The following points should be taken into consideration when selecting a composite type speaker.

1. The Woofer and Tweeter should be alike in efficiency, or the Tweeter should have slightly higher efficiency than the Woofer.
2. The Woofer and Tweeter should be equal in the lowest value of electric impedance from the voice coil.
3. The Woofer's characteristic should gradually decline in the bass, and abruptly decline in the treble at the crossover frequency.
4. The bass resonance frequency of the Tweeter should be equal to or lower than the crossover frequency.

Condenser

Refer to "Capacitor".

Condenser (Capacitor) Microphone



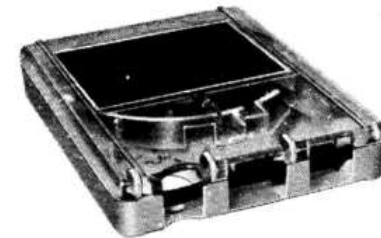
Used to convert sound to electrical energy which is amplified in an Amplifier.

Operates on the electrostatic principle. A thin, light conductive diaphragm and a fixed flat electrode are mounted approximately 0.03~0.05 mm apart, and a fixed voltage is applied to produce an electrostatic field. When sound waves cause the diaphragm to vibrate, the capacitance between the two electrodes varies and causes a capacitive voltage change.

Advantages are high sensitivity, small size and excellent characteristics. These features make it excellent as a measuring device.

The disadvantages are the need for an auxiliary power supply and poor noise characteristics when humidity is high or varies.

Conlay Type Cartridge



A cartridge utilizing an endless 3" tape used in car stereo systems prior to the introduction of the Lear Jet system.

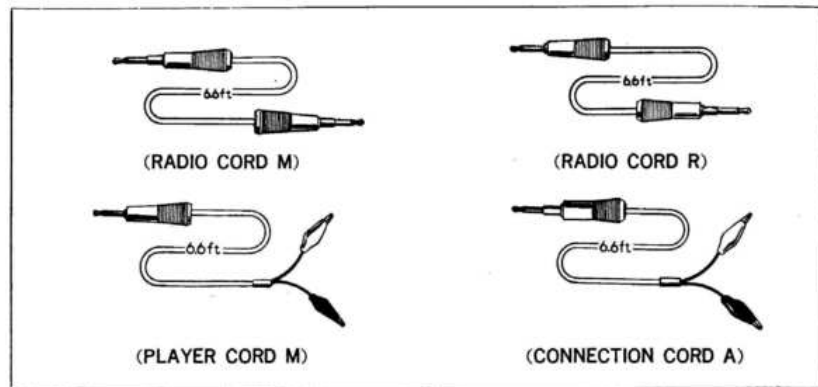
Features:

1. Built-in braking mechanism.
2. Tape speed 3-3/4 ips, 4-track stereo, high quality sound.
3. Easy operation. Insertion of cartridge operates the machine.
4. Playing time is 80 minutes.

Drawbacks:

1. Tracks must be selected.
2. Since graphite is applied to the endless tape as an abrasion reducing agent, the Head and Pressure Roller are apt to become dirty.
3. Tape life is shorter than in reel-to-reel system.
4. Fast forward and fast rewind are not possible.

Connection Cord



A Cord used when the output of a tape recorder is to be reproduced by an amplifier or speaker, or for recording from radio, TV, Hi-Fi amplifier, player, etc.

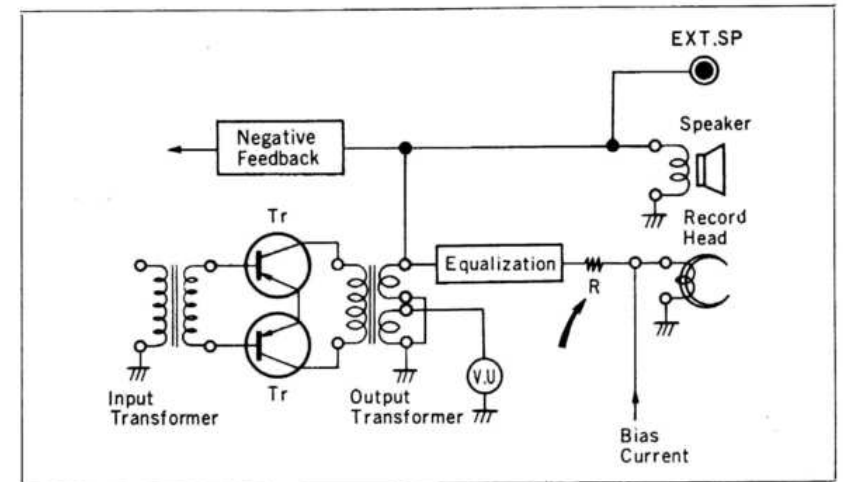
The connection cords for tape recorders which PANASONIC sells:

- * Radio Cord R & M Refer to "Radio Cord".
- * Player Cord Tape Recorder (MIC) ↔ Player (OUT)
- * FM Cord Tape Recorder (AUX) ↔ FM Tuner (OUT)
- * Speaker Cord Tape Recorder (EXT.SP) ↔ Ext. Speaker
- * Connection Cords A, B, C, D, etc.

Constant Current Circuit

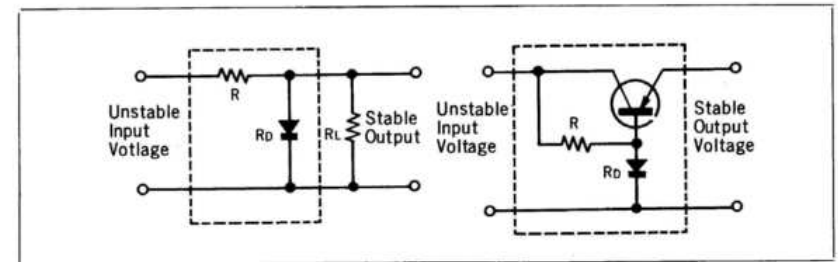
Maintains constant signal currents to the Recording Head at all audio frequencies.

Since the Recording Head has high inductance (L) compared to resistance (R), the recording signal currents are reduced as the frequency increases ($X_L = 2\pi fL$). A constant current is required for each audio frequency in order that a magnetic recording of constant strength will be made on the tape. For this purpose, a large resistor is generally inserted in series with the recording Head.



In general, the impedance of the Recording Head at 1 KHz is 2~3KΩ. By inserting a series resistor (R) of 100 KΩ~200 KΩ, the current becomes almost constant at any audio frequency.

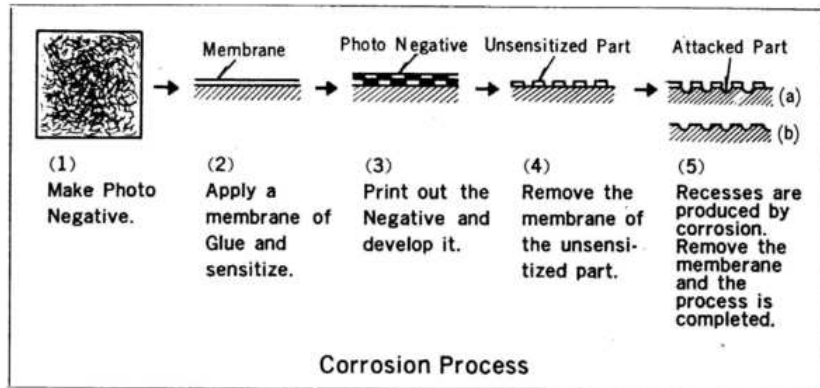
Constant Voltage Circuit



Transistor circuit stability depends upon maintaining stable voltages. Since fluctuations of the power source is a major cause of instability, the power is stabilized by a constant voltage source.

Zener devices can be used to provide constant voltage. Two examples are shown in the figure.

Corrode Processing

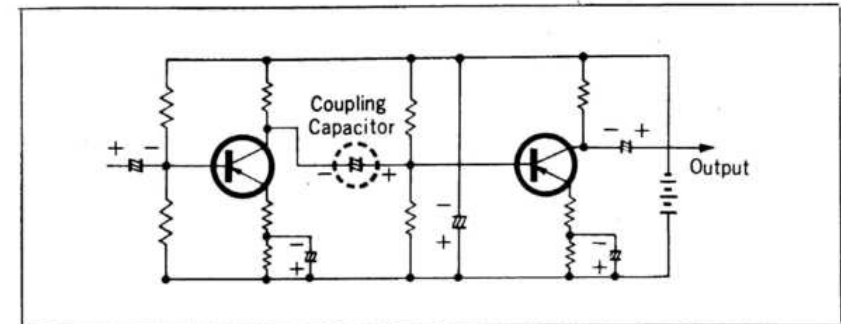


Used for making leather and aventurine patterns on the name plate (ornamental plate), plastic case, etc.

The figure above and the explanation below give an example of Corrode Processing.

1. PHOTOGRAPHIC NEGATIVE
Prepare a pattern which you want to corrode, and take a photo with contrast to produce the negative.
2. COATING
Form a coating of glue + sensitive agent on the surface of the metal pattern to be corroded.
3. PRINTING AND DEVELOPING
Print the negative (1) on the coat (2) and develop it.
4. REMOVAL OF COAT
Remove the unsensitized section of the coat.
5. CORROSION
Corrode the metal pattern with corrosive solution; the part where coat is removed dissolves and forms a concave.
6. FINISHING
When coat is removed from the sensitized section, the rugged pattern is completed.

Coupling Capacitor



A capacitor used for bias point stabilization and blocking DC in RC-coupled amplifier circuits.

Used in transistor circuits, since it is compact and shows good frequency response. However, RC coupling is inferior to transformer coupling in transistor circuits since circuit efficiency is as low as 10% due to mismatching.

CPS

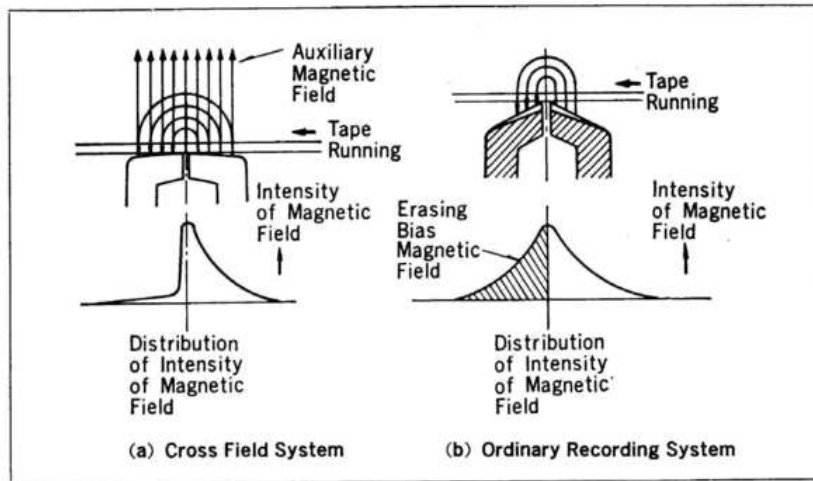
Abbreviation for cycles-per-second, also often shortened to cycles. Recently replaced by HzPS (Hertz per second).

Cross-Field System

An AC Bias recording system which provides improved recording characteristics in the high frequency range.

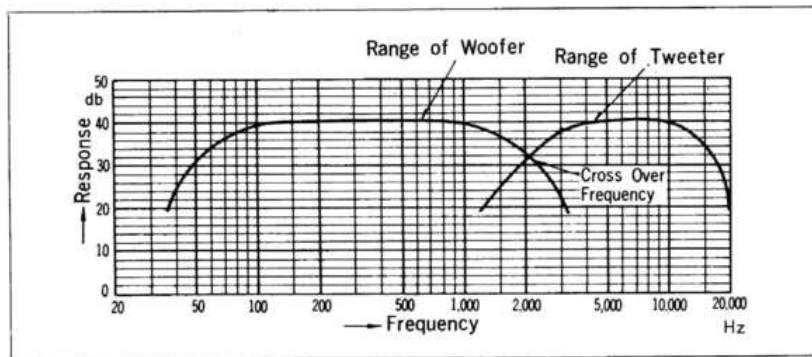
The commonly used AC Bias method suffers from decrease in high frequency response due to the erasing effect of bias current. As the recorded tape passes through the bias magnetic field, a partial erasure occurs.

In the Cross-Field System, an auxiliary magnetic field of opposite direction to the bias magnetic field is applied. This eliminates the bias magnetic field which has an effect on the said erasure.



Although this provides good results, it is difficult to adjust. Frequency response will change since Head abrasion causes changes in bias current. Readjustment then becomes necessary.

Cross Over Frequency



The frequency at the cross point when two amplifiers or speakers are used to cover a wide range of frequency.

For example, in a two-way (Composite Type) speaker system, the Cross Over Frequency is at upper frequency limit of the Woofer, and the lower frequency limit of the Tweeter, as shown in the figure.

In general, it is usually in the 1 KHz to 3 KHz range.

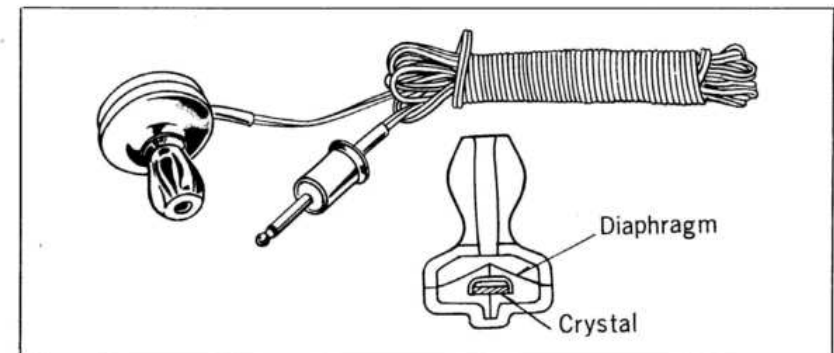
Cross Talk

Sound from one tape channel appears in the other channel. For example, when Track 1 is being played back, sound from Track 2 is also heard. In another case, sound from Channel 1 is heard while listening to Channel 2. This is Channel Cross Talk.

In stereo systems, leakage may take place between elements of the Head causing Cross Talk. However, tape has less Cross Talk than disc systems. The crosstalk is approximately 40 to 50 dB.

Cross Talk between tracks in a Tape Recorder increases if the height of the Head is improperly adjusted. Readjusting the Head, using proper measuring instruments, will correct this condition.

Crystal Earphone



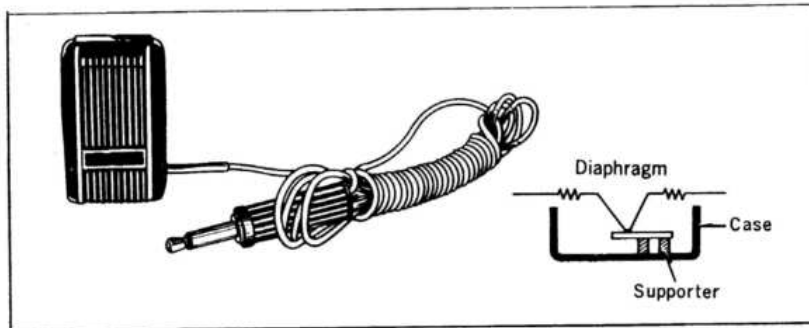
Converts electrical signals to sound. Is used to listen to sound without disturbing other persons and to shut out outside noises for the listener.

It operates on the principle that if a voltage is applied to 2 terminals of a Bimorph vibrator, a vibration occurs. This vibration transmitted to the diaphragm moves air and then the diaphragm in the human ear is moved.

Good high frequency response is impossible with this earphone due to the mechanical resonance of the crystal. Since no power is required to operate the Crystal Earphone it can be and should be connected to the Pre-amplifier output (Line Out).

If necessary to connect a Crystal Earphone to EXT. SPEAKER terminals, a speaker dummy resistor must also be used to prevent damage to the power amplifier.

Crystal Microphone



Used to convert sound vibrations to electrical voltages. It works on the principle that the physical pressure of a sound wave applied to the terminals of a Bimorph vibrator (two crystal plates adhering to each other) produces an electrical voltage.

The Crystal Microphone structure is simple, as shown in the figure. The sound vibrations are transmitted from the Diaphragm to the Bimorph.

Although inexpensive and light in weight, the Crystal Microphone has high sensitivity. However, if the load resistance (amplifier input) is incorrect, sensitivity decreases, low frequency response worsens and the sound becomes hard. Input resistance should be about 500 K Ω to 2 M Ω . Sensitivity may decrease if the microphone is exposed to direct sunlight (temperature higher than 40°C).

CSA

Canadian Standards Association (Safety Standards in Canada), which is so thoroughly enforced that it is impossible to sell or use electric appliances without the CSA approval mark.

Cue

Cue or cueing is useful for editing or reprinting tape. It is a method to locate specific sounds recorded on tape.

Although it is normally impossible to monitor sound while the tape is travelling during fast forward or fast rewind, a cue lever permits this monitoring. The cue lever brings the tape close to the Playback Head and the sound can be heard at that point on the tape.

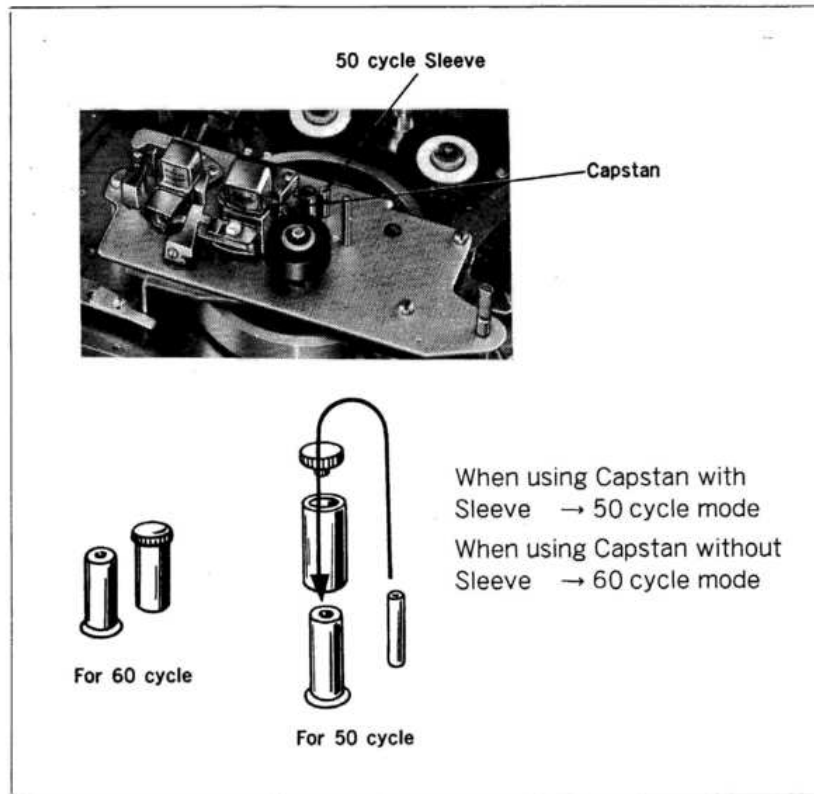
Another use is to temporarily stop the tape during recording or playback. Use of the Cue lever moves the pressure roller away from the Capstan which causes a brake to be applied to both reels. (Sometimes Supply Reel only)

Curling

When tape becomes unevenly elongated, the tape is no longer good for recording. Care should be exercised to prevent curling. The following are the causes of curling:

1. Tape is stored where temperature is high.
2. Tape is stored where humidity is high. (Sealing the tape container helps keep humidity out.)
3. Excessive tension is applied to the tape during fast forward or fast rewind.
4. Tape is stored for a long time after winding at high tension.

Cycle Change



When an AC tape recorder is to be used in an area where the power source frequency is different, it is necessary to modify the tape recorder so that it meets the new frequency. This modification is termed Cycle Change.

An AC Motor (Induction Motor or Synchronous Motor) rotates at a speed according to the power source applied to it. As a result, tape speed changes. Therefore, when a Tape Recorder set for 60 Hz (U.S. Standard) is to be used where the power source is 50 Hz, the recorder must be changed in one of the following ways:

1. Change the diameter of the Capstan Shaft by using the 50 or 60 Hz sleeve.
2. Change the diameter of the Motor Pulley by using the proper sleeve.
3. For a Shading Coil Motor, motor wiring must also be changed in addition to changing the Capstan or Motor Sleeves. (some sets)
4. For a Condenser Motor, the condenser must also be changed when the sleeves are changed. (some sets)

Cycle Counter (Digital Counter)



Used for measuring frequency, the measured value being expressed numerically.

Its main application for Tape Recorders is tape speed measurement. First, a recording of a 3,000 Hz signal is made on a recorder with minimum tape speed fluctuation. Then, the tape is played back on the recorder to be measured and the output is read on the Cycle Counter. The frequency is read and the tape speed deviation is calculated. For example, if the playback frequency is 3,030 Hz, the tape speed deviation is calculated as follows: $(3030 - 3000) / 3000 \times 100 = 1\%$.

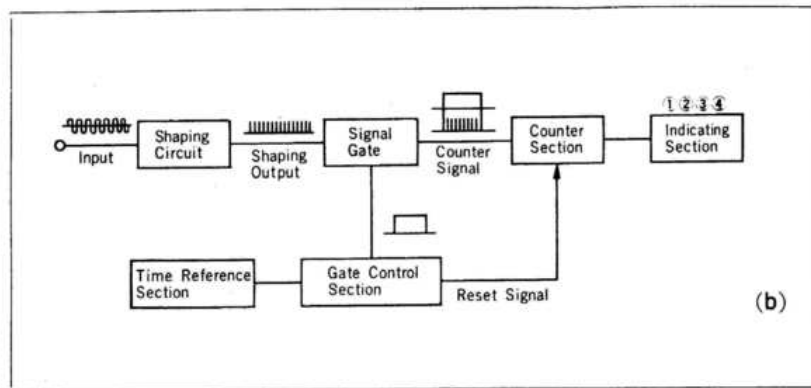


Figure b is a block diagram of a Cycle Counter. The tone-wave input is shaped into pulses by the Shaping Circuit and applied to the Signal Gate. Then, the pulses are passed through the Counter Section for as long as the Gate Control permits the passage. The number of pulses is calculated in the Counter Section and the numerical value of frequency is displayed in the Indicator Section.

Damping

When an abrupt change is applied to a speaker, or a high volume sound is abruptly removed, the speaker cone will continue to vibrate and unwanted sounds will be heard unless the vibration is damped. Speaker, cabinet, and amplifier all contribute to the ability to suppress the undesirable movement. As its unit in measurement, damping factor (DF) is used.

$$DF = \frac{|Z_{sp}|}{|Z_o|}$$

Where: Z_{sp} = Speaker voice coil impedance

Z_o = Internal impedance of the amplifier which drives the speaker

The larger the DF, the smaller the transient distortion. Therefore, Z_o should be maintained small. Damping factors up to 2 are usual for ordinary amplifiers (at 400 Hz) and around 15 for very good amplifiers.

DC

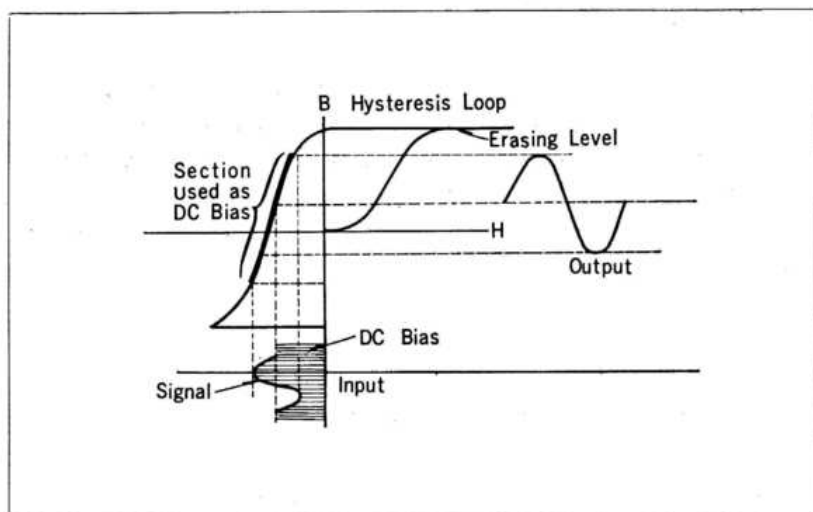
Direct current.

DC Bias

DC Bias does not always remain at point $B=0$ (no magnetization at all) when the signal is zero. This results in tape noise.

Although DC Bias method is simple, it has been replaced almost completely by the AC Bias method which yields lower noise.

Refer to Bias Current and AC Bias.



Two common methods of DC Bias are used: One utilizes the initial magnetization curve; the other, and more common method, uses the straight line portion of the hysteresis loop. For the latter, the tape is saturated in advance (N or S pole) and then a reversed polar bias magnetic field and signal are superimposed and recorded on the tape.

DC Erasing

An electrical method of saturation erasing of sound recorded on a magnetic tape.

A very simple circuit and simple structure are used for DC Erasing. Erasure is stopped merely by removing the erase current.

DC Erasing is often used in Battery type or AC/Battery type Tape Recorders.

Although some noise is present, and signal-to-noise ratio is somewhat low, DC erasing is convenient to use. Higher tape speeds produce more noise (higher than 7-1/2 ips).

Decibel (dB)

Used for comparing electrical points on a logarithmic basis. For example, it is used for comparing voltage, amperage, wattage as follows: Gain of an Amplifier is 20 dB (10 times amplitude) or can be used as units of voltage, amperage, wattage, such as, "Line output is 0 dB (1.0 V)".

The advantages of the use of the dB are:

1. Man's audio sensitivity is proportional to the logarithm of sound and linear to its volume
2. A wide range of amplitude variations can be expressed with a small figure.
3. Calculations are simplified. Total stage gains (expressed in dB) can be determined merely by addition of all dB gains.

Calculations using dB

1. Power: $10 \log_{10} W_2/W_1$
2. Voltage: $20 \log_{10} E_2/E_1$
3. Amperage: $20 \log_{10} I_2/I_1$

Demagnetization

Removing magnetism of the Tape Guide, Head, Capstan, etc. When the recorder's metallic parts that are in the path of tape travel become magnetized, a hissing noise is recorded on the tape.

The noise is particularly objectionable in 4-track systems which have lower output signal levels. Bringing a magnet or magnetic field to any part where tape runs is to be avoided.

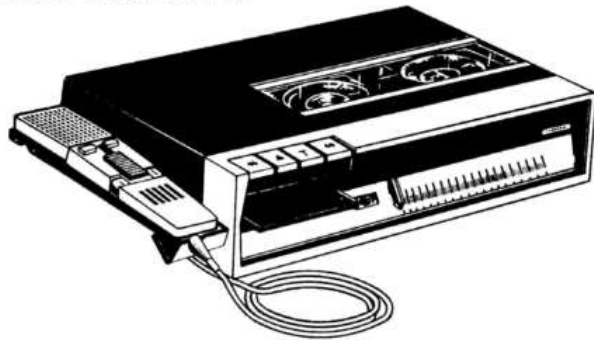
As for a Head, DC Magnetic component may remain on the tape due to a distorted bias wave form present during recording and will be reproduced as noise. A Head Eraser is used to demagnetize the Head.

DEMKO

Abbreviation of Denmark's Elektriske Materiel Kontrol (Danish Safety Standard).

It provides that Electric Apparatus of 42V in nominal voltage, Radios, TVs, Tape Recorders, etc. shall be inspected before use, delivery and sale, and includes other regulations about electric apparatus which have a bad effect, such as noise, etc. on radios.

Dictation Machine



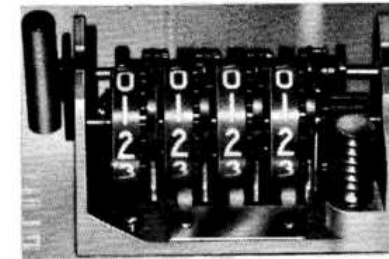
A recording/playback device designed for ease in use by a secretary to type the contents of the tape. Is usually used for dictation, conference recording, lecture recording, etc. There are recorders using discs, sheets, roll sheets, and magnetic tape. The latter is currently most popular.

Features:

1. Back Spacing is possible.
Back Spacing is also called Repeat. It is a means of rewinding the Tape temporarily during playback.
2. Stop, start, back spacing, etc. can be operated by remote control during recording and playback.
3. Recording, playback, fast forwarding and rewinding can be operated by remote control.

In many dictation machines, the speaker also functions as the microphone.

Digital Tape Counter



Provides a numeral indication as to position along the length of the recording tape. Permits location of known positions on the tape when a specific selection is desired.

The Tape Counter indicates an amount in proportion to the rotations of the reel shaft and not tape length. Therefore, although a relatively accurate indication can be obtained of tape position when playing back on the same machine on which the recording was made, the indication is not accurate on different models of different manufacturers. This is due to the use of different reduction ratios between the Reel Shaft and the Tape Counter.

Tape Counters are good for relative indications. The belt that connects the Reel Shaft to the Tape counter is loosely coupled to prevent loading the drive motor. Consequently, some slippage takes place and the indications are not completely accurate.

DIN Socket



When making a stereo recording or playback by connecting the tape recorder to a Hi-Fi Stereo Amplifier, 4 cords are generally required.

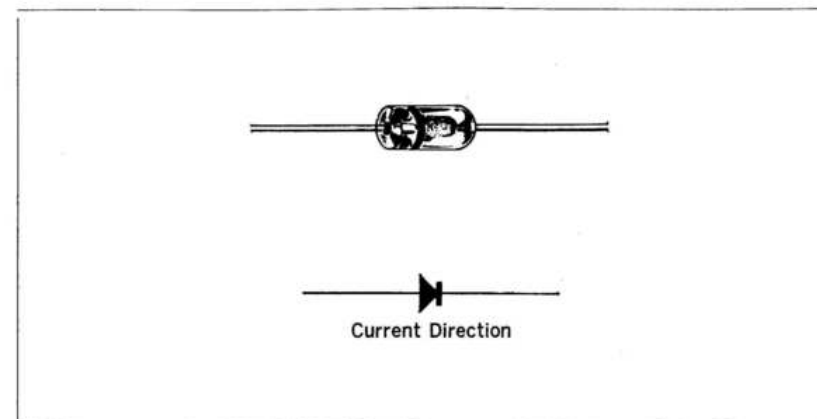
With this DIN Socket, only a 4-core Cord is required. Input and output of the Hi-Fi Stereo Amplifier are specified as follows:

Output Impedance	80 K Ω \pm 20 K Ω
Output Level	30 mV \pm 6 dB
Input Impedance	50 K Ω and over

While those of the Recorder are specified as follows:

Output Impedance	10 K Ω and below
Output Level	0.5V \pm 6 dB

Diode



When a very small amount of impurities is added to a pure crystal of germanium or silicon, an electrically positive semiconductor (P type semiconductor) and an electrically negative semiconductor (N type semiconductor) are obtained.

A Diode consists of a P type semiconductor combined with an N type semiconductor. Even if AC current is applied to the Diode, current flows in only one direction (as shown by the arrow in the above figure). This is the same property as for a vacuum tube diode. The Diode is therefore used for rectification (of the power circuit, AGC circuit and level indication circuit).

Distortion

Change in the wave form of an input current or voltage through the Amplifier. There are several types of distortion: frequency distortion, non-linear distortion, harmonic distortion, cross-modulation distortion, etc. and all of them are expressed in terms of percentage.

Refer to "Harmonic Distortion", "Inter Modulation Distortion" and "Waveform Distortion".

Distortion Meter



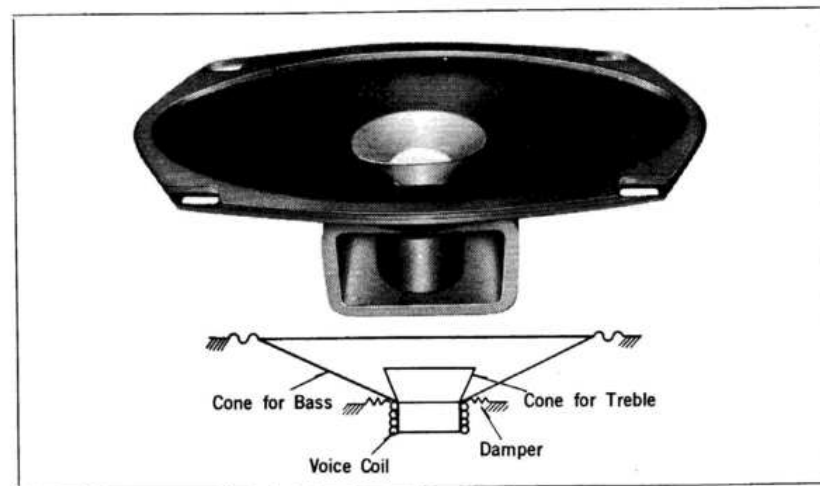
Used for measuring the higher harmonic distortion ratio of a Record or Playback Amplifier and the complete harmonic distortion range, through recording and playback.

It has a built-in electric circuit to divide the input signal (output from the tape recorder) into a basic wave and higher harmonic, and their ratio is indicated by the meter.

The following are cautions to be taken during measurement.

1. Use an oscillator with small distortion (at least less than 0.5%) to record the signal on the tape recorder.
2. Since even hum and noise components of the tape recorder appear as distortion, it is better to connect it through the Band Pass Filter to the Distortion Meter in order to eliminate them.
3. When wow and flutter are large, the fundamental frequency fluctuates and measurement becomes difficult or inaccurate. Therefore, it is necessary to make them small before beginning.
4. The distortion ratio differs according to the frequency and recording level. In general, the value is measured at a frequency of 1 KHz and the standard recording level (OVU).

Double Cone Speaker



A speaker having a large cone (Woofer) for reproduction of lower frequency sounds and a small cone (Tweeter) to reproduce the higher frequency sounds.

The advantages of each speaker size are:

1. Large diameter speaker: best reproduction of low frequencies, good power output, and small amplitude distortion.
2. Small diameter speaker: best reproduction of high frequencies, good directional characteristic.

Therefore, the Double Cone Speaker is designed so that the high frequency notes drive the small diameter speaker and the low frequency notes drive the large diameter speaker.

Double Play Tape

By reducing the thickness of the tape base from 50μ ($50/1,000$ mm) to 28μ , twice as much tape can be accommodated on the same size reel.

The tape lengths are:

2,400 ft. for 7" reel (standard tape: 1,200 ft.)

1,200 ft. for 5" reel (standard tape: 600 ft.)

400 ft. for 3" reel (standard tape: 200 ft.)

PANASONIC calls this tape "Golden S Tape".

D Double Recorder



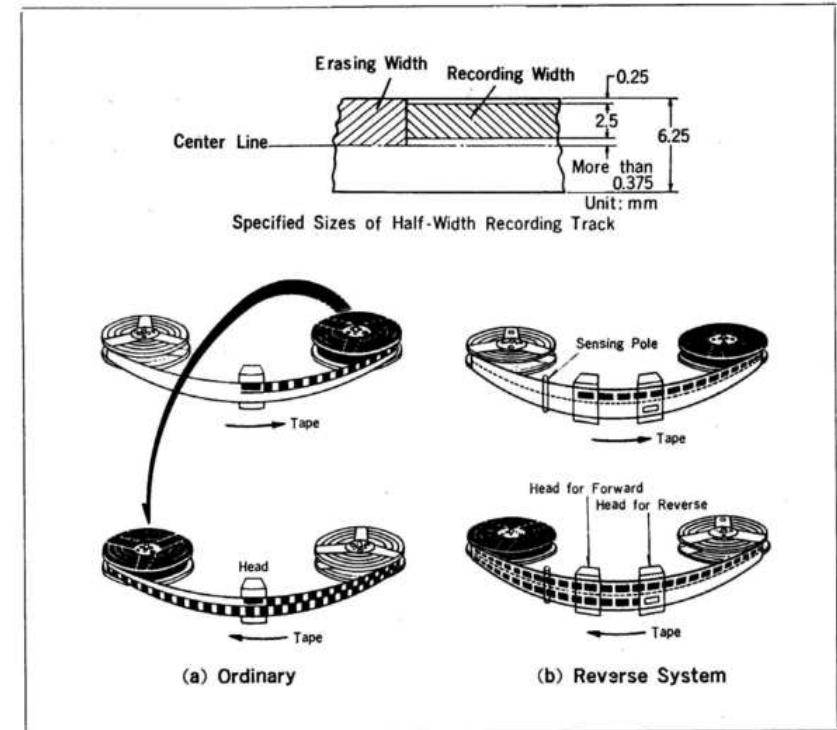
A Double Recorder is a Monaural Tape Recorder which has both the "Sound With Sound" and Mixing functions. In other words, besides the function of an ordinary tape recorder, it can make a recording on the two tracks separately, playback one track and record it on the other track while monitoring the former track by using an earphone.

This is possible with a tape recorder having a 2-track Stereo Head, or a 4-track Head and a 2-Channel Pre-amplifier.

For instance, it is possible to record accompanying music on Track 1 and then to record voice on Track 3 while playing back and monitoring the recorded track-1 music.

At the time of playback, the 2 recordings can be heard separately or mixed.

Double Track

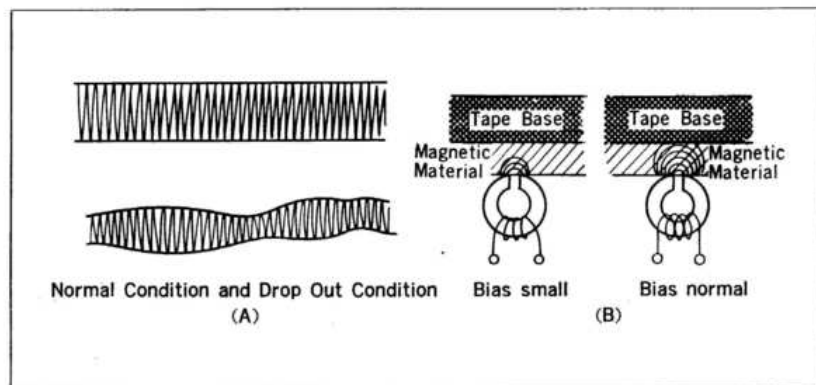


This is the system used for most monaural tape recorders. It is a system to record either half of the effective tape width. The effective tape width is determined by the thickness of the recording head core, and the core thickness corresponds to half of the tape width.

For Double Tracks (and Four Tracks as well), if the recording were made beyond the center line of the tape, it would mix with the recording on the other side to cause Cross Talk. Therefore, there is an interval between the tracks where no recording is made.

This interval is made wider for Double Track Stereo. It is economical since recording of both directions is possible, unlike the full track system, and is a type most likely to be popularized.

Drop Out

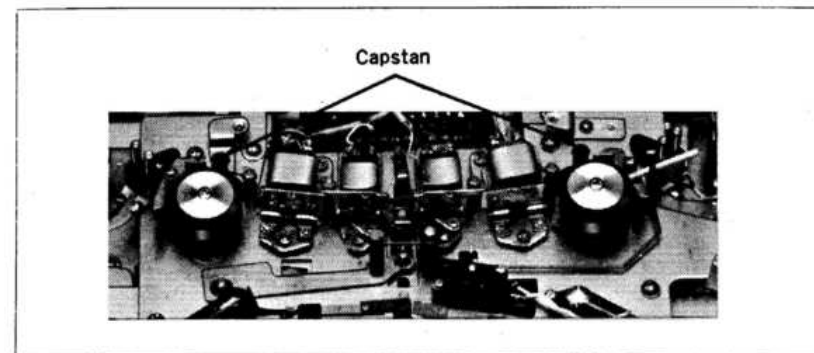


A sudden change in output level (amplitude modulation) of the tape during playback can be caused by Drop Out.

The causes are:

1. Uneven sensitivity of tape emulsion. The wider the track in use (e.g. a full track, or a track in a 2-track system) the more uniform and the difference heard is less apparant. But, for 4-tracks, uneven tape coating results in loss of sound completely.
2. Poor contact between tape and tape head. This can result from inadequate Head Pad or back tension. The thinner the tape base, such as in Golden Tape (150% Tape) or Golden S Tape (200% Tape), the better the contact and less drop out is experienced.
3. Drop Out occurs more often during recording than playback. When a new tape is used, it is advisable to smooth the surface before recording by running the tape through fast forward and fast rewind several times.
4. Inadequate bias. When the bias is too small, the magnetic field does not penetrate the full depth of the magnetic coating. Sensitivity varies at the places where the surface of the tape is not uniform (See Fig. B).
5. Drop Out is more apparant at slow tape speeds, and when the recording frequency is high.

Dual (Double) Capstan System



Two Capstans are placed between the Recording/Playback Head and Erase Head of a Tape Recorder. During recording and playback, the Pressure Roller is pressed against the two Capstans simultaneously and the tape is driven by them.

This is a Dual (Double) Capstan System. If two Capstans are incorporated in the recorder but only one is used, it cannot be considered a true Dual Capstan System.

The Dual Capstan System is used by PANASONIC and is particularly suitable for reversing-type Tape Recorders.

Features:

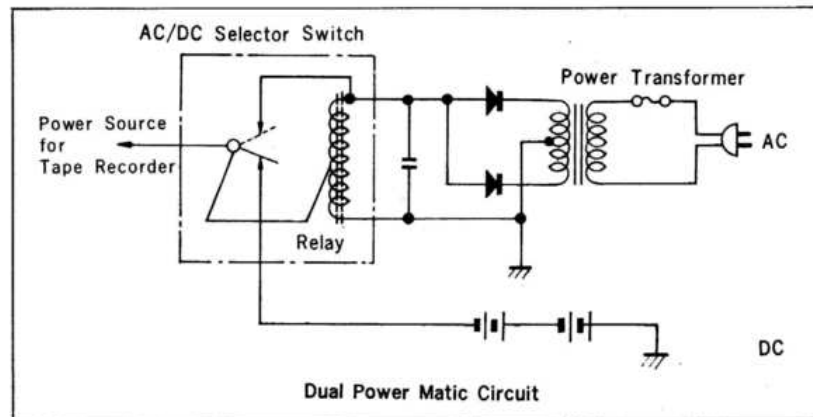
1. Reduction of Wow and Flutter.
Since the 2 Flywheels function simultaneously, inertia moment increases. Back Tension by the Supply Reel Table does not produce speed irregularity, because the running tape is regulated by the 2 Capstans.
2. Reduction of Tape Speed Fluctuation
In whatever position the tape may be, it does not change in speed because the running tape is regulated by the 2 Capstans.
3. Reduction of Level Fluctuation
Since the position of the tape running in front of the Head is kept constant by the 2 Capstans, the playback output level does not fluctuate to lower the sound quality.

4. Redoubled Life of Head

Due to the stability of the tape running in front of the Head, pressure on the Tape Pad, viz., pressure on the tape surface in contact with the Head, is reduced extremely.

5. The tape does neither loosen nor get twisted.

D Dual Power Matic



For selection between built-in battery and AC power sources in an AC/Battery tape recorder, switch operation or connection of power cord to the set has until now been necessary.

Dual Power Matic is a new method adopted by PANASONIC. When the power source plug of the tape recorder is connected to the AC power source socket, the built-in battery source is switched over to AC current power source automatically. When the power plug is pulled out, it is returned to the built-in battery source automatically.

The feature of this system is that even if the AC power source fails suddenly, or the power source plug slips off the socket, the switch is shifted over to batteries within a very short time (1/50 sec.), so that you can use it with confidence for an important recording without interruption. Besides, there is no such trouble as loosening or breakage of tape during fast forwarding and rewinding.

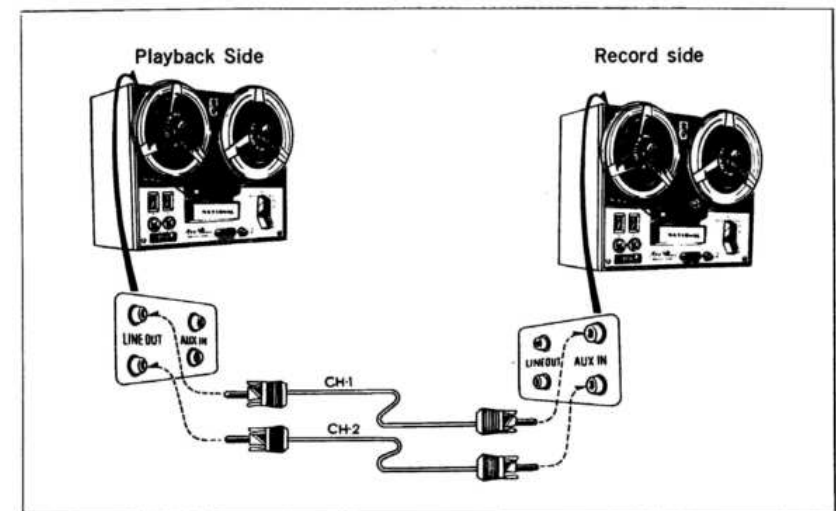
Dual Track

Refer to "Double Track".

Dual Track Recorder

A Monaural Tape Recorder on which two tracks can be recorded and played back individually but not at the same time.

Doubling



Recording the contents of one tape on another tape for one of the following reasons:

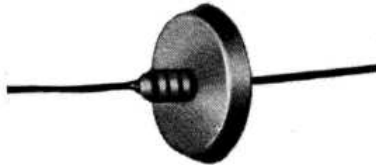
1. Need for more than one printing of the recorded tape (Refer to "Duplicator").
2. Need to preserve the original tape.

Recording is accomplished by connecting the playback output (LINE OUT) from one Tape Recorder to the AUX input of another Tape Recorder.

Dubbing

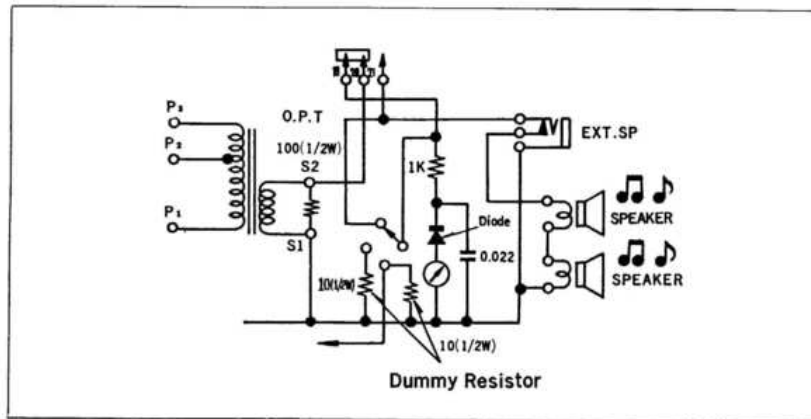
A method of doubling that is used in connection with sound movies. A recording, for example, of background music is superimposed over a previously recorded sound, the dialogue.

Dummy Coil



A coil used to replace the Erase Head. When making a monaural recording on a stereo recorder, the Dummy Coil is switched into the circuit to act as a load on the unused channel erase oscillator. The Dummy Coil has the same characteristics of impedance and current carrying capacity as an Erase Coil, but does not erase the channel.

Dummy Resistor



Used as a load to replace the speaker, particularly when adjusting or making measurement on the Tape Recorder. The dummy resistance value should be equal to the normal speaker impedance; i.e., to replace an 8-ohm speaker, an 8-ohm Dummy Resistor should be used.

However, since the speaker is of inductance, there is a variation of impedance to some extent depending upon the frequency.

Resistance is constant for each frequency. Therefore, it is necessary to remember that the resistance does not have exactly the same characteristics as when the speaker is connected.

Duplicator



A recorder to duplicate tapes. A single tape recorder is used to make a single duplicate tape, or for mass production of tapes, a special printer capable of duplicating ten tapes simultaneously can be used.

In order to shorten the time of duplicating, the master and duplicate tapes are run at two times (or greater) the normal speed. Since this requires greater frequency range capability, the duplicator must have good frequency response.

Dynamic Microphone



The most popular device for changing sound to electrical energy in current use. In comparison with the crystal or Crystal or magnetic microphones it has more uniform characteristics. In addition, it is less susceptible to high temperature and moisture. It produces less distortion and noise than the other types.

The principle of operation of the Dynamic Microphone is as follows: Sound waves cause a coil to move within a fixed magnetic field. Voltages proportional to the speed of coil vibration are produced as an output of the moving coil. The diaphragm is usually constructed of a thin, light and strong material such as duralumin or plastic.

Two types of dynamic microphones are used in tape recorders: high impedance and low impedance. The high impedance dynamic microphone of approximately $10\text{ K}\Omega \sim 20\text{ K}\Omega$ requires a built-in transformer to provide an output large enough for amplifier input. The low impedance dynamic, approximately $200\Omega \sim 600\Omega$, has as many coils as possible to permit transformerless operation to provide the input voltage.

Dynamic Range

An indication of the maximum to minimum limits in sound.

The maximum amplitude that an amplifier can handle is determined by the amount of distortion that can be tolerated. The minimum sound level is determined by the amplifier noise. When the sound is very low it is masked by the noise.

The greater the Dynamic Range, the better the amplifier, for it is possible to reproduce sounds of great amplitude variations, i.e. both weak and strong sounds.

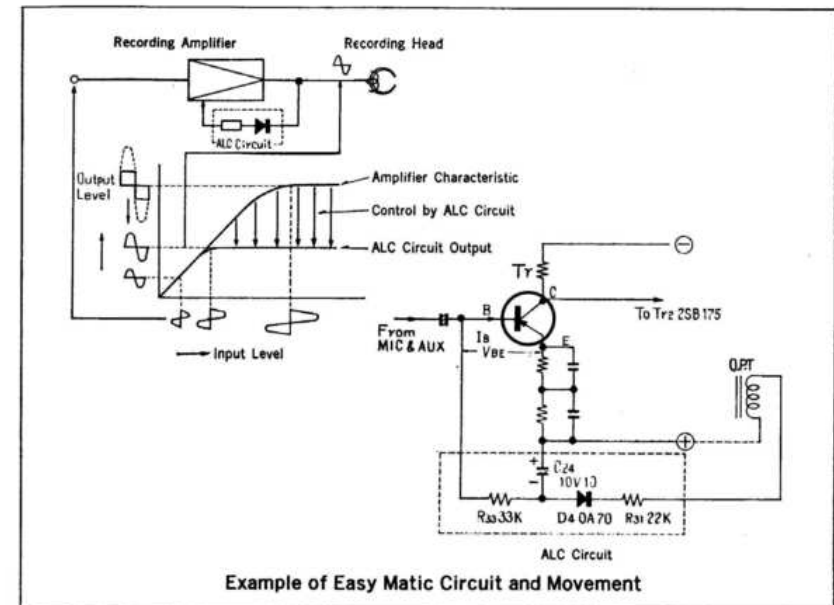
Earphone

Refer to "Magnetic Earphone" and "Crystal Earphone".

Earth

Also called "Ground". The basic point for measuring electrical potential (voltage). In Tape Recorders or other audio instruments, the chassis is normally Earth and its electric potential is equal to that of the earth.

Easy Matic



Also called AGC, ALC or Voice Matic. It permits making of recordings of various sound levels without continuous adjustment of the volume control knob.

Easy Matic permits inexperienced persons to make satisfactory recordings since high volume levels that would normally saturate the tape are kept within levels to prevent the distortion resulting from saturation. This is accomplished through the use of a feedback circuits in the amplifier. As shown in the figure, the most common method of reducing the distortions is by the use of DC feedback, which increases as the signal output increases.

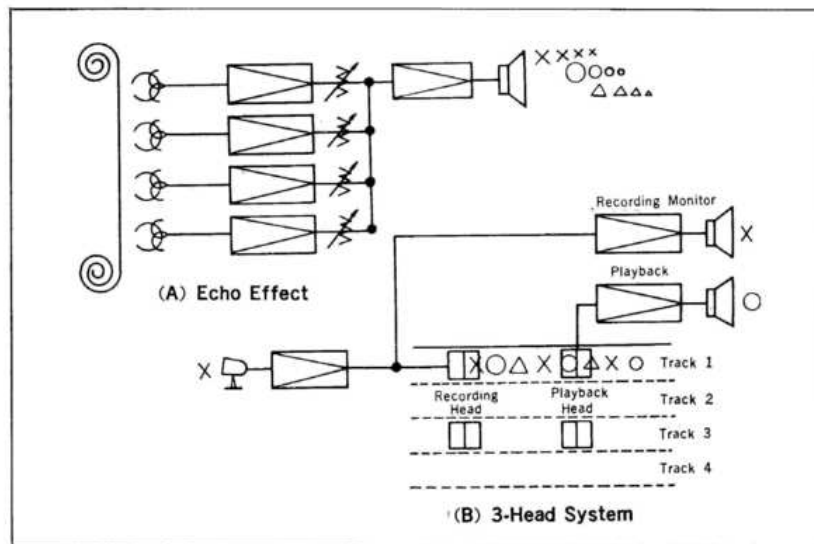
The original purpose of Tape Recorders, however, is to catch natural sound as it is, and therefore many of them are equipped with a Selector Switch to make this adjustment with the conventional Volume Control.

E

Echo

Reflected Sound. Sound reflected from a wall or a mountain and is heard as a duplicate of the original sound but somewhat later in time.

Echo Effect



This effect provides a sound reproduction of a sound somewhat later than the original. It can be produced in a Tape Recorder as follows:

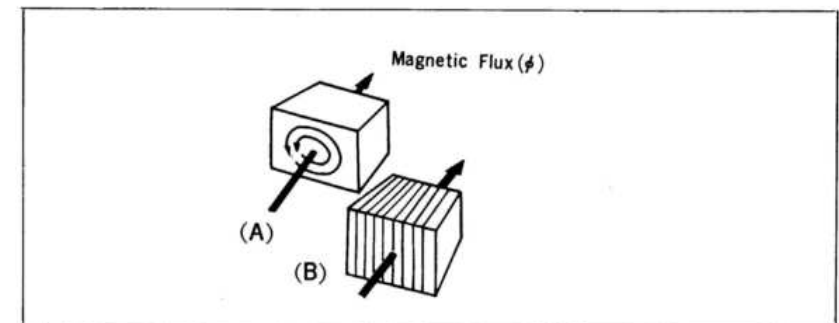
1. Many Playback Heads are arranged, as shown in Fig. A, and the played back sounds are mixed. The output of each Head should be made successively smaller. Echo intervals are determined by tape speed and intervals between the Heads.
2. In a 3 Head System, if record monitoring and playback are made simultaneously, as shown in Fig. B, a time lag results because of the interval between the Record Head and Playback Head. The slower the tape speed, the more the time lag.

E

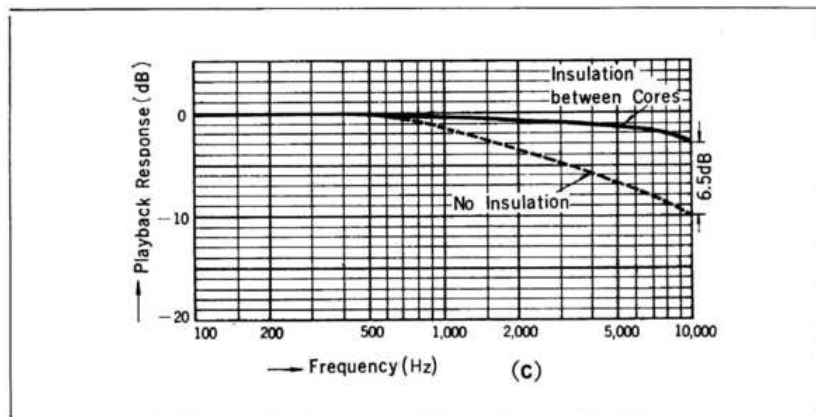
Echo Machine

An equipment to artificially create an Echo Effect and add it to the original recording. The usual method is to use one Record Head and two or more Playback Heads. Refer to "Echo Effect".

Eddy Current Loss



A magnetic loss experienced in iron cores, such as used in Recording and Playback Heads.



When the magnetic flux (ϕ) that passes through the iron core (Fig. A) changes, a current is induced in that core. The direction of current is such as to prevent the change in magnetic flux. Losses are greater at higher frequencies.

Eddy current losses are reduced by laminating the core (See Fig. B). High quality recording heads are made of laminated permalloy plates of approximately 0.1 to 0.2 mm thickness to reduce Eddy Current Loss.

Insulation used between the laminations further reduce the loss. Fig. C shows a comparison of loss for laminated cores with and without insulation.

Editing

The process of arranging recorded tape into a desired sequence by changing its order, cutting off undesired portions and joining desired portions.

Effect Record

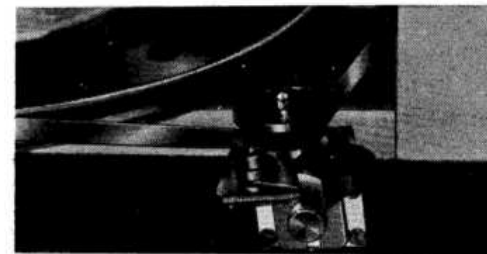


A record to produce sound effects to accompany a home movie theatre performance. Wind, thunder, laughter, jet airplane noise, automobile or other sounds are recorded.

E.I.A.

E.I.A. stands for Electronics Industry Association, which establishes various technical specifications in the U.S. for tape recorders, playback responses, tape widths, dimensions of tracks, etc.

Eight (8)mm Synchronizer

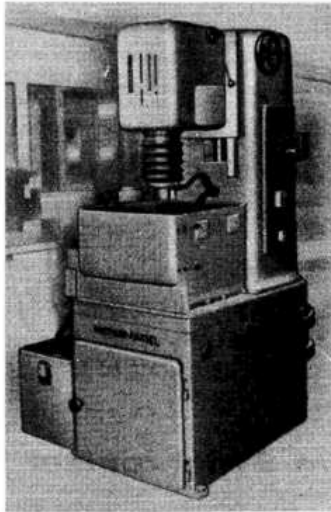


A method to maintain equalized speed of an 8-mm film projector and a sound recorder.

The usual method is to attach a stroboscopic disc to a Tape Recorder. A projection lens illuminates the stroboscopic disc and a mirror reflects the light variations. The projector speed is adjusted to make the strobo disc appear as if it were stopped. The projector and recorder are then in synchronization.

Since most 8-mm projectors employ series motors which fluctuate in speed with slight variations in load, the stroboscopic light should be viewed from time to time. The projector speed should then be adjusted to give the appearance of a non-moving strobo disc.

Electrical Discharge Machining



When parts to be machined require high precision, or when the material is too hard to be easily processed by ordinary machines (as in the case of titanium alloy or hardened material), this method is used.

Metal patterns such as the cams, gears, plate springs of complicated shapes, etc. are usually made by electrical discharge machining.

Sometimes it is also used for manufacturing parts directly.

Electrical Governor Motor

A DC Micro Motor equipped with a Transistorized Speed Governor; recently used for tape recorders, too.

Unlike the conventional Mechanical Speed Governor Systems, it has the following features:

1. The revolving speed, namely, the tape speed, can be changed easily by changing the circuit constant, and also can be changed in succession.
2. Free from spark noise such as that of a Mechanical Governor, or noise caused by contact switching.
3. Stands long use because there is no contact.

Constant Speed Control of the DC Micro Motor can be classified by the method of detecting the number of revolutions as follows:

1. Mechanical Governor (Centrifugal Governor)
2. Speed Control by Transistor
 - a. A system to detect and control the number of revolutions by the Speed Motor.
 - b. A system to detect and control the number of revolutions by counter inductive voltage.

In general, the Electrical Governor Motor converts the number of revolutions into voltage (2.b, above), and the voltage is taken as the reference for the number of revolutions.

In order to detect the number of revolutions by counter inductive voltage, the following are applicable.

1. Connecting the Armature to the Bridge Circuit.
2. Detecting signals proportionate to motor voltage and current, respectively.

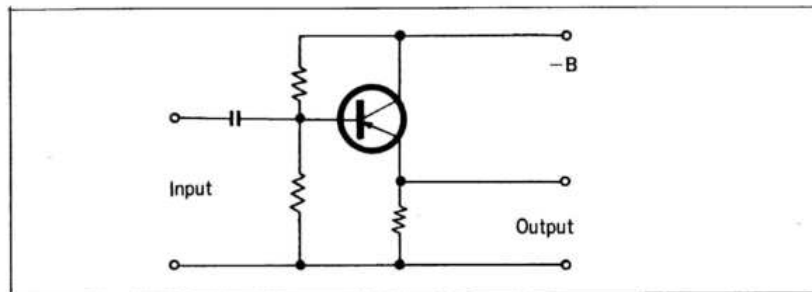
In general, the former is used more than the latter.

Electrification

When a glass rod is rubbed with cloth, positive electricity is produced on the glass rod and negative electricity on the cloth. Both the glass rod and cloth attract light weight materials such as a small piece of paper. This phenomenon is called electrification. The electricity of the electrified material is called Electric Charge. The amount of electric charge which can be accumulated on a conductive material is called Electric Capacity. The device by which the electric capacity is held between two conductive materials is Condenser.

When a tape recorder is used in a very dry atmosphere, the magnetic tape and rubber belt may become electrified. This can be prevented by use of anti-electrification agent.

Emitter Follower



Corresponds to the Cathode Follower of a vacuum tube system. Also called a Collector Earth. Since its output impedance is very small, it is used where the very low output impedance is required.

Current amplification:	$h_{fc} = 1 + h_{fe}$ (h_{fe} : Emitter earth current amplification)
Voltage amplification:	< 1
Input impedance:	large
Output impedance:	small
Input and output signal phases:	same
Feedback:	100% voltage feedback

Endless Cartridge

Refer to "Endless Tape".

Endless Tape



A Tape with its beginning and end connected to each other on a special reel. When threaded on a tape recorder, it can be played back continuously and repeatedly.

Graphite is applied to the surface of the Tape to reduce friction between the surfaces. Tape is sent out from the starting side of the Tape and is taken up to the ending side.

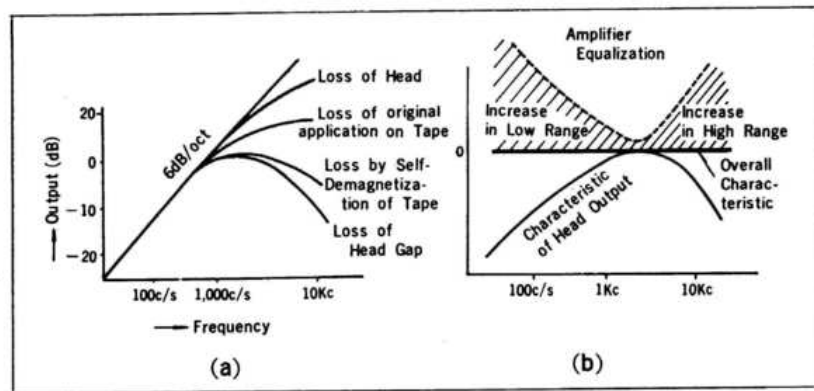
Because there is more tension on the takeup side than on the supply side of the tape, the surplus tension of the supply side is adequately reduced between tape and tape, and the tape moves smoothly.

Lear Jet type and Conlay type cartridges recently marketed use this Endless Tape system.

Main Uses: Background Music performance; Sales Guides; Recording of Telephone Response; Recording of Unexpected Sound; Advertising, etc.

Equalizer Amplifier

If all sound frequencies were recorded at uniform strengths (amplitude) and then played back, the output would not be uniform, but would have the characteristic of Fig. A. Compensation, or equalization, for the Head characteristics that cause this curve, is required. This is obtained by using an Equalizer Amplifier.



In the low frequency range, the voltage generated at the Playback Head is proportional to the amount of magnetic flux ($d\phi/dt$) which varies within the unit time. As shown by the 6 dB/oct curve, the lower the frequency, the lower the generated voltage.

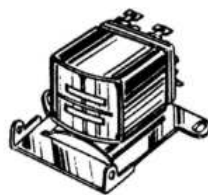
In the high frequency range, various losses, as indicated in Fig. A, reduce the output.

The Equalizer Amplifier compensates for the high frequency and low frequency losses to provide the compensated output shown in Fig. B.

Erase Head



(a) for 2-track



(b) for 4-track

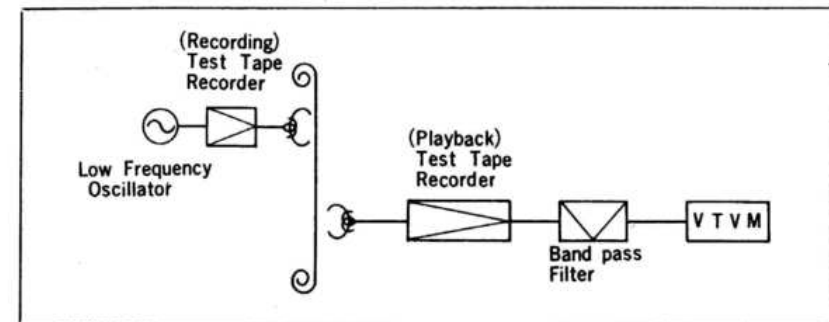
A Head to remove (erase) previously recorded sound on tape.

Since a strong magnetic field is required, the Head must be made of a core material of high saturation value, such as permalloy, silicate, steel and have sufficient ampere turns to provide complete erasure.

A small DC resistance is required in order to reduce heat generation, while a wide gap is used to provide a strong but not sharp magnetic field.

In general, when the gap is about 200μ ($200/1,000$ mm) for AC erasing, core loss due to high frequency is produced. Therefore, heat generation becomes larger than for DC erasing. An adequate heat resistant structure is therefore necessary.

Erasing Ratio



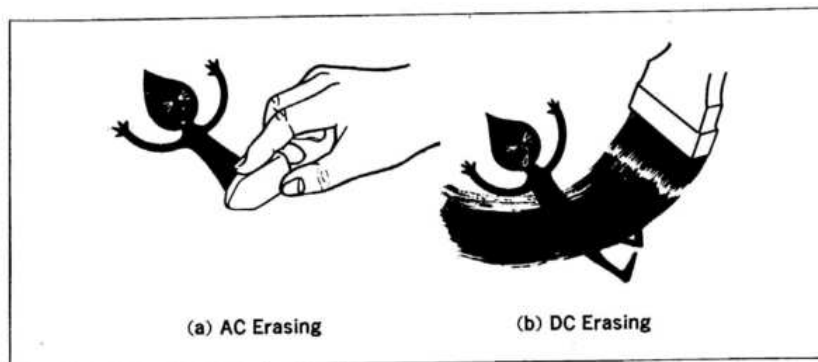
An expression of efficiency of the Erase Head in erasing previously recorded tape, expressed in terms of dB.

A measurement tape has a 1,000 Hz signal recorded at saturation level (10 to 20 dB higher than the normal recording level). The tape is erased and then played back. The ratio of playback output between the erased and recorded parts, expressed in dB, is a measure of the Erasing Ratio.

There is no difficulty at all for practical use above 40 dB, that is, when the output voltage ratio between the recorded part and the erased part is more than 1 : 100.

Erasing System

One of the important advantages of tape is the ability to reuse it constantly. Therefore, a previous recording must be erased before a new recording is made.



(a) AC Erasing

(b) DC Erasing

Two erasing methods are used: One is to return the tape magnetization to zero; while the other is to magnetize the whole tape to saturation.

The figure illustrates the zero method as the AC Erasing system, and the saturation method as the DC Erasing System (Magnetic erasing).

Although DC (Saturation) Erasing is simple, it leaves noise on the tape which produces a poor signal-to-noise (S/N) ratio.

As the tape speed increases, the differences between zero and saturation erasing become more apparent.

Saturation Erasing is most commonly used for Battery type or AC/Battery type Tape Recorders.

Extra Play Tape

50% more tape than standard is put onto the same reel.

The base of the Tape is made thinner so that the tape thickness becomes 38μ as compared with 50μ ($50/1,000$ mm) of standard tape. The tape lengths are:

- 1,800 ft. for 7" reel (Standard tape: 1,200 ft.)
- 900 ft. for 5" reel (Standard tape: 600 ft.)
- 300 ft. for 3" reel (Standard tape: 200 ft.)

PANASONIC calls this Tape "Golden Tape".

Fade In

The method of gradually increasing the recorded level. When editing tape. This can be accomplished by adjusting either the Recording or Playback Volume Control.

Fade Out

The method of gradually decreasing the recording level when editing tape. This can be accomplished by adjusting either the Recording or Playback Volume Controls.

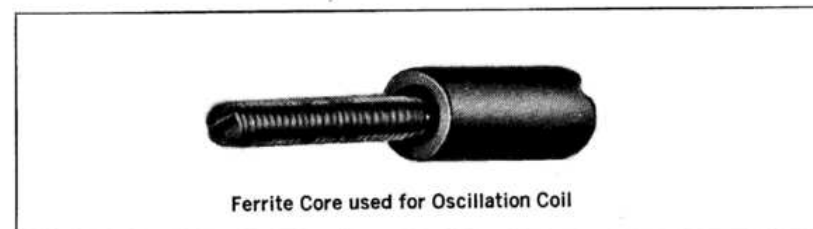
Fast Forward

To cause the tape to move rapidly in the same direction as recording or playback. Used to quickly reach a desired point on the tape.

Feed Reel

Same as Supply Reel. Refer to "Supply Reel".

Ferrite Core



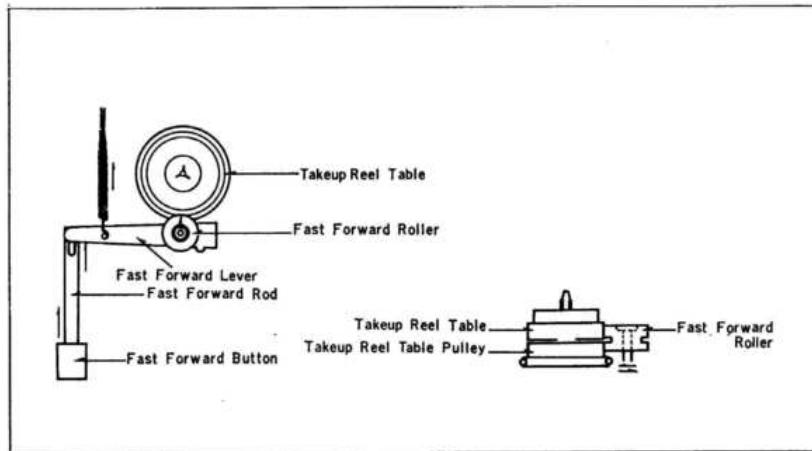
Ferrite Core used for Oscillation Coil

Made by compression molding of a mixture of powdered magnetizable materials such as silicon steel, cerdust, iron oxide, etc. with an adhesive agent of insulation material.

Since there are spaces between microparticles of the powder, magnetic saturation seldom occurs and there is little fluctuation in inductance caused by excitation current.

Used for the Erase Head, Oscillation Coil, etc., where large magnetic flux density is required.

F.F. Roller



This roller is used during fast forwarding to strengthen torque of the Takeup Reel Table.

The Takeup Reel Table of a tape recorder rotates with a little slip during playback or recording, thereby applying tension for takeup. But since the tape must be taken up quickly with a strong tension during fast forwarding, the F.F. Roller does so without any slip.

Fidelipac Type Cartridge

Refer to "Conlay Type Cartridge".

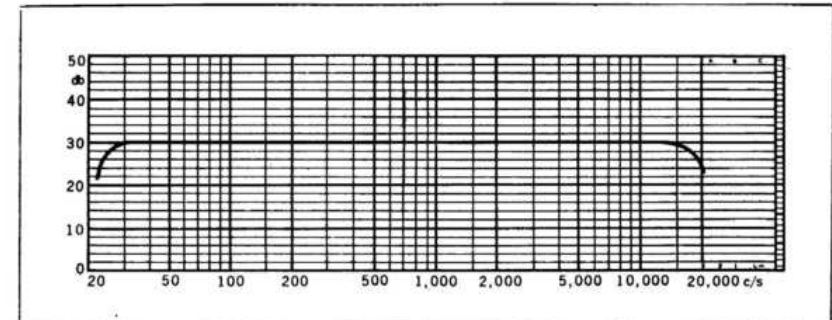
FINKO

Electrical Inspectorate (Finnish Safty Seandard).

It provides that Radios, TVs, Tape Recorders and all other electronic apparatus for home use or general use with an AC power source must undergo inspections and approval.

This standard is currently enforced with partial supplements to CEE and IEC, of which the most important is the regulation concerning Jamming Waves radiated from Radio and TV receivers.

Flat Response

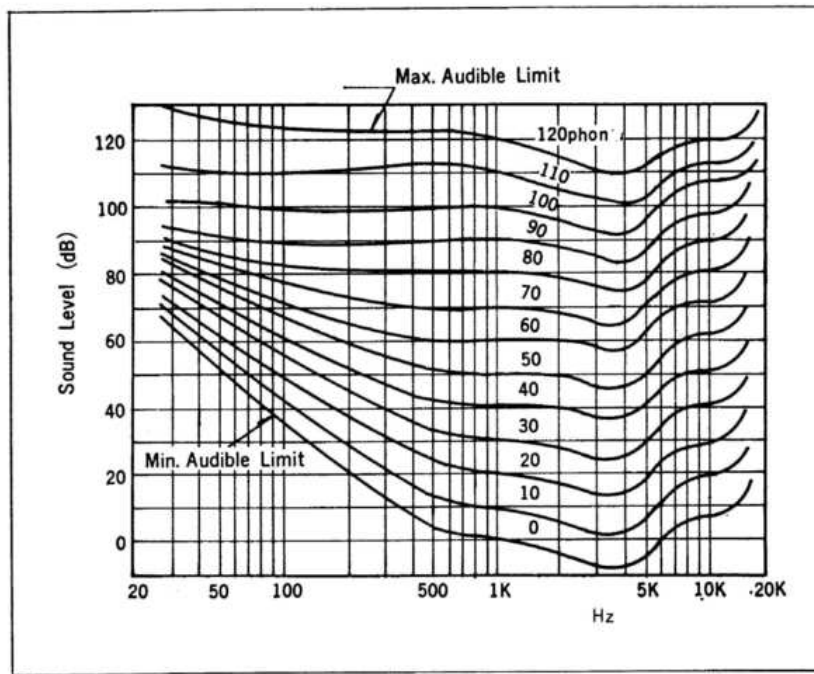


Describes the condition of audio equipment that shows an almost constant sensitivity throughout its entire frequency range.

A flat Response normally means that the frequencies from 20 to 20,000 Hz do not vary more than ± 3 dB from the standard 1,000 Hz tone.

Fletcher-Munson's Curve

Also called "Loudness Curve". A series of curves showing the frequency response characteristics of normal human hearing in the range of 20 to 20,000 Hz.



As shown by the curves, the human frequency response is not flat but varies considerably according to the strength (intensity) of the sound.

Ears are most sensitive to sounds in the 1 KHz to 5 KHz range. At the same time, they can tolerate very strong sounds. Sounds in this range include alarms, sirens, Morse signals, etc.

As the sound level is reduced, the sensitivity to high and low range frequencies decreases considerably. Consequently, when playing back music at low volume levels, it is necessary to increase, to some extent, both the low and high frequency ranges in order to compensate for the frequency response of the ear.

Flutter

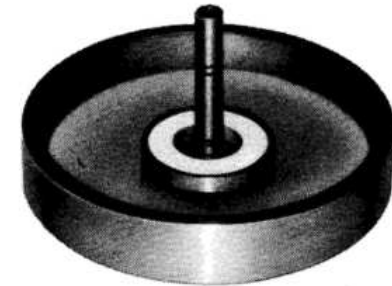
Refer to "Wow and Flutter".

Flutter Rate

The number of Wows and Flutters per second.

Refer to "Wow and Flutter".

Flywheel



A circular weighted disc directly connected to the Capstan to smooth out unevenness of rotation. Power transmitted from the Motor to the Capstan is not constant and the tape speed is therefore not constant. To reduce Wow and Flutter that would result, the Flywheel develops a constant rotational speed.

The Flywheel absorbs and accumulates energy when powered and discharges the energy when driving pulses are reduced. The rotational energy of a Flywheel is calculated as follows:

$$E = 1/2 \omega^2 \int r^2 dm = 1/2 \omega^2 J$$

Where, E= rotating energy

ω = angular velocity (rad/sec)

J = inertia moment

dm = minor mass located at the distance r from the rotating shaft

r = centroid radius

This shows that the inertia moment is in proportion to total mass and the square of the centroid radius. In addition, the rotating energy is in proportion to the square of the rotating speed.

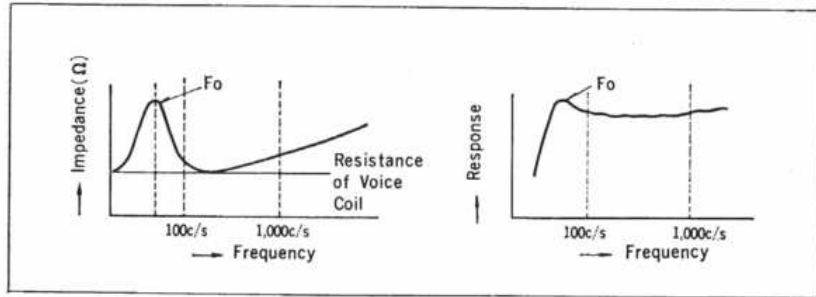
In other words, as the weight and centroid radius of the Flywheel increase, and the tape speed is high, wow and flutter decrease.

FM Multiplex

Frequency modulated wave modulated by two or more different sound frequencies at the same time. Modulation of two channels is called Double Modulus, while that of three channels is called Triple Modulus.

A transmitted Multiplex wave received in a Multiplex Receiver has the channels separated in the tuner section.

Fo



The frequency (F_o) is the point in the resonant curve of a speaker where a sudden rise is obtained in the low frequency range (Refer to figure).

Frequencies above F_o produce relatively uniform sound levels in the speaker. Below F_o sounds are reduced in proportion to the square of the frequency.

Generally, the lower the value of F_o , the better the speaker characteristics.

Foot Switch

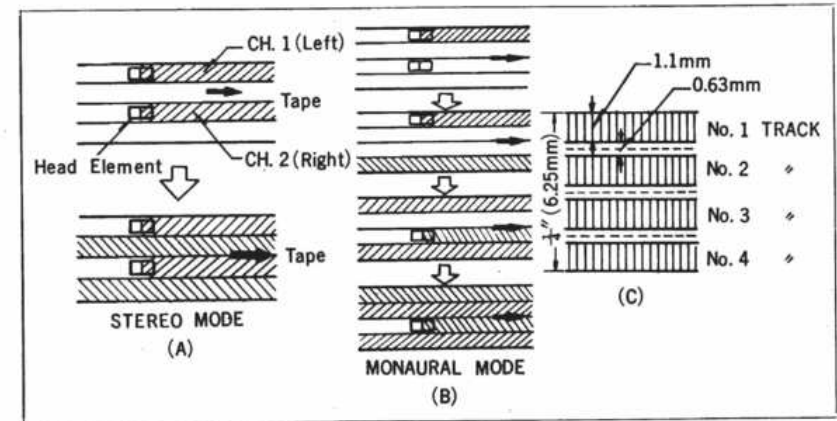


A foot operated pedal switch to start and stop an AC/Battery or Battery-type Tape Recorder.

Two types are used: one turns the recorder ON when the pedal is depressed; the other turns it OFF when the pedal is depressed.

The switch OFF type is more commonly used. However, this system cannot be connected to AC type Tape Recorders because it functions to switch low voltage DC motors ON and OFF.

Four Tracks



A system to make a recording on 1/4 of the tape width. Because the recording width is determined by the thickness of the Record Head Core, the core thickness must correspond to 1/4 of the tape width.

In general, there are two elements in one head; one to record and playback No. 1 and No. 4 Tracks, the other, No. 2 and No. 3 Tracks. If recording is made beyond the boundary line of each Track, it causes Cross Talk from the adjacent track. Therefore, an interval where no recording is made is reserved (as shown in Fig. C).

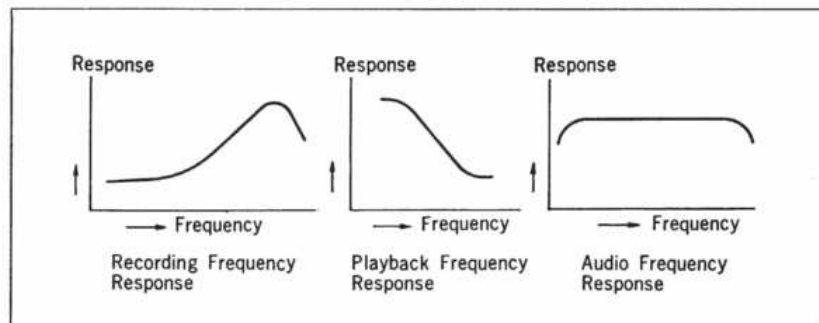
Features :

1. Recordings can be made in the stereo mode reciprocally.
2. Recordings can be made in the monaural mode for long playing time.
3. "Sound on Sound" or "Sound with Sound" are possible.

Drawbacks :

1. Sensitivity of the Head is lower than that of Double Track or Full Track. It is therefore necessary to make the amplifier gain larger.
2. Meticulous care must be exerted not to worsen the S/N Ratio.
3. Tape editing is difficult.

Frequency Characteristics

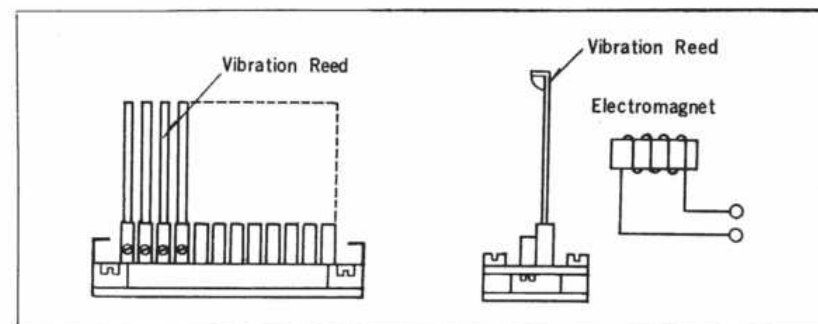


An indication of response obtained for changes of frequency. For audio frequency recording and reproduction, a flat characteristic over the entire frequency range is desirable. However, no matter how flat the response, the acoustic characteristics may be inadequate if a poor quality speaker is used.

Frequency Compensation

Synonym for "Recording and Playback Equalization".

Frequency Indicator

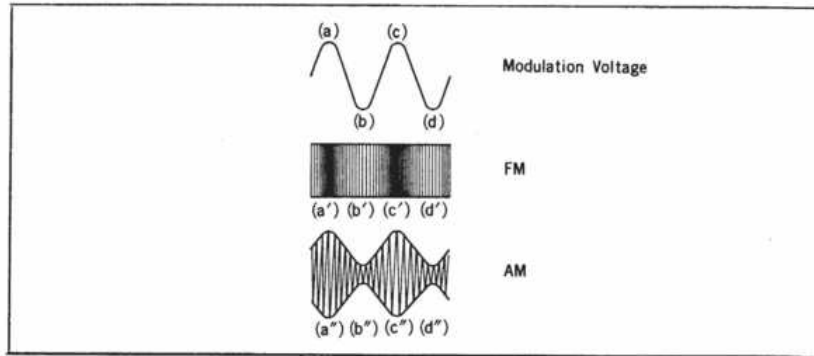


Used to measure the frequency of the AC power source. Tape speed depends on power source frequency and if accurate tape speed measurements are to be made, the source frequency must be known.

The most common is the Vibrating-reed type. Different length steel reeds are arranged and placed in an electromagnetic field. The AC source current excites the electromagnet causing the reeds to vibrate. The reed that vibrates indicates the AC frequency.

Other types of frequency indicators include inductive, moving-iron and current force types.

Frequency Modulation System



Used for FM broadcasting. A modulation voltage causes the frequency of the emitted wave to change while the amplitude remains constant.

This compares to amplitude modulation (AM) where the frequency remains constant and the amplitude of the emitted wave is changed by the modulation voltage.

FM broadcasts produce better sound than AM Because:

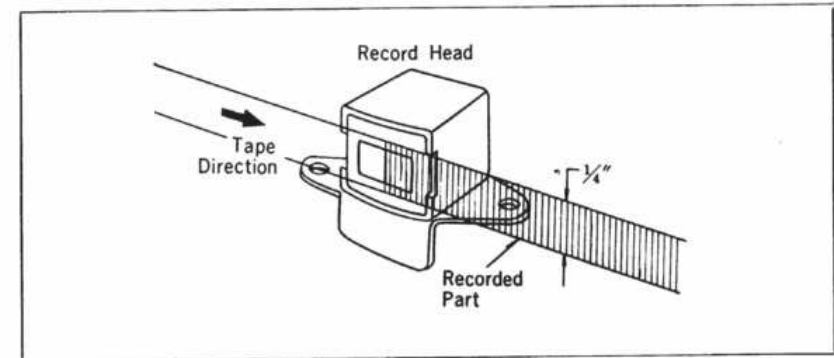
1. FM has a wide dynamic range (20 to 24 dB). In AM distortion increases suddenly with large modulation voltages (over 100% modulation). This does not occur in FM.
2. Wider frequency response is possible in FM broadcasts, (50 Hz to 15 KHz) compared with AM ranges of 50 Hz to 7.5 KHz. Increasing the range in AM increases noise.
3. FM produces less distortion.
4. FM causes less noise. Noise, usually amplitude modulation of the transmitted wave, is prevented by a limiter used in FM receivers.

FM can be used for tape recording. Distortion and level fluctuations can be reduced during playback. However, tape speed fluctuations are converted into fluctuations in the playback frequency, which in turn becomes a fluctuation of level after modulation. It is also necessary to record the carrier wave which is several times greater than the highest audio frequency to be recorded.

Frequency Response

An indication of the range of frequencies that can be obtained electrically in relationship to a Flat Frequency Characteristic. Refer to "Flat Frequency Characteristic".

Full Track



A system to record on the full width of the tape (6.25 mm = 1/4").

Because the recording width is determined by the thickness of the Record Head Core, the core thickness corresponds to the tape width. This system is not currently used in ordinary home tape recorders.

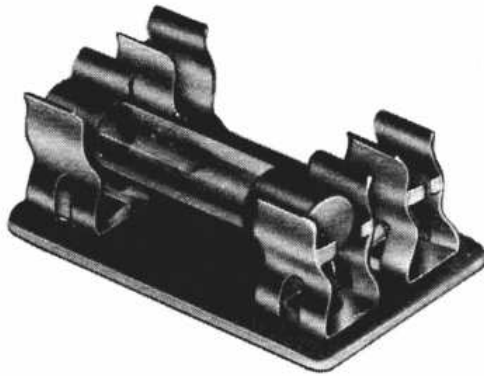
Features:

1. High sensitivity
2. Easy tape editing
3. Good S/N ratio

Drawbacks:

1. Since reciprocative recording is not possible, the tape must be rewound after use.
2. Recording time is short because recording is possible only in one direction.

Fuse



F

A device made of an alloy of lead or tin to protect electrical currents against high current overloads.

There are various shapes of fuses. For Tape Recorders, a wire fuse (thread fuse) is usually connected in the power circuit.

The fuse should resist a current of 1.45 times the rated level for more than five minutes and melt within one minute when current twice the rated value is applied.

Gain

The amplifying capacity of an amplifier. Also called Amplification. Gain is a ratio of input signal to output signal expressed in dB.

Amplifier Gain is measured using an Audio Frequency Oscillator and an attenuator. The gain of an ordinary Tape Recorder playback amplifier, measured at 1 KHz, is 60 to 70 dB.

Gamma Hematite

A kind of magnetic material used for magnetic tape.

After being pulverized into fine powder of less than 0.04 mil (1μ), it is heat-treated and coated onto the base at a certain thickness. Gamma Hematite ($\gamma\text{-Fe}_2\text{O}_3$) has high residual magnetism.

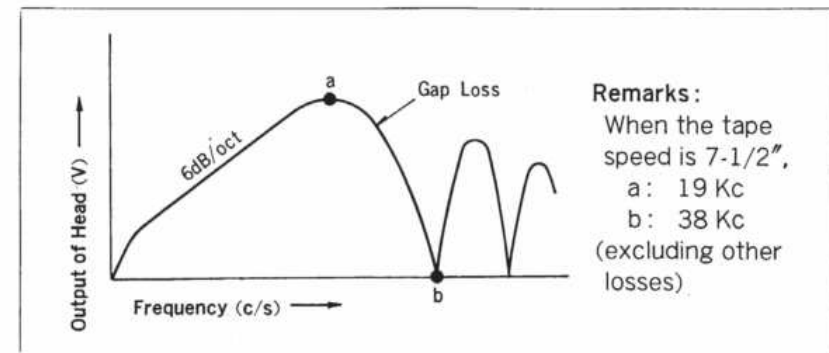
Magnetite is another type of magnetic material.

G

Gap

Refer to "Slit Gap".

Gap Loss



When a tape which is recorded at a constant level over the entire frequency range is played back, the induced electromotive force (e) produced at the Playback Head is shown by the following formula:

$$e \propto \frac{d\phi}{dt} (V)$$

This formula means that (e) increases in proportion to frequency. In practical use, however, when the frequency increases to a certain point, (e) gradually decreases until the output reaches zero. This is due to the loss caused by the gap of the Playback Head. Such a loss is called "Gap Loss".

Germanium

Table of Elementary Periods

										Inert Gas
										0
Metallic Element			Non-metallic Element							2 He
			III A	IV A	V A	VI A	VII A			10 Ne
			5 B 10.811	6 C 12.01115	7 N 14.0067	8 O 15.9994	9 F 18.9984			18 Ar
			13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453			36 Kr
	I B	II B								
28 Ni 58.71	29 Cu 63.546	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904			54 Xe
46 Pd 106.4	47 Ag 107.868	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9044			86 Rn
78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)			

An element which belongs to Group IV of the Periodical Table. It is the major raw material for transistors and diodes. It is produced from germanium ore, or as by-product when refining zinc, copper, silver, etc., or as a by-product of the coal industry.

To use it as a semiconductor, it must be refined to a purity of 99.99999999%, to which a 5-valent element such as Arsenic or Stibium is added as an impurity to manufacture a Negative type semiconductor, or a trivalent element such as Indium or Aluminum to make a Positive type semiconductor.

Compared with silicon, which is also an important raw material for transistors, germanium is easier to process.

Golden Tape

A trade name of PANASONIC's recording tape. It is 50% longer than standard tape and yet can be taken up onto the same reel. The thickness of the tape base is made thinner so that the thickness of the tape becomes 1.5 mil (38 μ) compared to 2.0 mil (50 μ) (1 mil = 1/1000 inch 1 μ =1/1000 mm) of standard tape.

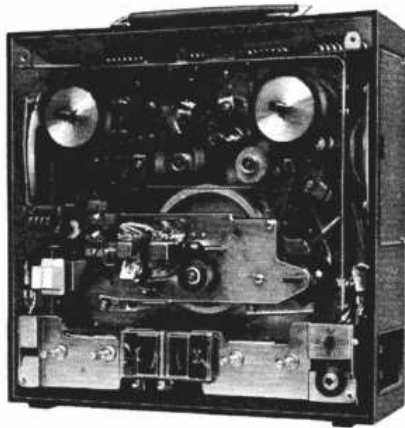
The tape lengths are

- 1,800 ft. for 7" reel (standard tape: 1,200 ft)
- 900 ft. for 5" reel (standard tape: 600 ft)
- 300 ft. for 3" reel (standard tape: 200 ft)

Golden Mechanism

A trade mark of PANASONIC tape recorders and, at the same time, the ultimate model of standard (7" reel-to-reel type) tape recorders.

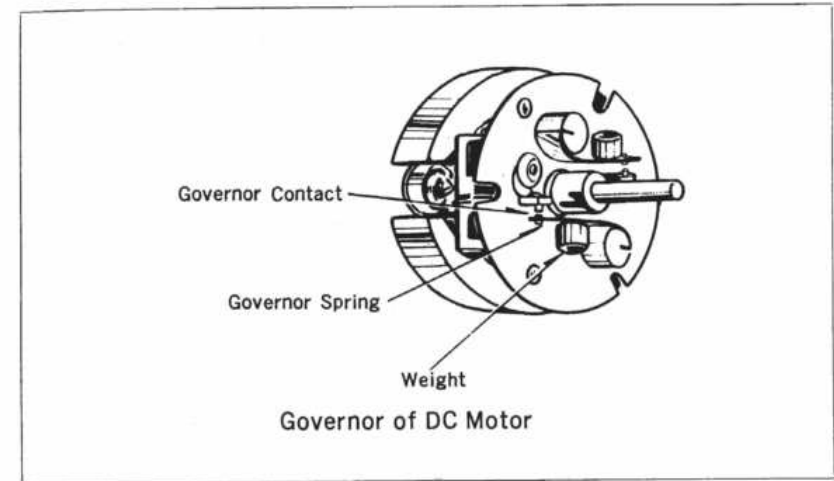
We have assembled one million units of this type. Our production continues to supply this simple and very high quality mechanism all over the world.



Features:

1. High accuracy and efficiency.
 - Since the molds for manufacture of parts are made by the Zig-boller Discharging Processing Machine, which provides precision finish of micron order, all parts are highly precise and accurate.
 - Shock absorber mechanisms of the Reel Table, Pressure Roller Rubber, Idler shape, etc. are designed to meet the original purpose of tape recorders.
2. Long life
 - Since "oilless metal" (oil impregnated bearing) is applied to all revolving parts, lubrication is not required, and a life of more than 1,000 hrs. is warranted.
 - A 4-pole motor with lower r.p.m. is used, extending the life of motor bearings twice as long.
3. Easy maintenance
 - Mechanism is simple, and its adjustment, maintenance and inspection can be done very easily.
 - The number of mechanical parts has been drastically reduced from 500 to 330.

Governor



Used to keep the rotating speed of a DC motor constant since the speed of the motor changes as supply voltage changes. Mechanical and electrical governors are used.

A common mechanical governor uses an ON-OFF switch attached to the Rotor. When current is applied, the motor rotates, and when the rotation reaches a predetermined level, the Governor's contact is opened by the centrifugal force developed by the rotation. The open contact cuts off the power to the motor and the rotational speed drops. Then, Governor contact closes to apply power again. Continuation of this action maintains the motor speed constant (usually at 3,000 rpm).

The mechanical governor is simple, compact and cheap. Unlike the Electrical Governor, no Motor Amplifier is required and no power is consumed.

The drawbacks of the Mechanical Governor are mechanical vibration and electrical noise production.

Refer to "Electrical Governor Motor" for details on that type.

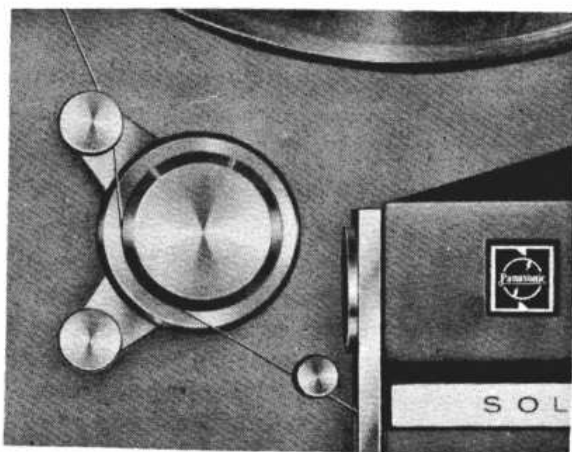
Grease

Together with oil, grease is used as a lubricant for tape mechanisms. It is often used for the sliding parts between levers, flywheels, operation cams and capstan shafts of most models.

The grease used for PANASONIC Tape Recorders includes Elogrease, Rimax, etc.

Usually, grease is not used for high speed rotating sections.

Guide Roller



Installed between the Supply Reel Table and Head.

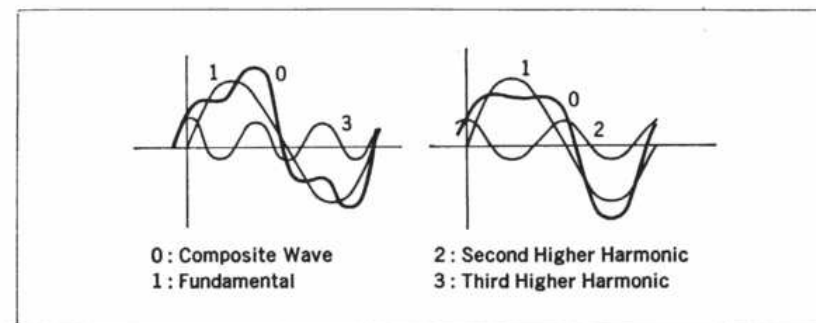
It leads the tape to the Head at the correct position (height) with appropriate tension.

This roller is particularly used in high quality tape recorders, while a Tape Guide is used instead in ordinary home tape recorders.

Half Track

The same as Double Track. Refer to "Double Track".

Harmonic Distortion



Distortion caused by non-linearity in an Amplifier.

If a pure sine wave of a single frequency is amplified in a non-linear amplifier, a distorted wave is obtained. The wave contains not only the original sine wave frequency, but multiples of that frequency called harmonics. Therefore, it is called Harmonic Distortion.

All harmonics distort the sound, but the odd harmonics (3, 5, 7, ...) are more apparent.

Harmonic distortion after recording and playback is, in general, approximately 5%.

Harmonic Distortion (ratio) is mathematically expressed as the square root of the sum of the squares of all harmonics, divided by the value of the sine wave fundamental frequency.

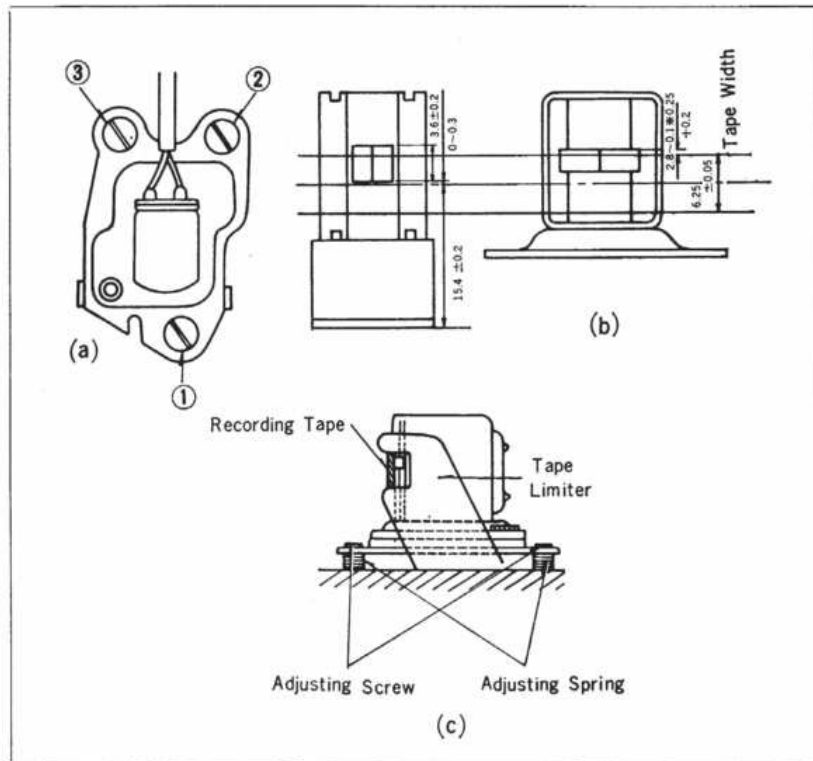
$$\text{Harmonic Distortion Ratio} = \frac{\sqrt{H_2^2 + H_3^2 \dots + H_n^2}}{H_1}$$

Where, H_1 = fundamental wave; H_2 = second harmonic wave;
 H_3 = third harmonic wave; H_n = No. n harmonic wave.

Head

Refer to "Magnetic Head".

Head Adjustment



The quality of a tape recording is determined by the adjustment of the Head. If the Head is replaced or repaired, it must be adjusted in position and azimuth to maintain the original recording quality, and to prevent crosstalk, lowering of sensitivity and attenuation in the high frequency range.

Position Adjustment

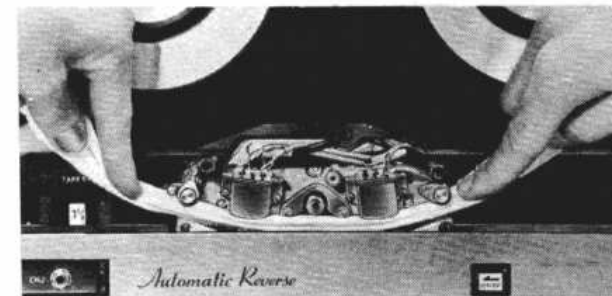
1. Transparent tape is preferred, but ordinary tape can be used.
2. First, adjust the Head height by use of adjustment screws 1, 2, and 3 to obtain the relationship between the Head Core and Tape, as shown in Fig. (b).
3. Make certain that the Head is not inclined as shown in Fig. (c). The Head Fixing Plate must always be horizontal.
4. Recently, there have appeared tape recorder Heads on which the height is determined by the Head Fixing Plate itself. For these, it is not necessary to adjust the height.

Azimuth Adjustment

If the slit is inclined, high frequency sound quality is reduced. A Standard Tape for Measurement is used for Azimuth Adjustment.

1. Attach a Dummy Resistor of 8Ω to the EXTERNAL SPEAKER terminals and also connect a VTVM to both ends of the 8 ohm.
2. Play the Standard Tape and adjust either screw 2 or 3 in Fig. (a) for maximum output indication on the VTVM. If both screws 2 and 3 are moved, it is necessary to make the Position Adjustment again.

Head Cleaning Ribbon



A cloth tape to clean the Head.

When the Head surface, particularly the front of the gap becomes dirty, a drastic drop in sound quality takes place. Therefore, the Head should be cleaned periodically.

The Head Cleaning Ribbon makes it easy to clean the Head without the trouble of removing the mount and panel.

Head Eraser



After long use, the Head Core may become slightly magnetized. The Head Eraser removes this magnetism that produces noise during playback and decreases high frequency response.

Headphones



Also called Earphones. A super-compact system used to listen to a Tape Recorder by placing them directly over the ears.

Dynamic, crystal, and capacitor types are used. The dynamic is in most common use.

Features

1. Does not disturb other persons.
2. Eliminates outside disturbances.
3. Less expensive than speakers.
4. Input requirement is not so high, and yet frequency response is good.

Hi-Fi

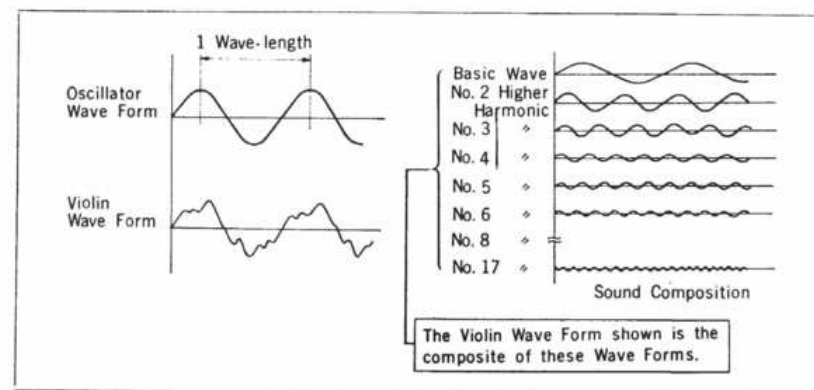
Abbreviation of High Fidelity. Usually means high quality sound.

Before the advent of the stereophonic system, Hi-Fi was very popular. The recording/playback instruments at that time were called Hi-Fi if they satisfied the following requirements.

1. Minimum distortion.
2. Flat frequency response.
3. Wide dynamic range.
4. Good transient characteristics which produce good tonal quality.

Stereo systems have made perfect sound fidelity possible.

Higher Harmonic



A frequency which is 2, 3, 4.....times (in multiple proportions) higher than the standard wave contained in sound.

If an existing sound is closely observed, it is found not to be a sine curve as output of an oscillator but, usually, presents a complicated wave form.

For instance, the sound of a violin is as shown in the above figure.

When it is analysed, there is first found the basic wave and also no less than 7 different high frequency waves.

The reason why the tone color differs for the same instrument at the same note is that the method of producing these higher harmonics is different.

High Impact Polystyrene Resin

A kind of plastic which includes butadiene rubber content to improve impact strength. It is used as the material for tape recorder cases.

H

Hiss, Hissing

A noise of relatively high frequency range. In tape recorders, it is produced when playing back the tape.

Howling

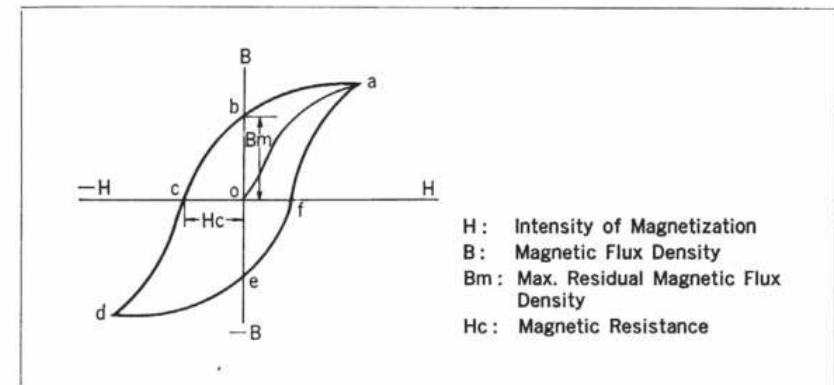
An oscillation caused by positive feedback. A part of the output is fed back to the Input Circuit and amplified, coming out as output. Then it is again fed back to the input and amplified there. The above procedure repeated, thereby causing oscillation. For instance, when sound monitoring is done and the Microphone is brought close to the Speaker, this phenomenon can be heard.

Hum

A noise that occurs in an Amplifier.

It is produced when an AC Power Source is used, being generated as output from leakage flux of a Power Transformer or AC Motor, picked up by the Head or from the ripple portion and amplified after rectification.

Hysteresis Loop



H

When a magnetic field is applied gradually to a magnetizable material which is not yet magnetized at all, it becomes magnetized as shown by the above curve o-a. B does not increase beyond a as it gets saturated.

Then, as the magnetizing power (H) is decreased, it does not follow the original a-o curve but follows the a-b curve. Even if H is placed at zero, there remains B of o-b.

When H is increased in the opposite direction, B gets to zero for the first time at c point. Thereafter, it takes the same form and follows the c-d-e-f-a curve, drawing a loop.

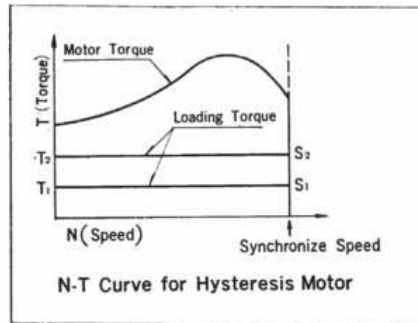
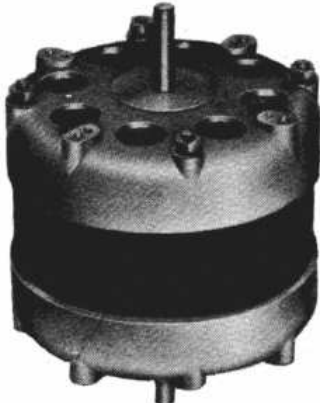
The curve o-a is called the initial magnetization curve and the entire loop, Hysteresis Loop.

Hysteresis Loss

The loss caused by the hysteresis phenomenon of magnetic material.

When the magnetic material is excited, the phase of excited current (i) advances beyond that of flux (ϕ). Then, phase difference between voltage (e) and current (i) becomes smaller than $\pi/2$, and the power is consumed at the circuit.

Hysteresis Synchronous Motor



Used as the capstan motor of 3-motor system tape recorders.

From the structural point of view, it resembles a bucket type induction motor. Permanent magnetic steel which has a magnetic field is used for its rotor.

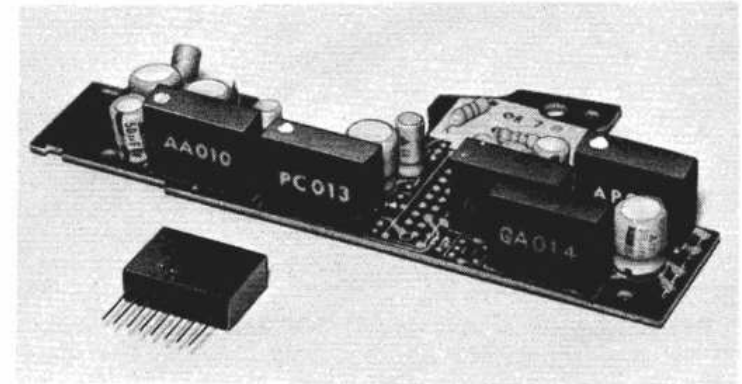
When power is fed to the motor coil, a magnetic pole different from that of the stator is produced at the rotor (in the magnetic material) by the rotating magnetic field of the stator.

Attraction power works between the two and the Motor starts rotation.

Features :

1. Rotation speed is not changed even by a considerable fluctuation in load and power source voltage.
2. There is little fluctuation in current due to load change.
3. Starting torque is small.
4. Starting voltage is high.

I.C. (Integrated Circuit)



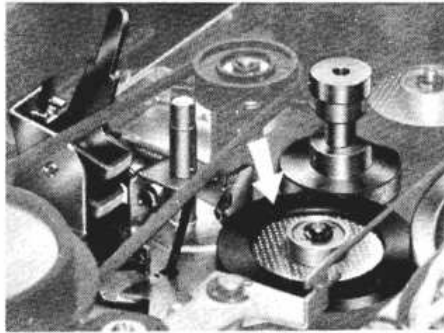
A thin-film state device that performs the electrical functions of many transistors and circuit elements. The figure shows an I.C. in the foreground, and a printed circuit board with many components all of which are replaced by an I.C..

Features :

1. Small and compact. An increase of 1,000 times in parts density is possible.
2. Reliable. As the numbers of parts and connection points increase, the reliability of equipment decreases. IC improves reliability. For example, there is a 20 time improvement in reliability between a transistor-type computer and I.C. type.

Although IC can be used in Tape Recorder electrical circuits, significant miniaturization cannot be expected in view of the Size of the Tape Mechanism.

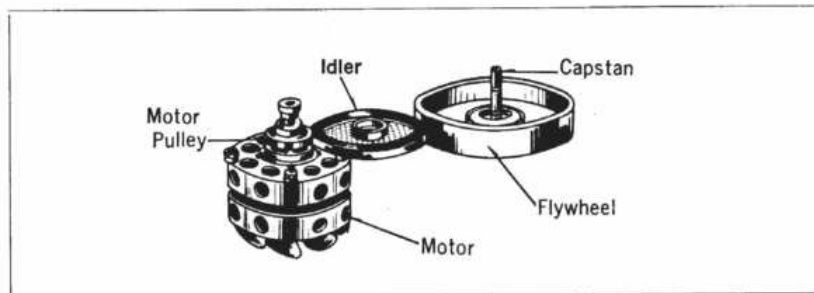
Idler



An intermediary wheel to transmit motor torque to the Capstan and Reel Table. It is located between the Motor Pulley and Flywheel in an Idler Driving System, and transmits motor rotation to the Flywheel (Capstan). In the Take-up Mechanism, it connects the Motor Pulley to the Reel Table, thereby rotating the latter.

Refer to "Idler Drive System".

Idler Drive System



One of the systems to transmit motor torque to the Capstan.

The Rubber Idler is interposed between the Motor pulley and Flywheel to transmit the motor torque. Mostly used for the Capstan Drive System.

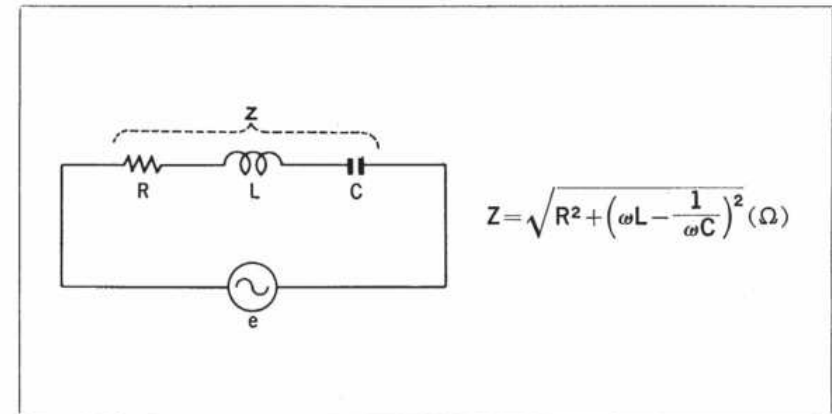
Features :

1. Idler absorbs motor vibration.
2. When the Motor pulley has different diameters and the Idler is moved vertically, tape speed can be changed easily.

I.E.C.

The International Electrotechnical Commission, which is a subsidiary of ISO (International Standard Organization). Tape recorders are standardized by the Recording Sub-Division, and specifications are delivered to all countries as recommendations.

Impedance



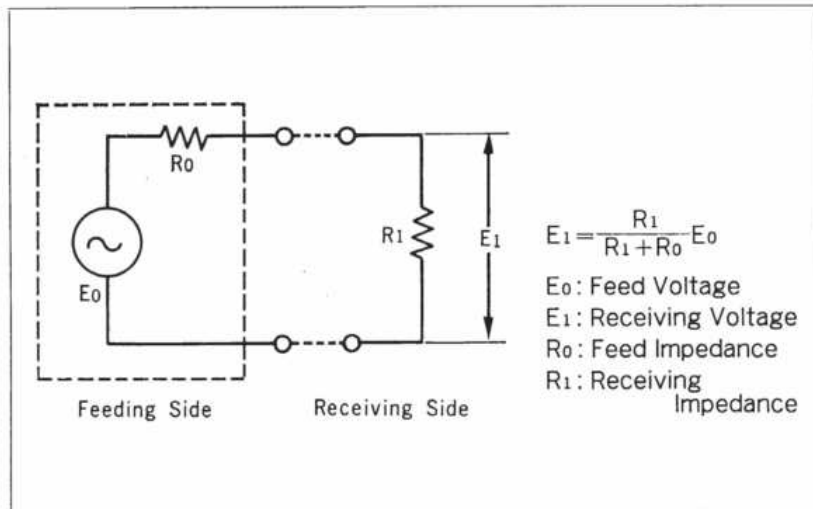
The AC circuit resistance equivalent to DC circuit resistance (R) is called Impedance (Z). Ohm's law for AC circuits, therefore, is $E=IZ$.

Because Impedance is a vector value, it is necessary to consider not only its amount but its direction (phase difference). Therefore, the impedance of the circuit shown in the figure is:

$$Z_{\text{ohms}} = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Where: R = Resistance (Ω)
 L = Inductance (H)
 C = Capacitance (F)
 $\omega = 2\pi f$
 $\pi = 3.14\dots$
 f = Frequency (Hz)

Impedance Matching



To equalize impedances of two circuits when the two circuits are to be connected. This is very important in design and use of amplifiers.

1. Power connection

Impedances of input and output sides are matched with each other in numerical value.

(Example) Connection of secondary side of Output Transformer to Speaker.

2. Voltage connection (Refer to the above figure.)

The connection is made according to the relation of $R_0 \leq R_1$.

The smaller the ratio of R_0 to R_1 , the higher the transfer efficiency.

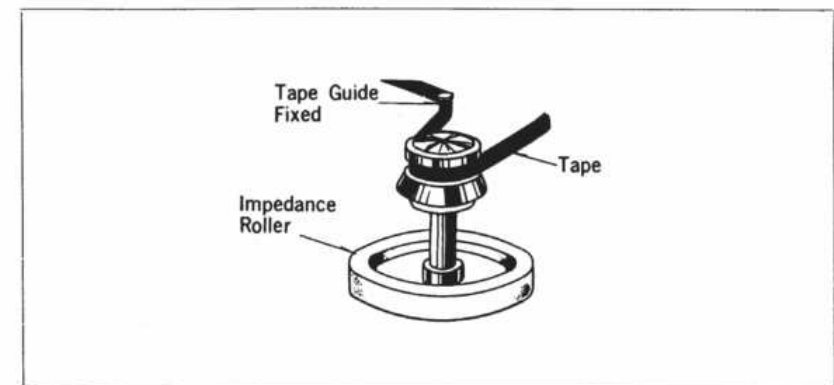
(Example) It applies to the relation between the microphone and amplifier. Impedance of microphone is made equal to or smaller than input impedance of amplifier.

3. Phenomenon which takes place in mismatching

1. Frequency response unsatisfactory.
2. Distortion loud.
3. Transfer loss increases, thereby changing input and output levels.
4. Amplifier may get damaged (for a power connection).

For instance, when a crystal earphone is used for many hours connected with an amplifier where a magnetic earphone should be used, or when no speaker is connected.

Impedance Roller



Synonym of Stabilizer. Refer to "Stabilizer".

Induction Motor

This is the most widely used type among the various kinds of motors.

Has a wide range of applications from small types for home use to large types for factory uses or construction works.

This motor consists of a Stator and Rotor, each provided with a coil.

The Motor rotates by application of torque produced between the rotating magnetic field of the Primary Coil (stator) and electric current thereby flowing in the secondary coil.

But for the rotating magnetic field, the Induction Motor would not function at all. The number of rotations of the Induction Motor N is shown by the following formula, and is smaller than the synchronous speed N_s (speed of rotating magnetic field). S means Slide.

$$N = (1 - S) N_s \quad N_s = \frac{120 f}{p}$$

where, f : power source frequency
 p : number of poles

Features:

1. Power Source is easily obtainable.
2. Simple and solid structure.
3. Motor speed is constant and does not fluctuate even when the load is varied.
4. Reasonable price.

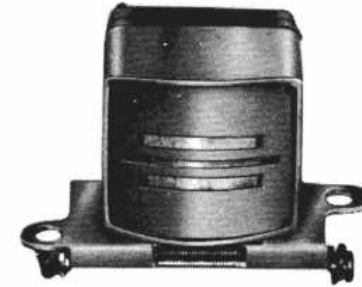
Inertia Moment

Refer to "Flywheel".

Initial Magnetization Characteristic Curve

Refer to "Hysteresis Loop".

Inline Stereo Head



Also called Stacked Head. A Record/Playback Head for Stereo combining CH1 and CH2 Head Elements at the same position.

Crosstalk is prevented by placing a Magnetic Shield between the Head elements. For proper stereo separation, Crosstalk should be lower than -20 dB.

Input Impedance

Impedance measured from the input side of the input terminal in a tape recorder or other sound apparatus.

There are two input terminals on a tape recorder: "MIC" and "AUX".

The "AUX" terminal may also be indicated as "LINE IN" or "RADIO".

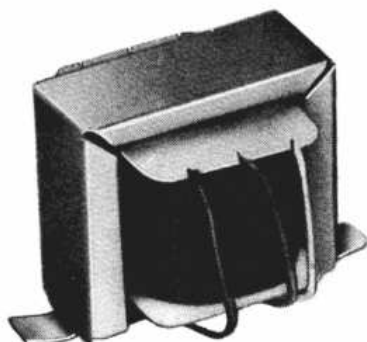
In order to record by connecting another sound apparatus to the input terminal of the tape recorder, it is necessary to have the input level of the tape recorder and the impedance matching each other. If the input level is higher than necessary, the sound is distorted. If it is too small, noise increases.

If impedance is not matched when a microphone or record player using a pick-up of ceramic or crystal type is connected, the frequency response and the level change. If impedance is not matched when recording is made through a Hi-Fi amplifier, the levels of both the tape recorder and the other apparatus may change.

In this connection, it is important to consider carefully the input impedance.

Refer to "Impedance Matching".

Input Transformer



Used to step-up voltages applied to inputs of a tube or transistor amplifier. In a push-pull circuit it supplies two necessary voltages that are equal in amplitude but opposite in phase.

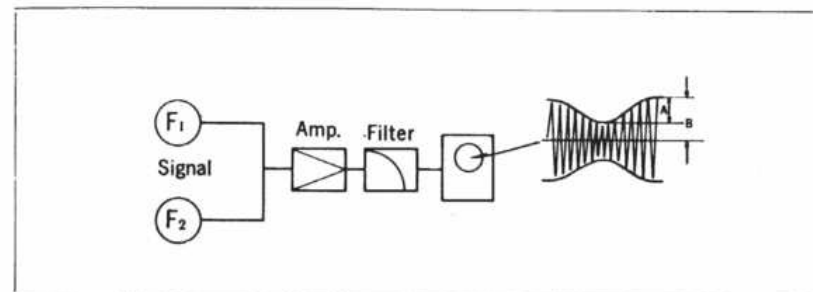
Internal Resistance

Resistance of a power source or of a measuring instrument. Its effect must be considered on the device connected to the source or instrument.

If the Internal Resistance of a power source is high compared to the device being powered, the voltage drop within the source reduces the available voltage to the output when current flows. Therefore, the lower the internal resistance, the more satisfactory the results.

When a tester or measuring device is connected to a circuit, the Internal Resistance of the measuring device must be higher than the circuit to be measured. Voltage measurement devices usually have 20 K Ω /V internal resistance. Ideally, a Vacuum Tube Voltmeter should be used because it has very high Internal Resistance.

Inter Modulation Distortion



The distortion which takes place when more than two different frequency signals are supplied at the same time to the Amplifier.

This distortion is caused when the frequency component corresponding to the sum or difference of the input frequencies is produced, or the signal voltage of one side influences the amplitude of the other signal voltage.

The actual sound contains many frequency components and, very often, it is necessary to amplify them at the same time. Meticulous care should be taken in this respect for Hi-Fi Amplifiers.

From the figure, the distortion ratio can be shown by the following formula:

$$IM \text{ (Inter Modulation Distortion)} = A/B \times 100(\%)$$

IPS

Abbreviation of Inches Per Second, a unit of speed.

IPS is used for tape speeds (7-1/2 ips, 3-3/4 ips, 1-7/8 ips etc.)

Jack

A Fixed Contact Terminal used for connecting an Electric Circuit by plug insertion.

Used for Microphones, Aux. Input Circuits, Ext. Sp, Line Output Circuits, etc. of tape recorders.

There are following kinds of Jacks.

1. Phone Jack
2. Miniature Phone Jack (Mini Jack)
3. Pin Jack

JIS

Japan Industrial Standard. Established to attain interchangeability of tapes between various manufacturers, of Tape Recorders, and to increase quality of the industry.

It covers tape recorders in general, but not reel drive systems, professional type recorders, and cartridge type recorders. Its specifications are based on the CCIR international standards for Tape Recorders.

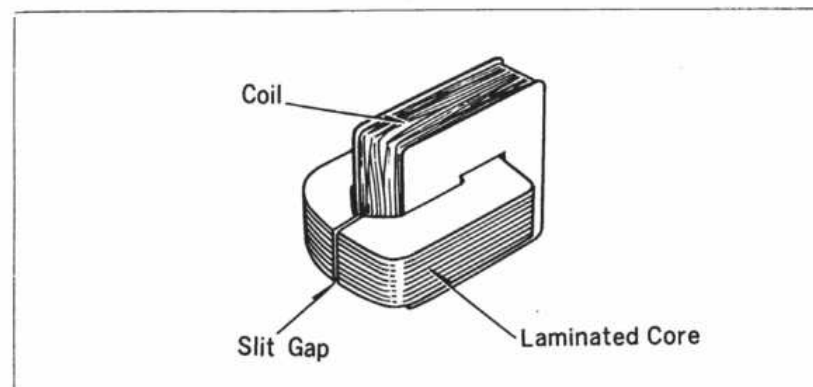
Standards and Specifications

JIS C 5509	Magnetic recording tape
JIS C 5510	Reel for magnetic recording tape
JIS C 5550	Tape recorder
JIS C 5551	Tape recorder test method

KHz

A unit of frequency, standing for Kilocycles.

1 KHz = 1,000 Hz

Laminated Head

The Magnetic Head core is usually made of thin laminated permalloy sheets. This is called a Laminated Head.

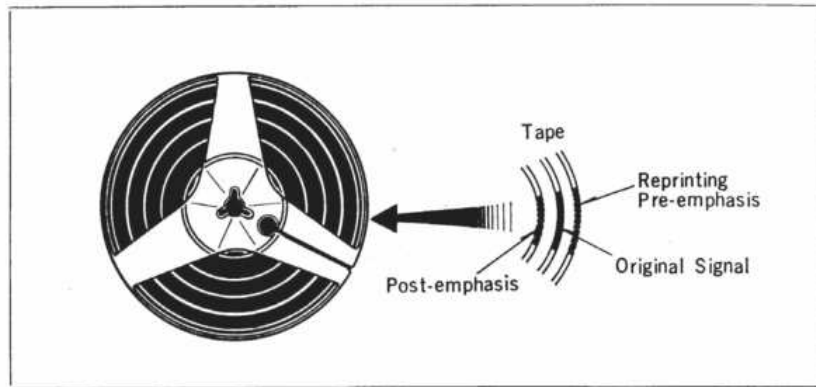
Lamination reduces the cross-sectional area to the passage of magnetic flux, and as a result, eddy current losses are reduced to a negligible amount.

Laminated Heads have small eddy current losses and the resulting sound quality, particularly in the high frequency range, is satisfactory.

Lapel Microphone

A small microphone with a clip that permits clipping to an article of clothing. Is usually a crystal-type microphone.

Layer Print



Recorded signals on one layer of tape exert a magnetic effect upon other layers that lie against it. The tighter the winding of the tape on the reel, and the longer the reel is stored, the greater the Layer Printing.

The figure shows the effect. The original signal will be heard on a layer of tape that passes through the Playback Head prior to the original signal. This is called Pre-echo. Signals that appear after the original signal are called Post-echo.

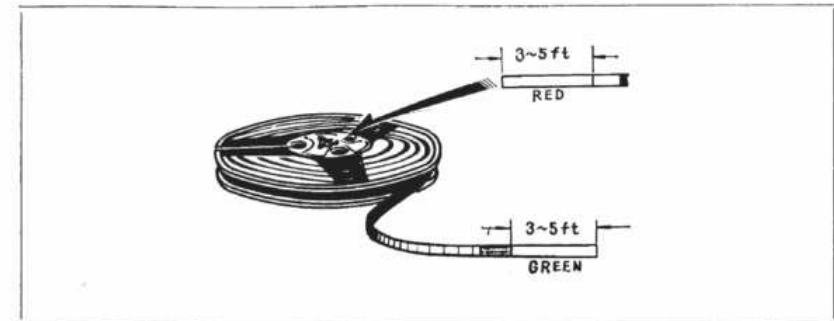
The degree of Layer Print depends on the magnetic material of the tape, thickness of tape, length of storage time, volume of original recorded sound, environment of storage, etc.

The effect of Layer Print is shown by the ratio of echo strength to original signal strength. In general, it is approximately 50 dB (300 times).

When storing Tape, attention should be paid to the following:

1. Before storing the Tape, take it up at low speed in the playback mode although it takes longer time, and not in the fast forward or rewind mode which tensions the Tape.
2. Avoid storing tape where temperatures may be high.

Leader Tape



Thick piastic base tape without a magnetic coating, used at the end or beginning of a reel of tape.

Lear Jet Tape



An 8-Track Cartridge developed by Lear Jet LTD., U.S.A. used mostly for car stereos, although has appeared for home use recently.

In it, an Endless Tape is wound up in the plastic case and a Pressure Roller is built in.

Uses:

1. For background music
2. For music playing

Features:

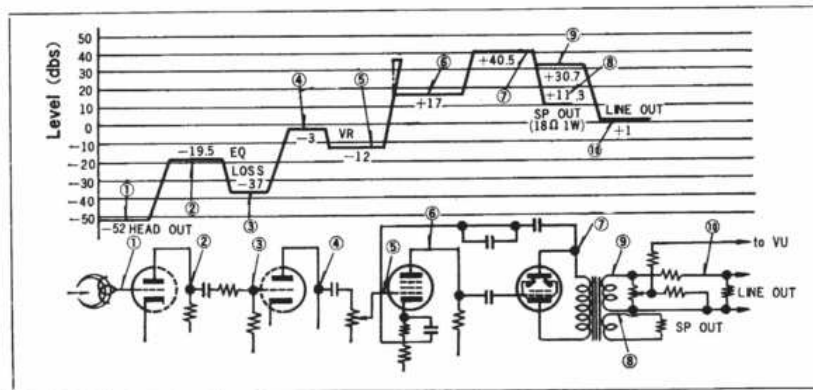
1. It is possible to record music for 80 minutes.
2. Because sensing foil is attached to the tape, tracks can be selected automatically.
3. Because Endless Tape is used, it can be played continuously.
4. Playback can be started simply by inserting the Cartridge.

Leakage Flux

In magnetic circuits, flux passes through materials that are magnetic conductors, such as iron, permalloy, silicon steel, etc. Some flux escapes from the conducting material and is termed Leakage Flux.

A Magnetic Head is made with a gap in the magnetic circuit, producing Leakage Flux in the gap.

Unwanted results are obtained by Motor and Power Transformer Leakage Flux affecting nearby parts.

Level Diagram

Used for clearly showing the degree of amplification, functioning level, gain distribution, etc. of each section of an amplifier.

This diagram is also used conveniently for early detection of trouble. when an Amplifier for which the gain at each stage is shown by the Level Diagram becomes out of order, it is possible to easily find the location of the trouble by checking the gain of each stage.

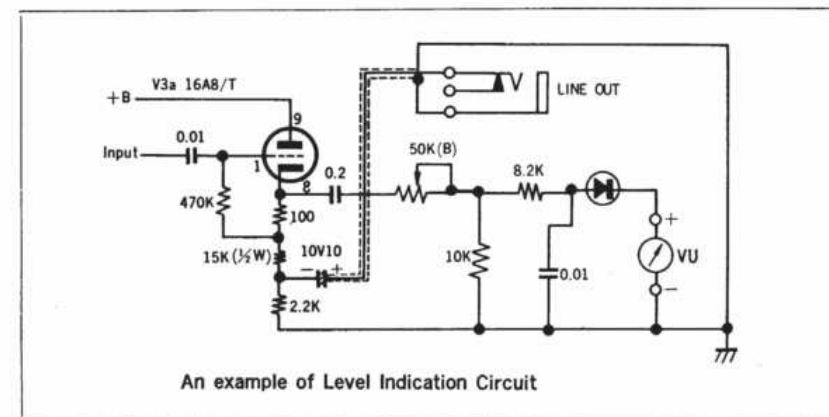
Level Fluctuation

Changes in Playback output level that were not in the original Recording level are Level Fluctuations.

It is caused by up-and-down movement of the tape through the Head, or improper contact between tape and Head.

In order to prevent this fluctuation, it is necessary to check the following:

1. Check for correct type and placement of Tape Guide and Tape Limiter.
2. Check for correct Pad Pressure.
3. Check for correct tension.
4. See that tape is not curled.

Level Indicator Circuit

An example of Level Indication Circuit

A visual indicator of recording level, playback level, battery voltage, etc.

Indicators that show the condition of the monitored voltage include:

1. Ampere meters
2. VU meters
3. Incandescent lamps brightness
4. Neon lamp flickering
5. Magic eye closure

Transistor Tape Recorders usually use small ampere meters, while high-quality machines use VU meters.

Lever System



In this system each function of the tape recorder (playback, fast forward, rewind, stop, etc.) is operated by a Lever. When the Lever is moved, the cam directly connected to the Lever moves for the desired operation.

The advantage of this system is that the structure is so simple that all operations can be performed by one Lever.

Linearity

A characteristic of the Amplifier output as related to the input variations. Good Linearity requires the ability to provide amplification without distortion, whether strong or weak input. Such an Amplifier also has a wide dynamic range.

Line Input

Refer to "Aux Input".

Line Output

Terminals used to connect the output signal to another Tape Recorder or to a power amplifier. In general, the impedance of the Line Output is 1 K Ω at a level of 0 dB (1-V).



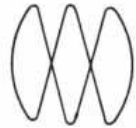
The Line Output is usually taken from a Pre-amplifier which has a better frequency response than the EXT. SPEAKER connections. Since the signal is taken before the Output Transformer, it cannot be used to operate a Speaker or Low-impedance Earphones.

Lissajous' Figure

The pattern displayed on an oscilloscope to check an unknown frequency against a known one.

Frequencies are applied to the vertical and horizontal inputs of the oscilloscope and the patterns shown in the figure are obtained. When both frequencies are equal a straight-line or oval is obtained. Other patterns show the ratios of the frequencies.

The phase differences between the two signals can be determined from the ratio of the projected length of the oval on either axis to the length that crosses the axis.

Lissajous' Figure	Frequency Ratio
(a) 	1:1
(b) 	2:1
(c) 	3:1

Used for measuring bias and erase frequencies in Tape Recorders.

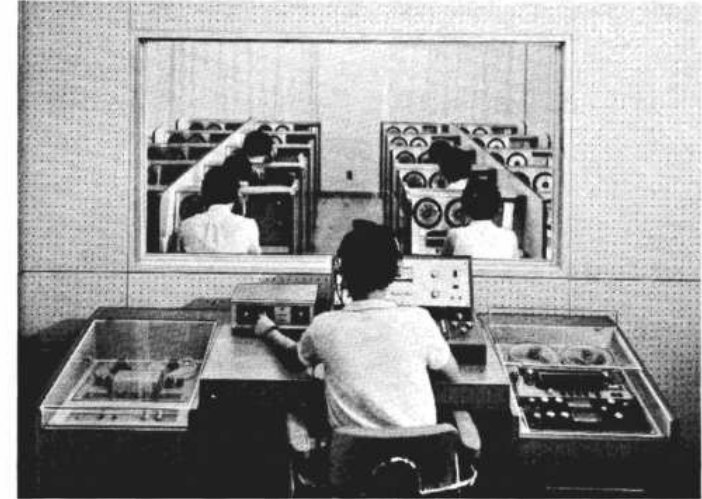
L. L (Language Laboratory)

A recently popularized system of language study used in schools and language institutes.

The System includes a Master Section (operated by the Teacher) and the Listening Booths (where the students sit) containing Tape Recorders connected to the Master Section.

The advantages of this method are:

1. Hearing and speaking abilities are considerably improved.
2. Different programs (four or more) can be supplied independently. Students can be divided into groups for separate group lessons. Therefore, students at different skill levels, can be taught at the same time.



3. The student's pronunciation and that of the teacher can be recorded for immediate comparison.
4. Students and teacher can communicate. This enables the teacher to give personal guidance.
5. Students can concentrate on the lesson without outside distractions.
6. All students can listen to the program with the same sound level and sound quality.

Load Impedance

The impedance of a device connected to the output of an electrical device, expressed in Ω at 1,000 Hz

For best results the load impedance and output impedance must be matched.

Refer to "Impedance Matching".

Loudness Control

A volume control that compensates for different volume levels at the high and low frequency ranges to the response of a listener's ear.

Refer to "Fletcher-Munson's Curve".

Loudness Curve

Synonym for "Fletcher-Munson's Curve".

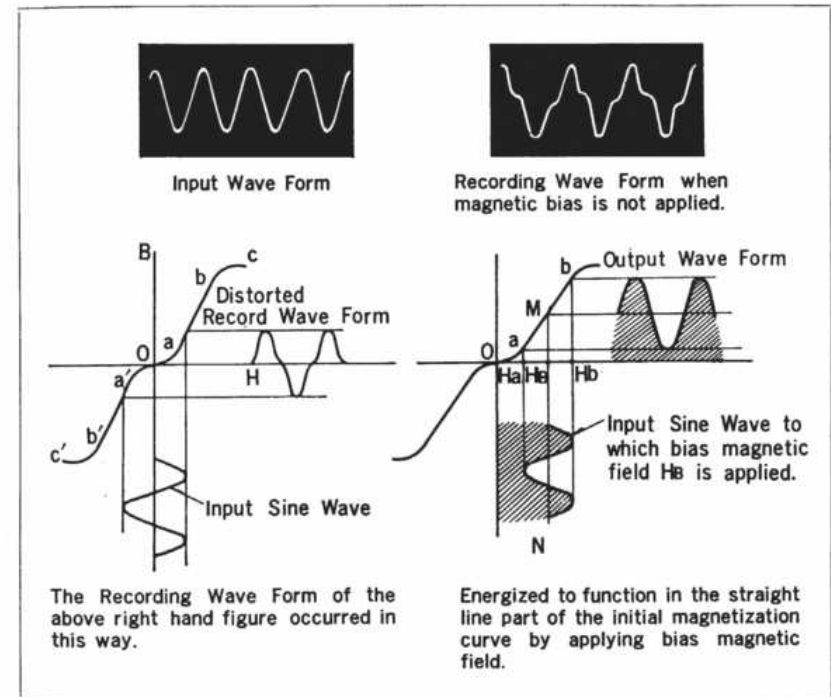
Refer to "Fletcher-Munson's Curve".

Magnetite

A kind of magnetic material for magnetic tape. Its chemical symbol is Fe_2O_3 (Another typical magnetic material is γ -hematite, $\gamma\text{-Fe}_2\text{O}_3$).

Its advantage is high resistance to demagnetization.

Magnetic Biasing

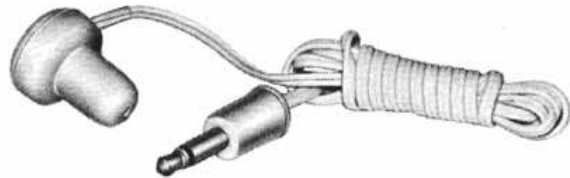


A most important element in providing recordings of good quality sound. Recordings must be made along the linear portions of the BH curve (Hysteresis Curve) to prevent distortion. The figure illustrates this and also shows that the magnetic field (H_b) is applied before recording. The H_b is called Magnetic Bias or Bias Magnetic Field.

There are three methods of Bias.
(Refer to the respective terms)

1. DC Bias
2. AC Bias
3. New AC bias

Magnetic Earphone



Permits listening to sound undisturbed by outside sound or noise. There are two types: the ear hanging and ear plug types.

The Magnetic Earphone is constructed with a coil wound around a permanent magnet. Audio currents applied to the coil, vibrate a diaphragm as a result of the action of the magnetic field produced, acting with the permanent magnetic field.

Impedance is generally between 8 and 16Ω.

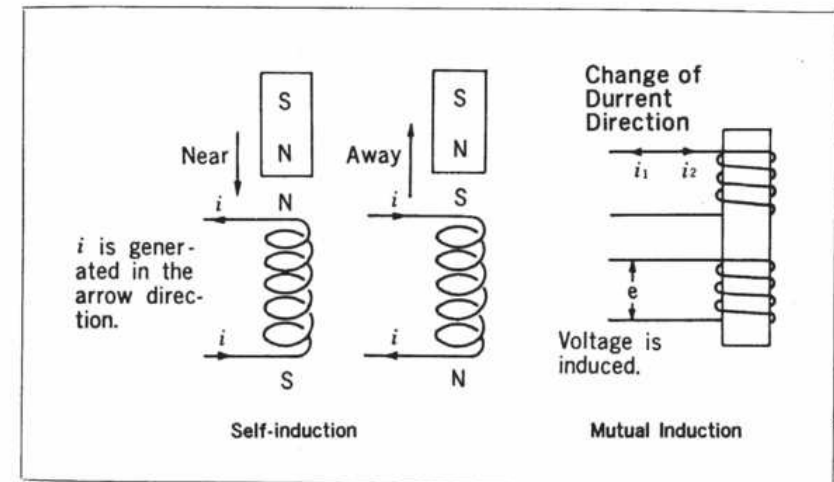
Magnetic Head

Converts electrical energy from the Amplifier section of a Tape Recorder to magnetic energy to record on the magnetic coating of tape.

It is classified as follows by functions, structure, and track.

(By Function)	(By Structure)	(By Track)
Erase Head	Laminated Type	Full Track
Record Head	Pole Piece Type	Double Track
Playback Head	Sure Type	Quarter Track
Record/Playback Head	Coinciding Type	Eight Track
All-in-one Head		

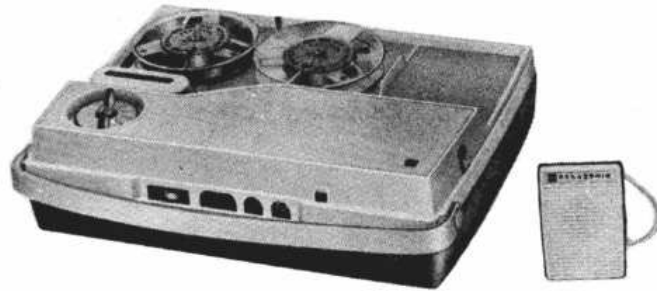
Magnetic Induction



When a magnet approaches or moves away from a coil, electromotive force is induced in the coil in such a direction as to prevent a variation of magnetic flux crossing the coil; and or when the direction of the current flowing in the coil is changed, inductive electromotive force is produced at the coil in such a direction as to prevent magnetic flux concentration. The former is called Mutual Induction Effect, and the latter is called Self-Induction Effect.

The Transformer is an application of Mutual Induction. The relation between the Tape and Playback Head is an example of Self Induction.

Magnetic Microphone



A coil is placed between fixed pole pieces of a magnetic field. Sound vibrations cause an iron piece to vibrate and an electromotive force corresponding to the variation of reluctance between the magnetic poles is produced at the coil.

Features

1. Output is more than that of a dynamic microphone.
2. Resistances to temperature, moisture, and mechanical impact are almost the same as the dynamic microphone.
3. It can be made relatively light and compact.
4. Price is a little lower than that of the dynamic microphone.

On the other hand, it has the following drawbacks:

1. Distortion is considerable.
2. Frequency response is not so good.

Therefore, it is seldom used at present.

Magnetic Recording

Sound is recorded on tape by changing it into varying strengths of magnetism. This is called Magnetic Recording. Other methods of recording are optical (sound moving pictures) and mechanical (disc records).

The advantages of Magnetic Recording are:

1. Previous recordings can be erased, permitting reuse of the tape.
2. Long recordings can be made in a single tape.
3. Tape can be reused thousands of times without deterioration.
4. Recorded tape can be stored for a long time (more than 10 years).
5. Recorded tapes are easily edited.
6. Excellent sound quality and good S/N ratios are obtainable.

Magnetic Tape

Made of an iron oxide coating on a plastic base. Used for recording the magnetic field produced by audio currents passing through the Magnetic Head. The residual magnetism of the magnetic oxide retains the sound recording.

Refer to "Tape Base", "Standard Tape", "Golden Tape", "Extra Play Tape", "Double Play Tape", "Triple Play Tape", "Cartridge Tape", and "Endless Tape".

Magnetization

Magnetization means that a magnetizable material such as magnetic head of tape guide becomes magnetized unnecessarily by DC.

When it is magnetized, it, in turn, magnetizes the passing tape by DC. Then tape noise is produced and S/N ratio also becomes bad. It is necessary to erase, with an eraser, any magnetizable material which has been magnetized.

Refer to "Demagnetization".

Manual Reverse

Refer to "Mechanical Reverse".

M Master Tape

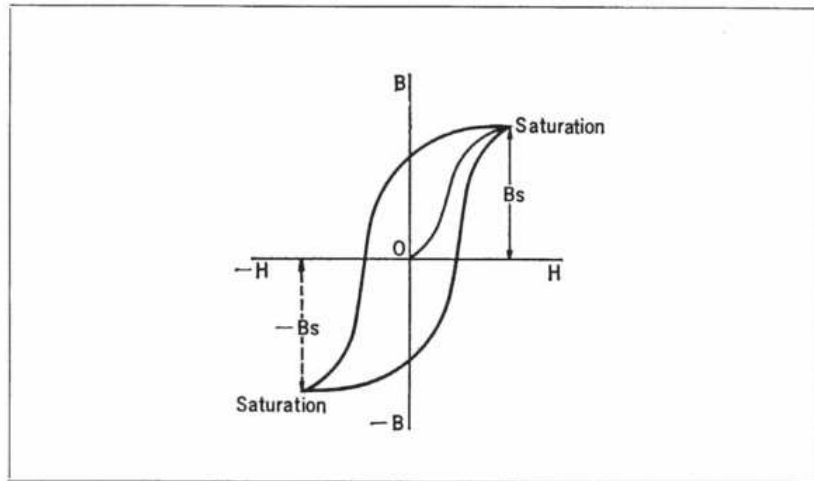
The teaching tape used in language laboratories.

Matching Transformer

Efficient transfer of power or voltage requires matching the load impedance to the power source impedance. The Matching Transformer is used for this purpose.

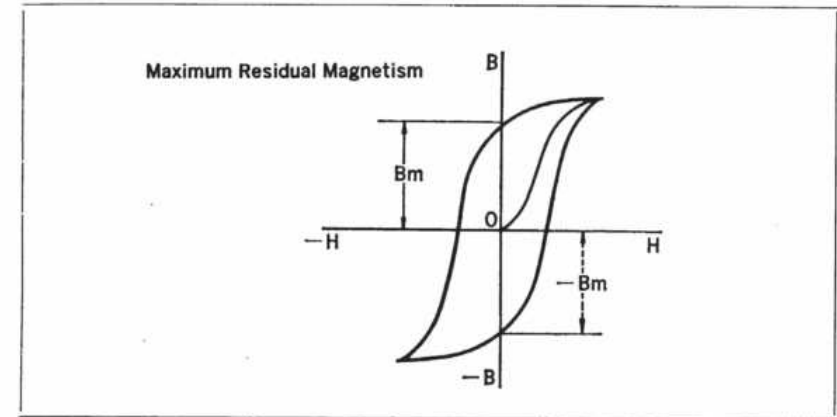
Audio output transformers and input transformers are examples of Matching Transformers.

Maximum Flux Density



The flux density (B_s), namely magnetic flux per unit area at the saturation point, when a magnetizable material is magnetized by DC.

Maximum Residual Magnetism



If a magnetizable material is magnetized with direct current until it is saturated, residual magnetism remains when magnetization is stopped suddenly. Maximum Magnetism means the maximum value of this residual magnetism expressed in terms of magnetic flux per unit area (B_m).

Material having a high value of maximum magnetism is termed a Ferromagnetic Material. For a tape recorder, the magnetic substance of the tape has a high value of maximum magnetism.

Maximum Power Output

The maximum undistorted power that can be obtained from an Amplifier with a single frequency input.

It can be calculated as follows:

$$P = \frac{E^2}{R}$$

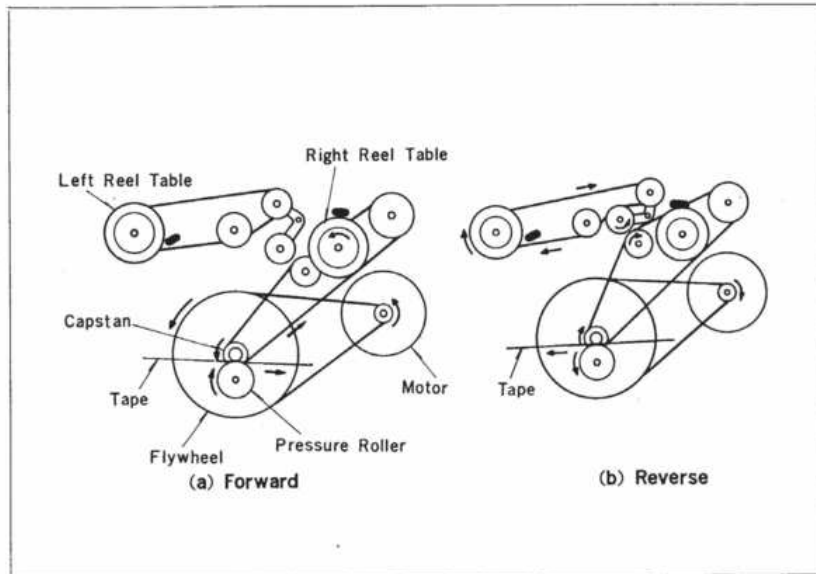
Where: P = Power (watts)

E = Voltage (volts)

R = Load impedance (Ω)

Refer to "Power Output".

M Mechanical Reverse



The action to reverse tape direction mechanically and instantaneously by lever action without the need to touch the tape.

The mechanism to perform this function is simple and capable of record and playback operation without interruption.

Operation: When the Function Lever is moved from the FORWARD position to the REVERSE position:

1. The FORWARD/REVERSE Selector Switch changes the polarity of the motor voltage, thereby reversing the rotation, that is, reversing the direction of the Capstan.
2. The FORWARD/REVERSE Selector Switch replaces the FORWARD Heads with REVERSE Heads. At the same time, the Pad for FORWARD moves away from the FORWARD head surface.
3. The object of motor torque transfer through the takeup belt is changed from the Right Reel Table to the Left Reel Table, and the tape is taken up by the Left Reel Table.

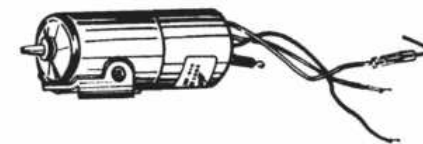
Comparison: Difference between the Reverse Mechanism from the ordinary Mechanism.

1. Center capstan drive system: The Capstan and Pressure Roller are positioned between the FORWARD Heads and REVERSE Heads, driving the tape. For details, refer to "Center Capstan Drive".
2. Left and right reel tables are symmetrical: During FORWARD operation the left side is for supply and the right side is for takeup, but during REVERSE, the opposite. Each reel is therefore equipped with both supply and takeup functions.
3. Belt drive system: To transfer motor torque to capstan, the Belt Drive System is generally used. This system accords with the reversing action of the motor which is switched over instantaneously, and transfers the torque smoothly in either FORWARD or REVERSE direction without moving from its position.

Micron

A unit of length corresponding to 10^{-6} of 1 m (1/1,000,000 m), or 10^{-3} of 1 mm (1/1,000 mm).

Micro Motor

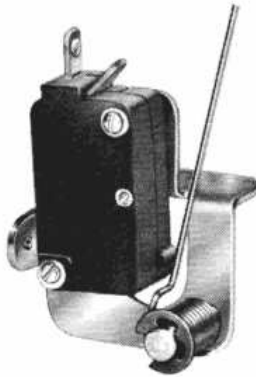


A small battery-driven, precise motor with the following specifications:

1. Input max. 3 W
2. Length max. 2.4" (60 mm); Diameter max. 1" (25 mm)

Since it does not require a large space, it can be used for:

1. 8 mm movie cameras and
2. Portable tape recorders

M Micro Switch

A super-small Snap Switch which performs quick ON/OFF and sure contact.

For a tape recorder, it is mainly used in the power source circuit. For instance, the arm of the Shut-off switch interlocks with this switch. By use of tape tension, when the tape comes to the end, the arm energizes the switch and the set stops automatically.

Microphone

The device to faithfully convert sound into electric vibrations.

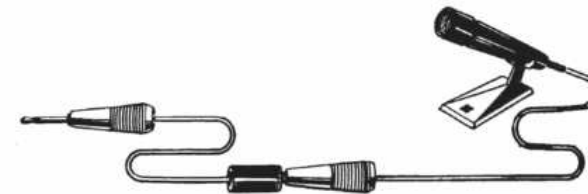
Refer to "Dynamic Microphone", "Crystal Microphone", "Magnetic Microphone", "Lapel Microphone", "Condenser Microphone", "Ribbon Microphone", and "Wireless Microphone", respectively.

Microphone Mixer

Permits simultaneous recording of a conference of many people or band performance, etc. by use of several microphones. It mixes the different sound levels of the microphones.

Features (PANASONIC's RP-981)

1. It can be connected to 3 microphones, level control for each of which can be independently adjusted to effect complete mixing.
2. It is possible to use any microphone, of either high or low impedance.
3. It can be connected to either the Mini Plug or Phone Plug.

Microphone Extension Cord

Used when the Microphone Cord is not sufficiently long. On one end, there is a Mini Jack (or Phone Jack), while on the other end there is a Main Plug (or Phone Plug).

M

If it is too long, the frequency response may decrease. It may also be used as a Speaker Cord or Recording Extension Cord.

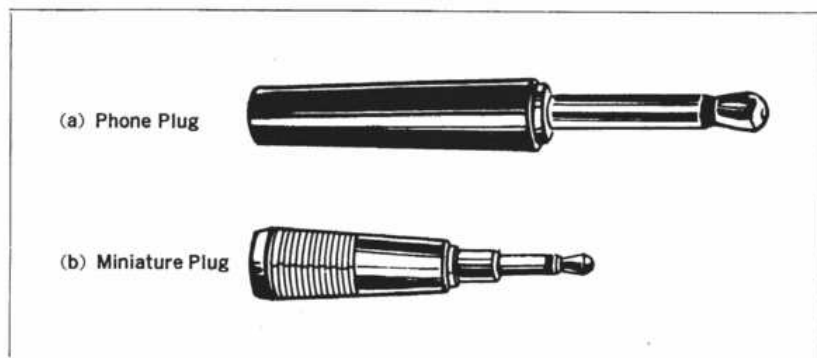
PANASONIC Special Accessories:

RP-8027 Mic. Connection Cord A (with Mini plug/jack)

RP-8028 Mic. Connection Cord B (with Phone plug/jack)

Mil

A unit of length. 1 mil is equivalent to 1/1,000 inch. This unit is used for representing a very small thickness such as that of tape, etc.

Miniature Plug

A small plug used for connecting a tape recorder or microphone to another instrument. (A larger one for the same purpose is called a Phone Plug.)

Mismatching

Lack of impedance matching.

Refer to "Impedance Matching".

M**Mixer**

Refer to "Microphone Mixer".

Mixing

Recording or playback of two or more sounds superimposed on one channel.

Refer to "Microphone Mixer".

Modulation Noise

Refer to "Inter Modulation Distortion".

Moltprene

A foaming polyester resin particularly rich in elasticity. Used for preventing mechanical vibration, etc., and also used to prevent resonance of spring or cabinet in a tape recorder.

Monaural

Synonym for Monophonic. Refer to "Monophonic".

Monitor

Refer to "Recording Monitor".

M Monitor Head

The Playback Head for tape monitoring.

Refer to "Recording Monitor".

Monophonic

Recording of an orchestra performance or other sound on a disc or tape by collecting the sound onto one electric circuit by use of one or more microphones; or it means the sound played back therefrom. Unlike stereophonic, Monophonic has no so-called stereophonic feeling in respect of width, depth, movement, etc., but is generally used for recording and playback.

Also called Monaural.

Mono Printer

The accessory device for reprinting (or dubbing).

In general, 2 tape recorders are used for reprinting.

When this device is used, it is possible to make a recording on the mother tape and reprint tape at the same time by threading them on one tape recorder.

Mono Track

Refer to "Full Track".

Mother Tape

The originally recorded tape. To preserve this tape, it is reprinted on another tape and the Mother Tape is saved.

M Motor Direct Drive System

The system to drive a tape directly without intermediary devices such as idler, belt, etc. The Motor shaft acts as the Capstan. As a result, no wow or flutter occurs.

A Hysteresis Synchronous motor is used in the Direct Drive System, and speed changes can be made by changing the number of poles.

Multi Track Recording

A method of making a recording by dividing the tape into many tracks by use of a Multi-element Head.

The feature of this system is that it permits recording for a long time. On the other hand, however, it has the following drawbacks:

1. The track width becomes narrow, the playback output decreases and the S/N ratio worsens.
2. It requires dimensional precision.
3. The Head is difficult to manufacture.
4. Its operation is complicated.

It is therefore not often used for general tape recorders, but used for such special applications as:

1. Recording various signals.
2. When magnetism is used for memory device of computer.

Music Power

The instantaneous power output obtained with a single frequency input having 10% distortion in the output.

The new method of expressing power output, based on the fact that recording or playback sound is not always continuous, is use of instantaneous output.

M

The power output is calculated by reading the output voltage with an input signal that produces 10% distortion in the output, as follows:

$$P = \frac{E^2}{R}$$

Where: P= Power (watts)
E= Voltage (volts)
R= Output impedance (ohms)

Some manufacturers rate Music Power with 5% or 3% distortion in the output.

Refer to "Power Output".

Mylar Tape

Also known as Polyester Tape. It is thinner than conventional tape base materials such as acetate cellulose, and its playing time is 1.5~2 times as long as conventional tape on the same reel. (Our brand name: Golden and Golden S Tapes).

Refer to "Polyester Tape".

NAB (NARTB)

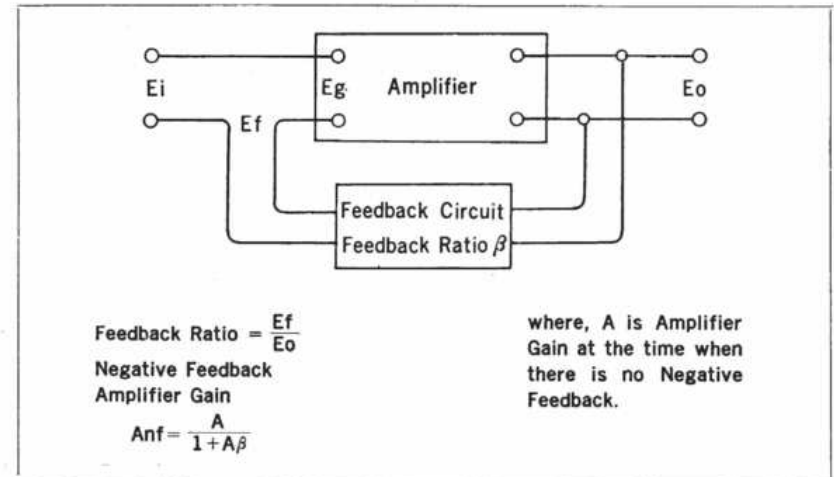
The National Association of Broadcasters is an association of private broadcasters in the U.S.

Within this association is the Recording and Playback Standard Committee which determines the standard for tape recorders, disc recorders, etc. for broadcasting use.

General tape recorders in the U.S. are manufactured in conformity to NAB.

NAB was once called NARTB.

Negative Feedback



Negative Feedback is the part of the amplifier output which returns to the input side and is amplified again.

If the amplification degree is higher than when there is no feedback, it is called Positive Feedback, while if the amplification degree decreases, Negative Feedback.

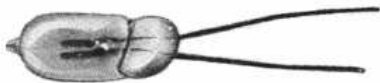
N

The above figure shows a circuit to illustrate the function of the Feedback Amplifier.

Because the Negative Feedback brings about the following effects, it is used in almost all amplifiers:

1. Frequency characteristics improved.
2. Distortion is low.
3. Noise and cross modulation between noise and sound are low.
4. Adjustments of input and output impedances are possible.
5. The gain remains constant even if power voltage fluctuates or performance level of transistor or that of vacuum tube is unstable.
6. Damping factor can be improved for a power amplifier.

Neon Lamp



Lights when the applied voltage reaches a certain level. Due to this property, it is used as a recording level indicator.

A transformer is used to raise the recording level to about 65 Volts, which can cause the bulb to discharge and light.

During playback the Neon Lamp is used as a pilot lamp (PANASONIC RQ-300S, RQ-503S, etc.)

The point of lighting is adjusted about 10 dB lower than the standard recording level. Therefore, the best recording is made when the Neon Lamp flashes.

Neoprene Rubber

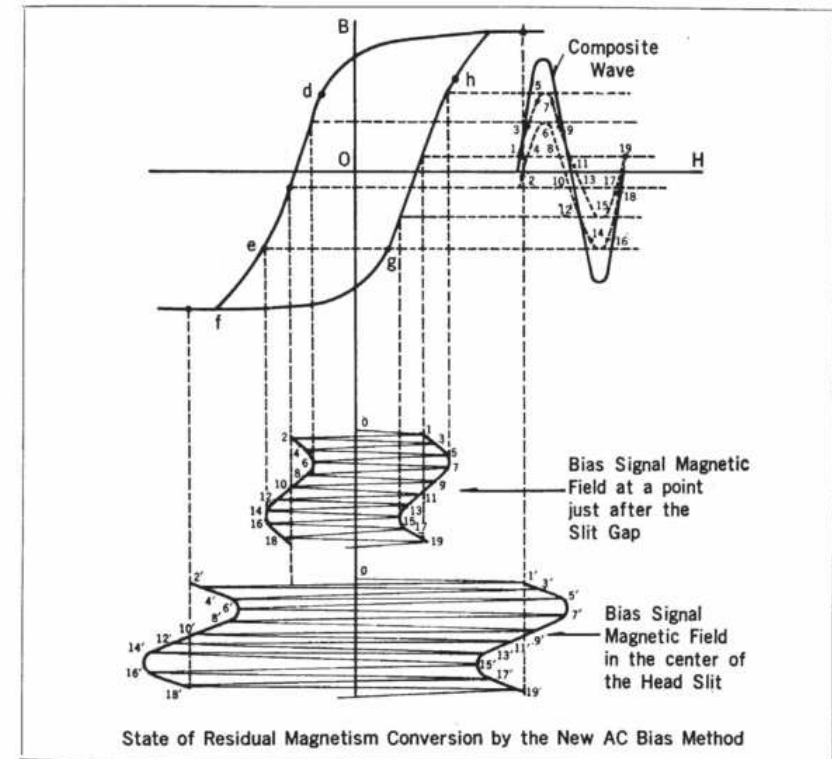
Refer to "Chloroprene Rubber".

NEMKO

Norges Elektriske Materiell Kontroll (Norwegian Safety Standard).

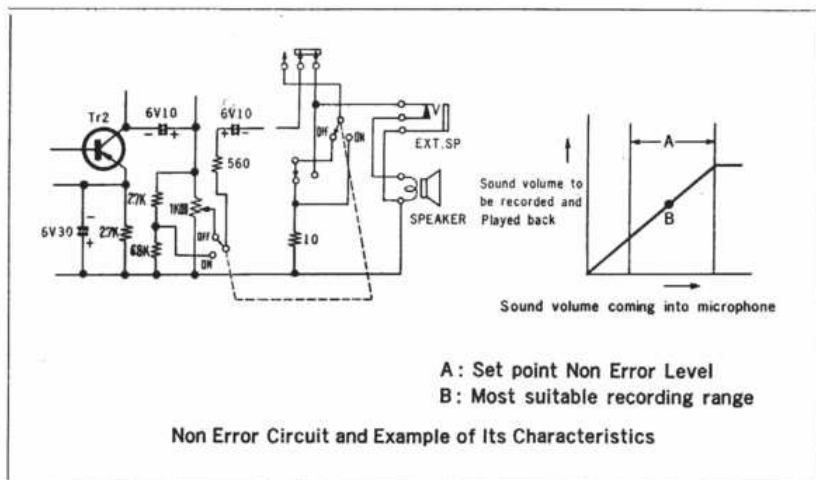
All electric appliances which require an AC Power Source, such as tape recorders, radios, television sets, record players, etc. must be approved by this institution prior to their donation, sale or use.

New AC Biasing



The system by which AC Bias is greatly increased in volume and selected so that the magnetic substance of the tape is sufficiently saturated at the center of the slit gap of the Recording Head (where the magnetic field is strongest).

Non Error



A system enabling even the beginner to make a recording without error. Recordings can be made without adjustments of the volume control and without making a test recording first. In addition, playback without distortion is obtained.

The schematic diagram in Fig. (a) shows a Non Error Circuit.

When the switch is set to ON, the volume control is cut out of the circuit, and instead, a connection is made to a fixed voltage divider. Therefore, the output amplitude is fixed. The same action takes place during playback.

The operation is the same as if the volume control was set at a fixed position that was most suitable for recording and playback. This position is usually 60% to 70% of the rotation of the volume control.

The figure shows the recording and playback characteristics with the Non Error Circuit.

Octave

When there are two sounds, A and B, and their frequency ratio is 2 : 1 or 1 : ½, their relation is called the Difference of 1 Octave. (For instance, the frequency which is higher by one octave than 100 Hz is 200 Hz.)

Ohm

The unit of electric resistance; indicated by the symbol "Ω".

One ohm is equal to the electric resistance which produces the potential difference of one volt by current of one ampere.

Ohm's Law

The basic law of electric engineering, discovered by Ohm in 1827. Potential difference V between 2 points arbitrarily selected on a wire in which current is flowing is proportioned to the current intensity I .

When it is set as $V=RI$, the proportioned constant R is the resistance between the said two points.

Oil

There are many rotating parts in the mechanism of a tape recorder. Oil, as well as grease, is indispensable as a lubricant for each rotating shaft, and is used for the capstan shaft, pressure roller shaft, guide pulley, etc.

In general, No. 5 Oil, Spindle Oil, etc. are used for tape recorders.

Oilless Metal



Oilless Metal is prepared by impregnating oil into the numberless spaces between metallic particles. In a tape recorder, it is used widely for the Capstan Bearing metal, Reel Table Bearing metal and other Pulley Bearing metals.

When the Shaft or the Metal itself rotates, the impregnated oil oozes out, making it unnecessary to lubricate this Metal.

There are two types of Oilless Metal; steel and iron. The ratio of impregnated oil to the metal volume is about 15%.

One Motor System

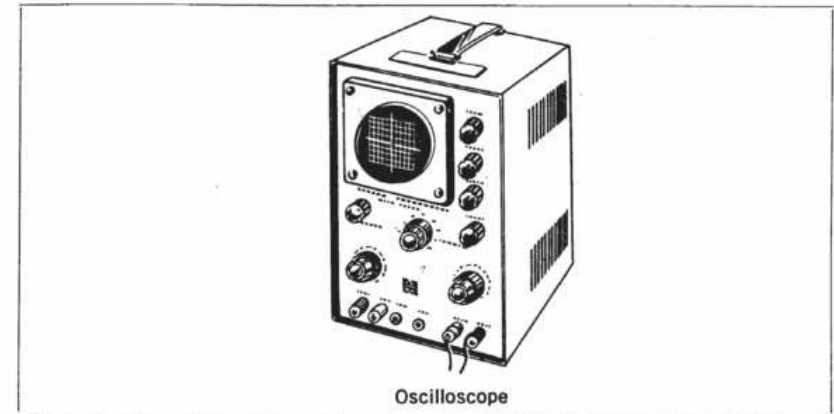
A mechanism in which one motor turns the Capstan to drive the Tape and at the same time turns the Reel Table to takeup (or rewind) the Tape.

This system is used for most tape recorders except for those of professional class.

An Induction Motor is usually employed for this purpose. Since one motor does various functions, the motor torque must be sufficient to cover all such functions.

The structure requires an Idler and Belt. In addition, many parts to transmit torque are also necessary, and these make the mechanism somewhat complicated. But it is still far cheaper in cost and lighter in weight than the 3-motor system.

Oscilloscope



Oscilloscope

More exactly, it is called Braun Tube Oscilloscope. It is a very convenient instrument by which various electric properties and changes according to time lapse can be observed.

Indispensable for designing and after-service of tape recorders.

By use of the Oscilloscope, the following can be measured and recorded as pictures:

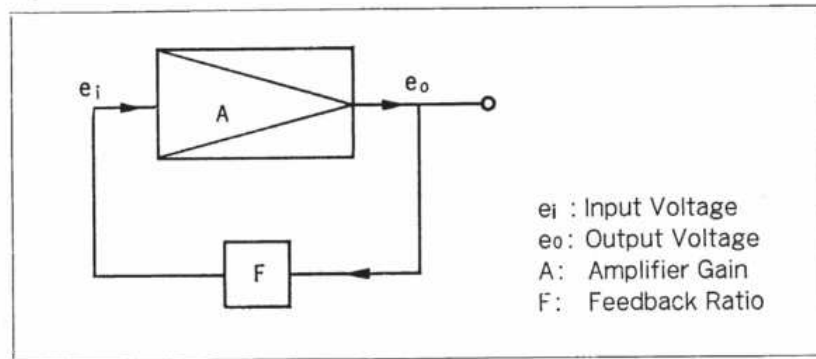
1. Measurement of oscillation frequency
2. Observation of each wave form
3. Observation and analysis of wave form distortion
4. Analysis of noise

The above are examples in relation to tape recorder characteristics. In addition, it is possible to measure the difference in phase, etc.

Oscillation

Electric vibration occurring by itself or by stimulation from others. An instrument to produce oscillation is called an Oscillator.

The figure above shows the fundamental form of an Oscillator.

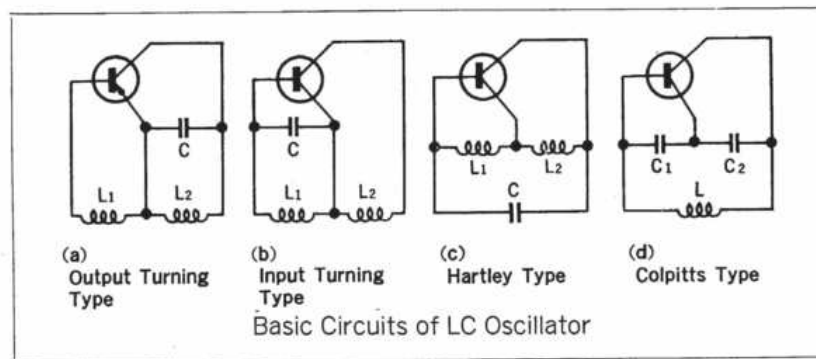


Suppose that there is an input voltage of e_i , it is amplified 'A' times at the amplifier and becomes e_o appearing on the output side. This e_o is multiplied 'F' times (actually less than 1) by the Feedback Circuit, and is fed again to the input terminal of the amplifier to be amplified again. This process is repeated to continue oscillation.

The following are conditions for oscillation by an oscillator:

1. A (amplification degree) \times F (feedback ratio) > 1
2. Input and output phases be so connected that their relation becomes positive feedback.

Oscillator



A device which makes oscillation to convert DC energy into AC energy.

There are the following varieties:

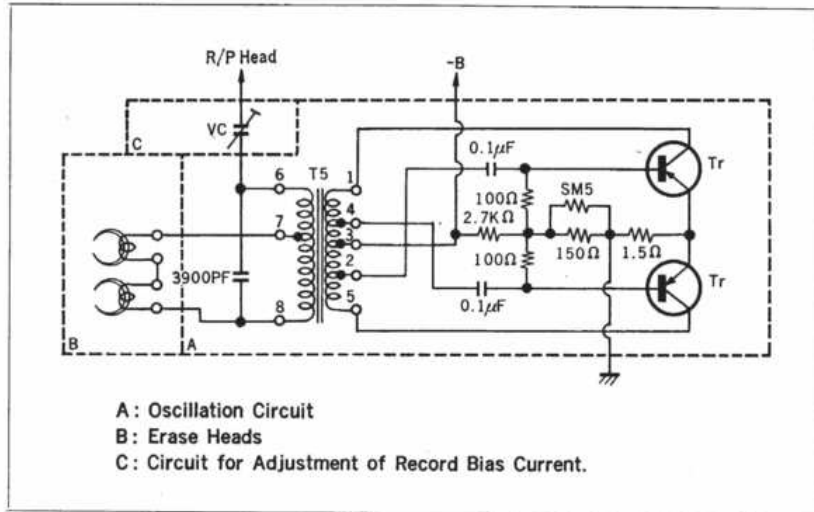
1. LC Oscillator
As explained below.
2. RC Oscillator
Refer to "RC Oscillator".
3. Crystal Oscillator
Uses piezo-electric effect of rock-crystal plate and has high stability in terms of frequency.
4. Magnetostriction Oscillator
Uses the phenomenon of magnetism distortion to stabilize frequency. Its frequency range is between the tuning fork oscillator and crystal oscillator.
5. Beat-frequency Oscillator
Has two sets of sine wave oscillation circuits which are superimposed together to produce beat frequency.
6. Tuning Fork Oscillator
Achieves reversed combination of vacuum tube oscillator by way of tuning fork through electromagnetic induction. It has high frequency-stability.

Of the above, the most generally used are the LC and RC Oscillators, which can be classified, respectively, as follows:

	LC Oscillator	RC Oscillator
Tuning Type	Output Tuning Oscillator Input Tuning Oscillator Hartley Oscillator Colpitts Oscillator	Tarman Oscillator Bridge T-form Oscillator Parallel T-form Oscillator
Bridge Type	Meecham Oscillator	Wienbrig Oscillator
Phase Shifting Type	LC Ladder Type Oscillator	RC Ladder Type Oscillator

The illustration above shows the standard diagram of Tuning LC Oscillators.

Oscillator Circuit

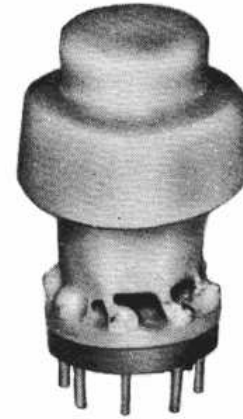


Most of today's tape recorders use the AC bias recording system, requiring an Oscillation Circuit which generates bias current. The Hartley Circuit or Colpitt Circuit is often used as the Oscillator Circuit. An essential condition for the above is that there be no great amount of Harmonic distortion in the oscillation waves. In particular, if the oscillation waves are asymmetric, the same effect as if DC were superimposed is produced and causes noise. Oscillation frequency of the Oscillation Circuit is 30~100 KHz.

Oscillator Coil

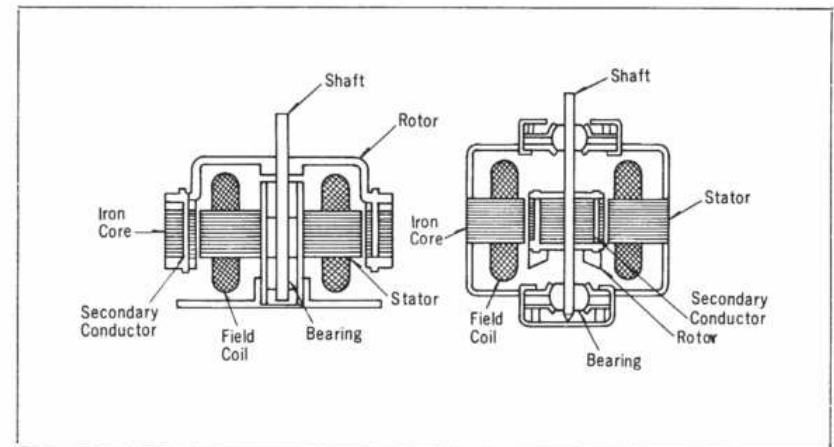
Used for oscillating high frequency (30~100 KHz), for bias current and erasing current.

Oscillation frequency is produced by resonance of oscillator circuits L (inductance) and C (capacitance). If L is changed, oscillation frequency varies.



Therefore, when the Dust Core in the Bobbin of the Oscillation coil is moved, the amount crossing the magnetic flux coil varies. Thus the value of L can be changed.

Outer Rotor Motor



Compared with an ordinary motor which has a Fixed Coil outside and a Rotor inside, the Outer Rotor Motor has the Stator inside and Rotor outside. Both are theoretically the same.

Features:

1. Copper loss is small because the coil end of the Stator Coil is short.
2. Flutter is minimized because inertia of the Rotor is large.
3. Its structure is simple. The bearing is simple, and complicated devices, such as automatic centering, are not required.
4. Cooling effect is large because the Rotor rotates in contact with external air directly.
5. Coiling is easy.

Output

The abbreviated term for the Output of Pre-amplifier and Power Amplifier.

Output Terminals for tape recorders are:

1. Line Output* (Terminal to connect External Amplifier.)
2. Speaker Output (Also called Ext.Sp. The Terminal to connect External Speaker.)
3. Monitor Output (Terminal to monitor with an earphone.)
4. Headphone Output (Terminal for headphones.)

Power output is shown by the following:

- | | |
|--------------------|----------------------|
| 1. Rated Output* | 3. Music Power* |
| 2. Maximum Output* | 4. Peak Music Power* |

The unit is W (watt) or mW.

Voltage output is shown by voltage or dB.

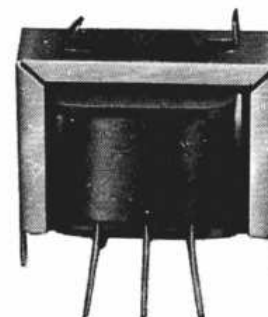
* Refer to the specific terms.

Output Impedance

Impedance of output terminals: EXT. SP., LINE OUT, etc. When an Extension Speaker or other Amplifier is to be connected to this Terminal, it is necessary to match their impedances.

For tape recorders, the EXT. SP. is generally 8Ω , and the LINE OUT is about $1\text{ K}\Omega$.

Output Transformer



Efficiently supplies the signal amplified by the Main Amplifier to the Speaker. It is an Impedance Matching Transformer.

It is so designed that the impedance of the primary coil (on the Main Amplifier side) is high while that of the secondary coil (on the Speaker side) is small.

This is because output impedance of the Main Amplifier is high, while that of the Speaker is low.

However, since the output transformer is inevitably liable to cause deterioration of frequency response, distortion, and transmission loss, the so-called OTL Circuit (which does without the transformer) is often used these days.

Refer to "OTL Amplifier".

OTL Amplifier

OTL stands for Output Transformerless. It refers to a Main Amplifier without an Output Transformer.

The purpose of a transformer is to connect high impedance on the Amplifier side with low impedance on the Speaker side. The transformer can be omitted by:

1. Lowering the output impedance of the Main Amplifier.
2. Increasing the impedance of the Speaker.
3. Both 1. and 2. together.

Features of the OTL Amplifier:

1. Low distortion
2. Good frequency response
3. High transmission efficiency
4. Compactness

The OTL Amplifier is used for PANASONIC Tape Recorders RS-810S, RS-780S, RS-761S, etc. The SEPP (Signal Ended Push Pull) system is employed for their circuits. This lowers the output impedance of the Main Amplifier and, therefore, is most suitable for the OTL Amplifier.

Oxide

Iron oxide.

Very fine powder of iron oxide is used for the magnetic layer of tape.

Pan-A-Track

A system capable of sound-with-sound recording and mixing playback—a feature of Stereo Tape Recorders.

On Channels 1 and 2, different signals are recorded respectively, mixed and played back through one speaker.

This is advantageous in language study and music (song) practice.

It is also convenient when stereo music is to be re-recorded on a monaural tape recorder. Naturally, a set having this feature can also be used as an ordinary stereo tape recorder.

Refer to "Sound-With-sound".

Patch Cord

A cord to connect CH-1 and CH-2 for sound-on-sound recording.

Sound-on-sound recording is sometimes controlled by a switch, and a patch cord is not required.

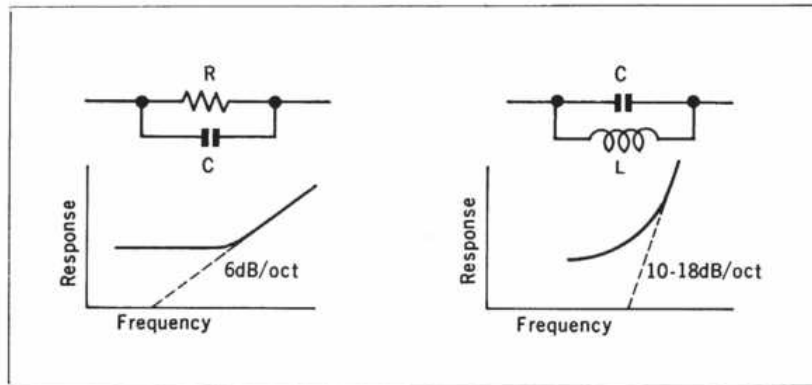
Refer to "Sound on Sound".

A Connection Cord.

Peaking Circuit

The Circuit for providing a frequency response with a peak, and is the Resonance Circuit for L.C. For tape recorders, it is mainly used as an equalizer during recording on high class models.

The Equalizer Circuit, during recording, usually consists of parallel circuits R and C. But it is impossible to obtain characteristic other than 6 db/oct., and it is somewhat insufficient to supplement various losses of the Head.



Therefore, for high class models, more than 6 db/oct is obtained by making use of the resonance characteristics of L.C. so as to improve the overall characteristics.

Refer to "Recording and Playback Equalization".

Peak Music Power

The instantaneous maximum power output without regard to distortion, when a single frequency is applied to the amplifier input. Theoretically, it is twice as much as Music Power.

Refer to "Music Power" and "Power Output".

Permalloy

A material used for the Magnetic Head Core.

It is an alloy of iron containing 78~80% nickel. It has a high permeability (μ_0 : 80,000~100,000) in a weak magnetic field and is essential as the material for the Record/Playback Head Core.

Refer to "Permeability".

Permeability

Corresponds to the conductivity of an electric circuit (reciprocal of inherent resistance). The higher permeability the magnetic material has, the easier the magnetic flux passes through it.

Therefore, materials of high permeability are used for the Transformer Core, Head Core, Dust Core of coil, etc.

1. Permeability (μ) is shown by the following formula.

$$\mu = \mu_0 \mu_s, \text{ where } \mu_0 = \text{permeability in a vacuum}$$

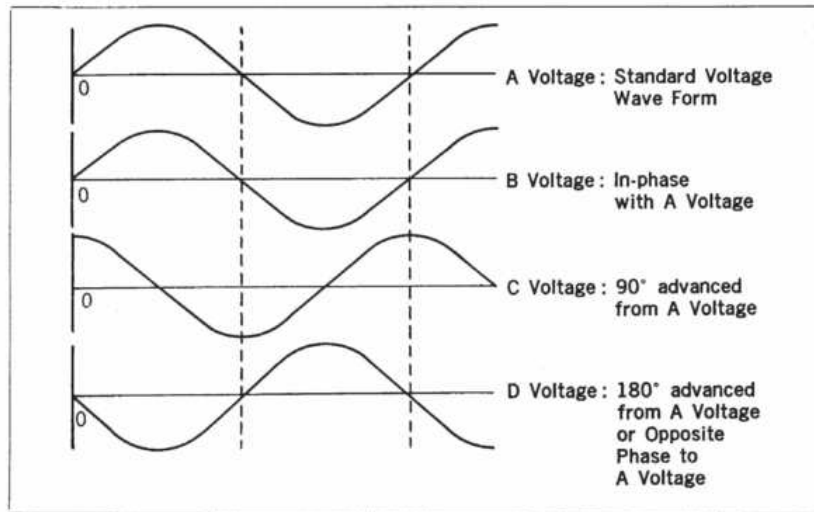
$$\mu_s = \text{specific permeability of the material}$$

2. For non-magnetic material, $\mu_s \cong 1$, and therefore $\mu = \mu_0$.
3. For a highly magnetic material, μ is bigger because μ_s is bigger. The following are the μ_s of the materials used for tape recorders. (max. specific permeability)

MATERIAL	PART	SPECIFIC PERMEABILITY
45% permalloy	Erasing Head Core	more than 200,000
78.5% permalloy	R/P Head Core	more than 800,000
Silicon steel plate	Transformer and Motor Cores	6,000 ~ 10,000
Ferrite	Erasing Head Dust Core	5,000 ~ 6,000

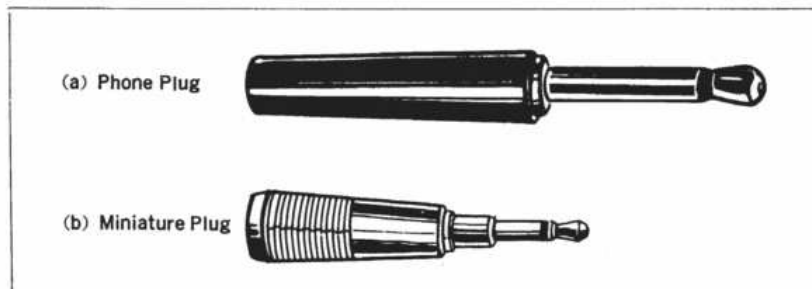
Phase

1. When there are two or more alternating currents of the same frequency, the time relation dependant on voltage fluctuation (or current fluctuation) for each current is termed a Phase. In general, it is represented by the angle (electrical angle) given by reckoning 1 cycle as 360°.



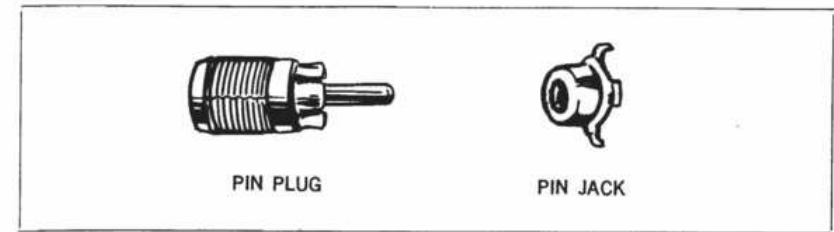
2. In a stereophonic system, unless the polarities (\oplus and \ominus terminals) of both speakers agree with those of the output transformer, the phase will deviate and the stereo effect will be lost. In a high-grade stereo amplifier, a Phase Selector Switch is installed in order to prevent such a phenomenon.

Phone Plug



A larger plug than the miniature plug. Very often used for Microphone Plugs, etc.

Pin Jack



A connection terminal used for connecting the External Amplifier or Tape Recorder for playback or recording.

Plastics

Synthetic resins made mainly from petroleum or coal by chemical reaction.

They have wide applications in place of glass, wood and metal.

They are also used in many parts of tape recorders (see table).

There are many varieties of plastics, each having different features. The general features are:

1. Light in weight and yet often stronger than glass, concrete, wood, etc.
2. Suitable as insulation materials, because of their good insulation of electricity and heat.
3. Do not absorb water, have good chemical resistance and do not rust.
4. They can be made transparent or in any desired color.
5. Because of mass production, their prices fluctuate little. Molding and processing are easy and quick.

On the other hand, maximum usable temperature is low and thermal expansion is large.

Surface hardness is insufficient and they may easily scar.

Because they have excellent electric insulation, an uneven leather-like processing is given to their surface to hide such scars as may occur.

Tape Recorder Parts	Kind of Plastic
Case (Cover)	Polystyrene, ABS, AS (Polypropylene)
Reel Table	Polystyrene
Microphone & Stand	Polystyrene
Tape	Polyester, Acetate Cellulose
Knob	Polystyrene, ABS
Transparent Cover	Acrylic Resin
Leather	Polyvinyl Chloride

Play

Synonym for Playback. Refer to "Playback".

Playback

The general term to indicate the magnetic, electric and mechanical actions to reproduce the original sound from recorded tape.

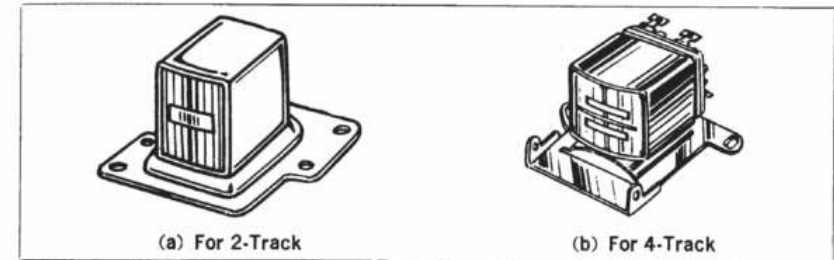
When the recorded tape is forwarded while keeping it in contact with the Playback Head, an inductive electromotive force is produced on the Playback Head corresponding to the residual magnetization on the Tape. This electromotive force is amplified in the Playback Amplifier and led to the Speaker.

As its mechanism, the Capstan and Pressure Roller forward the tape at a constant speed, and the forwarded tape is taken up by the Takeup Reel Table without becoming loose.

Playback Equalization

The characteristics of the Playback Head deteriorate in both the High and Low frequency ranges. In order to compensate, the Low frequency range is increased during playback. For details, refer to "Recording and Playback Equalization".

Playback Head

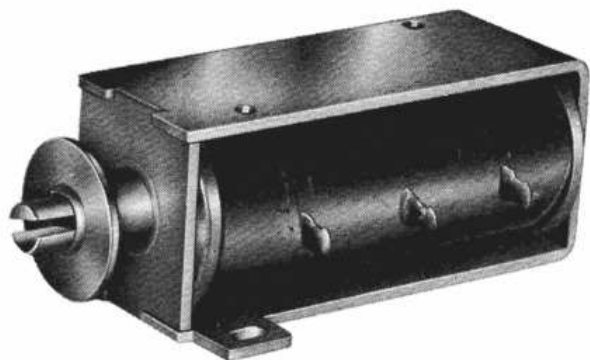


Picks up sound from recorded tape traveling in contact with the Head. Its structure is similar to that of a Recording Head, although from the theoretical standpoint, the Playback Head works as a generator.

Characteristics are:

1. Structure
Permalloy with a high permeability of 78.5% is used for the Head Core and is usually laminated to reduce eddy current losses.
2. Impedance and Output
Many coils are used to provide as high an output as possible from the small residual magnetism of the recorded tape. The Head impedance is usually 2 to 5 K Ω (at 1 KHz) and its output level is approximately 40 to 50 dB (0.01 to 0.03 V).
3. Slit Width
The narrower the width the greater the frequency response. But, sensitivity decreases. Therefore, a compromise is required, resulting in slit widths of 0.08 to 0.20 mil (2 to 5 μ).

Plunger Relay



A piston type electromagnet which has an iron core and attracts the core by magnetization of the coil.

Because of its strong attractive power, it is suitable for the brake mechanism, pressure roller, pressing mechanism, reversing mechanism, etc. of tape recorders.

Polyester Tape

One of the base materials of magnetic tape. Preferably used as the base material for longer recording tape developed recently.

Features:

1. High strength. It does not break easily, and therefore can be made thin. This material is used as the base for PANASONIC's Golden Tape (total thickness 1.5 mil= 38μ) and Golden S Tape (total thickness 1 mil= 28μ).
2. Very resistant to temperature and humidity and, therefore, can be preserved for long periods.

Though it seldom breaks, it may stretch when a heavy load is applied. Care should be taken, therefore, not to apply excessive tension.

Polypropylene

A plastic. Excellent in stiffness, elasticity, tensile strength, surface hardness and, in particular, resistance to bending fatigue. Because it can be used for hinges and at the same time cabinet in one molding, it is used as a cabinet material for tape recorders (specially for the Upper Cover with Hinges, Covers for Accessories, etc.).

Features:

1. It is milky white translucent, and quite similar to polyethylene. Its specific gravity is the lowest of all plastic. Printing and bonding on it are difficult.
2. Its frequency response and voltage resistance are particularly excellent. Since it does not absorb moisture, it shows no deterioration in electric properties caused by humidity.
3. It has good heat resistance compared with other thermoplastics and can stand high temperature up to ca. 150°C . However, depending on its structure, it may burn (although recently an improved grade with fire retardant properties, based on asbestos, etc. has been developed).

Post Emphasis

Compensation to increase the Low Frequency range during playback. Refer to "Recording and Playback Equalization".

Power Amplifier

Produces audio power to drive Speaker and is itself driven by the Pre-amplifier section. An input of approximately one volt can produce power outputs of from several watts to hundreds of watts.

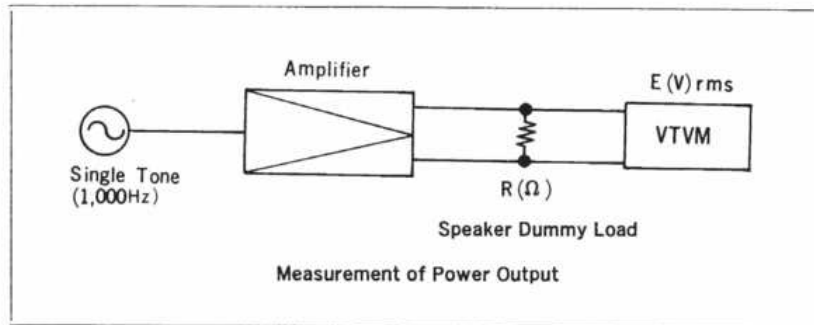
It is also called Main Amplifier or Base Amplifier.

The requirements of a Power Amplifier are:

1. Produce undistorted even output of the low and high frequency ranges.
2. Produce sufficient power output.
3. Contain little hum and noise.
4. Be stable. It should not oscillate nor vary in characteristics with temperature changes.
5. Must have adequate damping factor.

Refer to "Push-pull Amplifier" and "Single Ended Push-pull Amplifier".

Power Output



The electrical, not acoustic output of an Amplifier usually measured with a 1 KHz input signal at a predetermined percentage of distortion.

Power output can be calculated as follows:

$$P = \frac{E^2}{R}$$

Where: P=Power (watts)
E=Voltage (volts)
R=Output impedance (Ω)

There are four common methods of expressing Power Output,

1. Undistorted Power Output
2. Maximum Power Output
3. Music Power Output
4. Peak Music Power (Rated Output)

Refer to the specific terms for details.

Power Source

Portable tape recorders are either BATTERY type or AC/BATTERY type (Dual Power Matic), while AC is used for tape recorders other than portable ones.

The Power Source Circuit for PANASONIC Tape Recorders is explained below.

1. Power Source Voltage Selection:

Since the Power Source Voltage varies from one country to another, it is necessary to adjust the tape recorder for the specific voltage.

The Power Source Voltage Selector Switch is installed for this purpose.

For Popular Models AC or AC/BATTERY Setting
2 choices, viz., 110 V or 220 V

For High Class Models (7" tape recorder or larger)

6 choices, viz., 100 V, 115 V, 125 V, 200 V, 230 V or 250 V

2. Variation of Power Source Voltage:

It is preferable for the Power Source Voltage to remain standard, but it may vary according to the power situation in each region. PANASONIC Tape Recorders are designed to work even if the voltage fluctuates by $\pm 10\%$ of the voltage setting. For instance, it is guaranteed that a tape recorder set at 220 V will function in the range of 198 V~242 V.

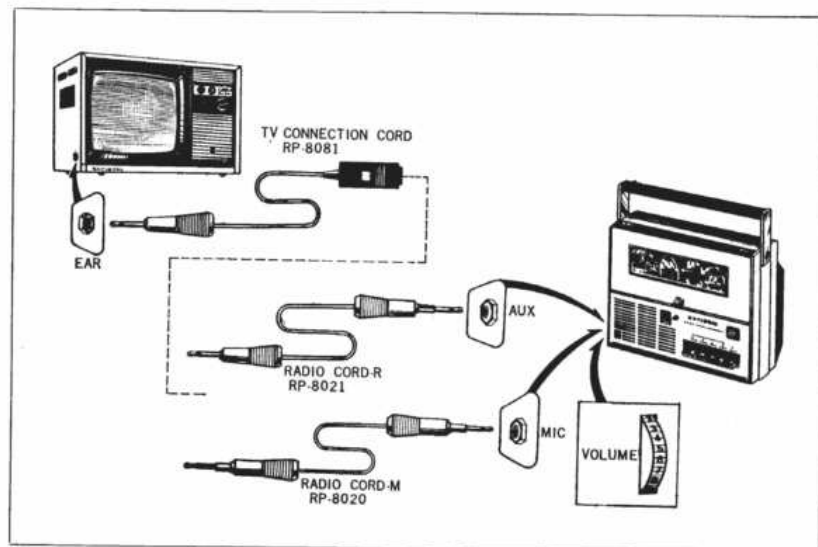
3. Correction of Power Source Frequency and Tape Speed:
Refer to "Cycle Change".

4. Humming:

Since the Amplifier of a tape recorder is a High Gain Hi-Fi Amplifier and the Playback Amplifier boosts the low frequency range, hum is liable to occur. In order that a good S/N ratio be obtained, a Filter Circuit (which is comparable to a high class amplifier) using a large capacity Capacitor (or many Capacitors) is used after rectification. The Short Ring in the Power Transformer is also used for this purpose.

P

Power Transformerless



Originally developed to make tape recorders lighter in weight but not used at present for the following reasons:

1. Depending upon the polarity of the AC line, leakage may occur and cause electric shock.
2. In some instances, hum and other noises increase.

However, it is often used for AC radio and television. This system does not employ a power transformer, and the heaters of vacuum tubes are all connected in series.

Therefore, it is so arranged that the total heater voltage becomes equal to the power source voltage.

When recording is made by a tape recorder from a power transformerless radio or TV, Radio Cord M (RP-8020), Radio Cord R (RP-8021) and TV Connection Cord (RP-8081) are used together.

P

Pre-Amplifier

Used for applying the voltage required for Power Amplifier by amplifying the output from the signal source without causing any distortion or noise.

The signal source might be the microphone, playback head, pick-up, radio or TV broadcasting tuner, etc. Their output levels differ from each another and are, moreover, small. In addition, their frequency response is not very good.

Therefore, it is of no use to supply these outputs to the Power Amplifier directly. It is necessary to supplement and improve each signal.

In addition, volume- and tone-control circuits, equalizer circuit, and an amplifier to connect to another amplifier, become necessary for the Pre-amplifier depending upon the way of use.

Pre-Emphasis

Compensation of the high frequency portion already present at the time of recording.

Noises inherent in tape are distributed mostly in the relatively high frequency range, and it is important to compensate the high frequency range when recording to maintain good S/N ratio.

Pre-Recorded Tape



Tape on which a recording has already been made commercially, especially music tapes by famous artists.

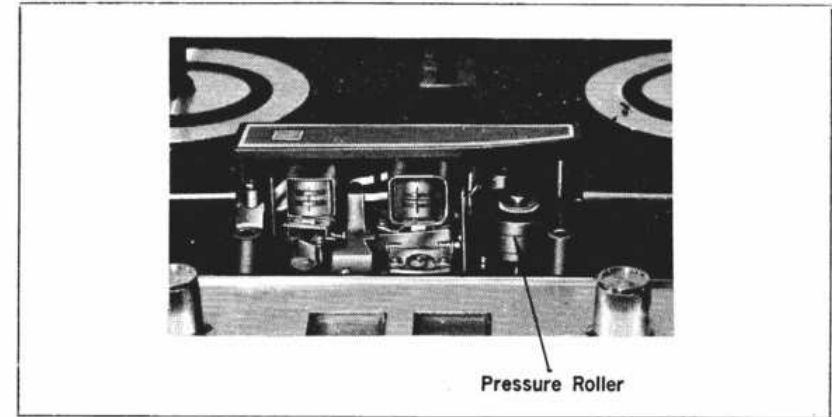
Pre-Scoring

Chiefly used for songs or dances of musical movies, etc. It is the first of 2 stages, sound recording prior to filming of the action.

Presence

The effect, created during tape playback, as if one were listening to music in a Concert Hall. For this effect, the fidelity to original sound must be good, and the sense of direction and depth are needed. A true feeling of Presence is only possible with stereo.

Pressure Roller



A Rubber Roller which rotates while being pressed against the Capstan in order to make the tape run at a right speed without slipping between the capstan and the tape. It is also called a Pinch Roller.

The width of the Pressure Roller is usually twice that of the tape.

When the width is too small, slipping may take place to prevent the tape from being sent smoothly. When it is too wide, parallelism may deviate to cause one-side elongation of the tape. Pressure of the Pressure Roller varies for each set and cannot be generalized. It ranges from ca. 300 g for portable tape recorders to ca. 2 Kg for stereo tape recorders.

Pressure Pad

Synonym for Tape Pad. Refer to "Tape Pad".

Public Address System

Refer to "Sound Monitor".

Pulley

Each tape recorder uses the following pulleys, which are located respectively between the main parts to transmit motor torque.

- | | | |
|-------------------|------------|--------------------------------------|
| 1. Motor Pulley | (Location) | Motor ↔ Idler Pulley |
| 2. Idler Pulley | | Motor Pulley ↔ Flywheel |
| 3. Rewind Pulley | | Motor Pulley ↔ Reel Table |
| 4. F.F. Pulley | | Motor Pulley ↔ Reel Table |
| 5. Guide Pulley | | Tape |
| 6. Tension Pulley | | Tape |
| 7. Reel Pulley | | Idler Pulley ↔ Reel Table
or Belt |

Push Button Operation



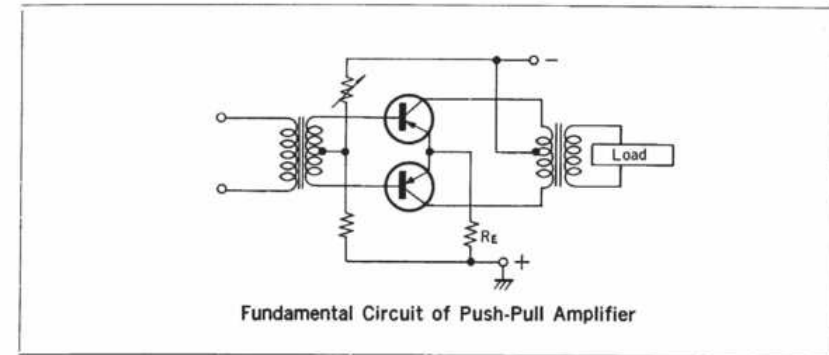
A system to change by push-button the operations of recording, playback, stop, rewinding, etc. Both the Mechanical type and the Electric type serve the same purpose.

Features :

1. Operation is simple.
2. Change of operation can be effected instantaneously.
3. Long life and less trouble.

For a Push-Button of electric type with relay, operation is very soft and light.

Push-Pull Amplifier



A system in which two vacuum tubes or two transistors (4 for stereo) are used for output amplification of the Main Amplifier.

Currently, the push-pull system is used for most Tape Recorder Amplifiers, especially Transistor Type Amplifiers.

The features of the push-pull system compared with the single system are:

1. The low frequency range characteristic is good even if a compact output transformer core is used.
2. Because even-number higher harmonic frequency is offset at the transformer, output increases without distortion.
3. Because movements of class AB or class B are possible, output per unit increases to improve the efficiency.
4. Ripple at the power source is offset by the output transformer and does not appear in the power output.
5. The power source voltage is not influenced by the amplifier. In addition, a decoupling circuit is not required in the former stage.

PVC (Polyvinyl Chloride)

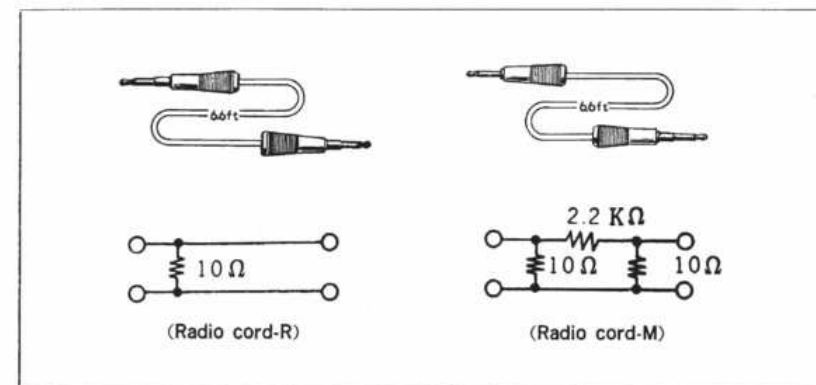
One of the base materials for Magnetic Tape. It has high mechanical strength and is currently used as the base material for Extra Play Tape or Double Play Tape.

Quarter Track

The same as Four Tracks. Refer to "Four Tracks".

Q

Radio Cord



The connection cord used for recording from radio, TV or another tape recorder. It is, of course, possible to make such a recording by use of a microphone, but this method is accompanied by the following drawbacks:

1. Sounds in the surrounding area are also recorded at the same time and become noises.
2. The sound may deteriorate to some extent because it is recorded through the microphone.

Therefore, input is given electrically by use of a connection cord. There are two kinds of cords, viz., Radio Cord R and Radio Cord M.

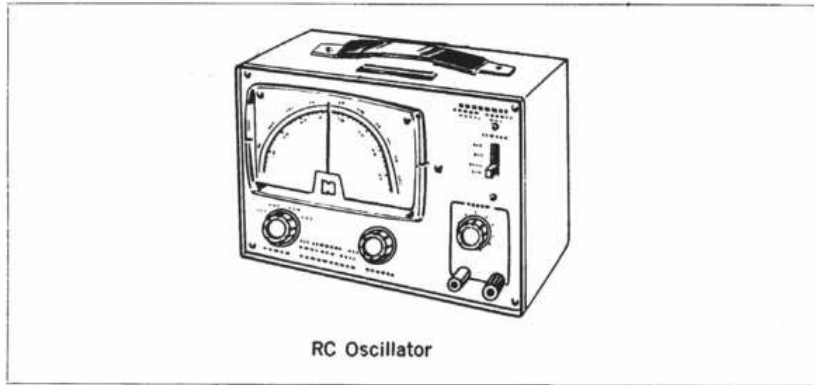
The former is to connect the AUX or Radio Jack of the recording tape recorder to the Earphone Terminal of the radio, TV or other tape recorder, while the latter is to connect the MIC Terminal of the recording tape recorder to them.

Rated Output

Synonym for Undistorted Power Output. Refer to "Undistorted Power Output".

R

RC Oscillator



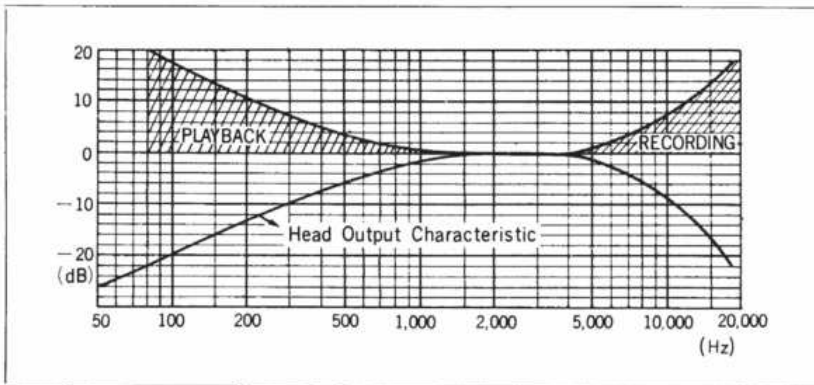
RC Oscillator

R

A low frequency oscillator used for measuring frequency response of Amplifiers and for testing Speakers, etc. Its Circuit consists of Resistor, Capacitor and Vacuum Tube.

Wien Bridge type Circuit and Sartzter type Circuit are mostly used in Variable Frequency Oscillators.

Recording and Playback Equalization



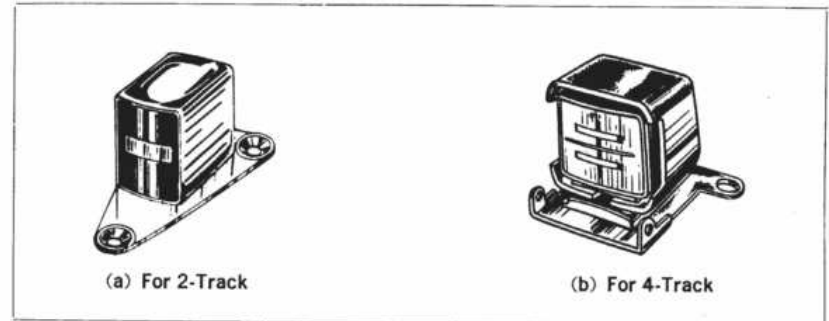
The Head characteristics produce less volume at low frequency and high frequency ranges as shown in the figure. In order to produce a flat output, compensation is provided in the recording and playback amplifiers. This is called Recording and Playback Equalization. The high frequency range is compensated at the time of recording and the low frequency range at the time of playback.

Recording Equalization

Refer to "Recording and Playback Equalization" and "Equalization Amplifier".

R

Recording Head



The Recording Head is a kind of electromagnet. It changes superimposed current of bias and signal into strong or weak magnetism so that the recording is made faithfully on the tape.

For a home use ordinary tape recorder, the Recording Head serves at the same time as the Playback Head. Therefore, its impedance is as high as 2~4 KΩ. However, for the Head of a tape recorder exclusively used for professional purposes, the impedance is as low as 100Ω or thereabout.

Recording Monitor

Used for actually monitoring the sound to check if the recording is being made normally, without relying on the level indicator only.

There are two methods, viz., Source Monitor and Tape Monitor.

1. Source monitor

The signal which has not reached the Recording Head yet, namely the output of the Recording Amplifier, is monitored. PANASONIC's "Sound Monitor System" is an example of this source monitor. This system is, in general, used for 2-head type tape recorders.

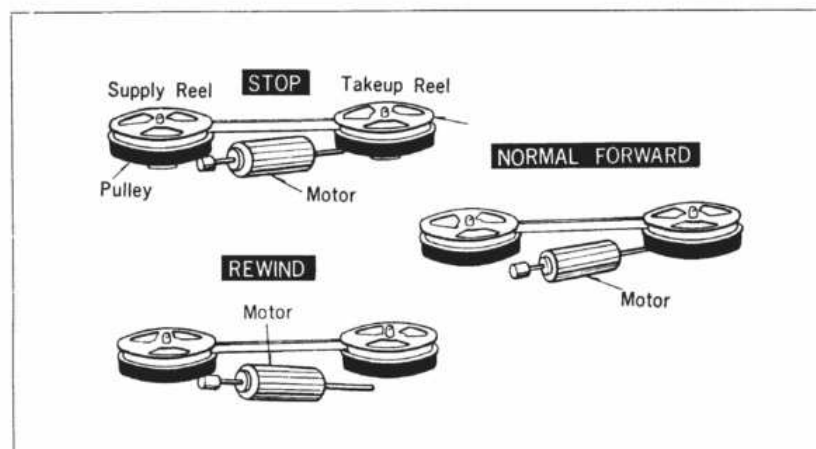
2. Tape monitor

This system is used for 3-head type tape recorders.

The recorded sound is played back immediately by the playback head and monitored.

With this system, echo recording is also possible by utilizing playback sound.

Reel Drive System



One of the tape driving mechanisms for recording and playback.

This system uses neither Capstan nor Pressure Roller, but transmits motor torque directly to the Reel Table, and the tape is taken up onto the Take-up Reel by its rotation.

The Capstan Drive System forwards tape at a constant speed, while with this Reel Drive System, tape speed varies continuously. Therefore, there is no interchangeability between the two systems. However, the latter is often used for memo purposes because it is compact and low in price.

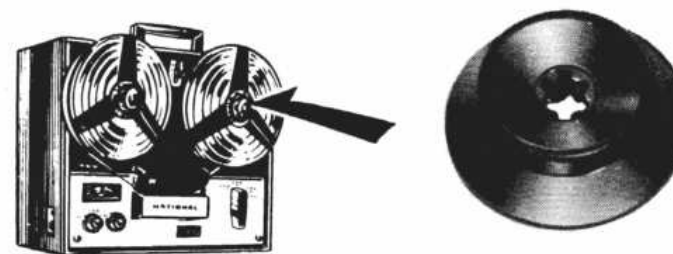
Because motor rotation is constant, the rpm (N) of the Reel Table is also constant. But because the diameter of the takeup tape (r) changes continuously, the tape speed S is not fixed.

If tape speed is represented by S :

$$S_1 = 2\pi r_1 N \quad \text{at the beginning of take-up}$$

$$S_2 = 2\pi r_2 N \quad \text{at the end of take-up}$$

Reel Holder



For vertical type tape recorders and high class tape recorders whose rewinding and fast forwarding are done at high speed, a Rubber Holder is used for holding the Reel to the Reel Table lest the Reel should move off or vibrate.

Reel-to-Reel System Tape Recorder

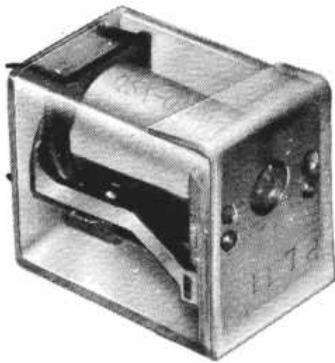


Records, plays back or erases while the Tape is being forwarded from the Supply Reel and taken up by the Take-up Reel, and is most commonly used at present.

The opposite is the Endless System recently used for 8-Track Cartridge and 4-Track Cartridge players.

The 2- or 4-Track Compact Cassette of Philip's type is a Reel-to-Reel system Cassette.

Relay

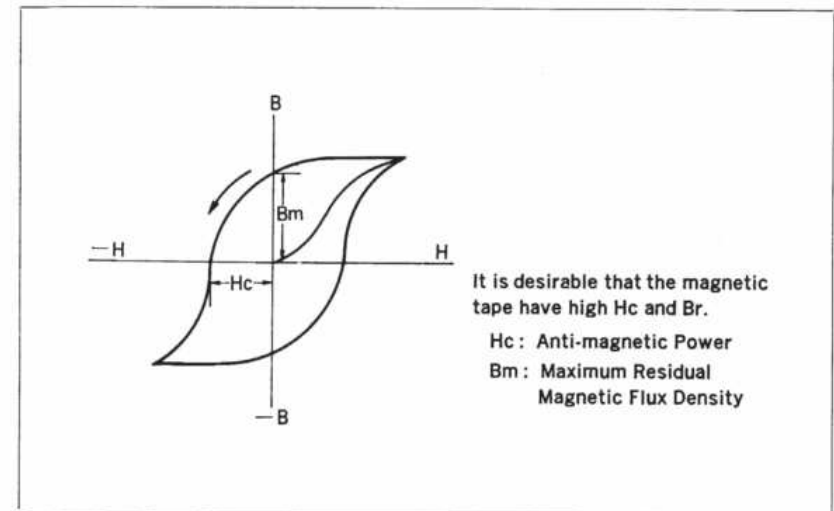


Used for making and breaking of electrical circuits. Operates on the magnetic effect, in that an electrical current flowing through the coil produces a magnetic field to move the Relay contacts.

Tape Recorders usually use non-polar electro-mechanical relays.

In PANASONIC Tape Recorders with Dual Power Matic, a relay switches between AC power and Battery power.

Reluctivity



The amount of reversed magnetic field required to return the residual magnetism of the magnetic material to zero, and is represented by H_c .

The higher the value of H_c , the more difficult the erasure of the residual magnetism.

However, the higher the value of H_c , the better the results of recording tape.

Remote Control



A device to record playback and stop a tape recorder at a distance from the set.

Most tape recorders of the electromagnetic push-button type can be operated by remote control, while many portable types are equipped with the Power On-Off Switch at the microphone to start and stop the tape.

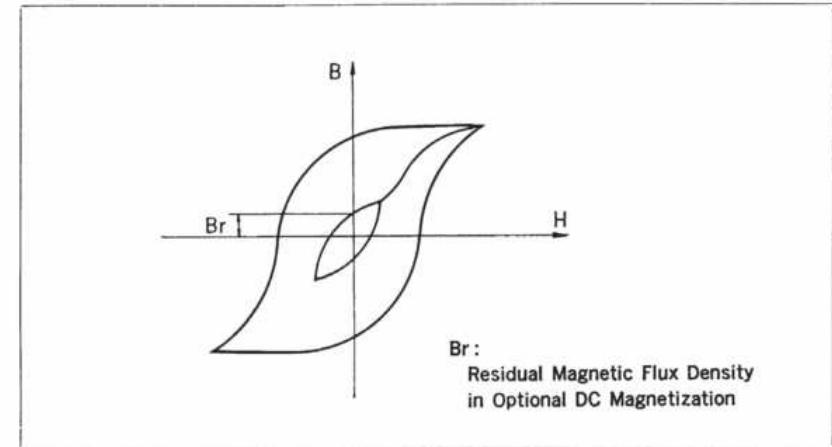
Reproduce

Synonym of "Playback".

Re-recording

When the tape is edited, or when the tone quality or volume of sound recorded on the tape is uneven, it is necessary to playback the recorded tape and adjust the volume and tone quality to an equal level for the complete length of the tape. This recording after the adjustment is termed Re-recording.

Residual Magnetism



When a magnetizable material is magnetized, some magnetism in it remains even when the magnetic field is removed. This is called Residual Magnetism and the amount of magnetic flux per unit area is called Residual Magnetism Density.

RETMA

Radio Electronics Television Manufacturers EIA Association, recently known simply as EIA.

Reverberation

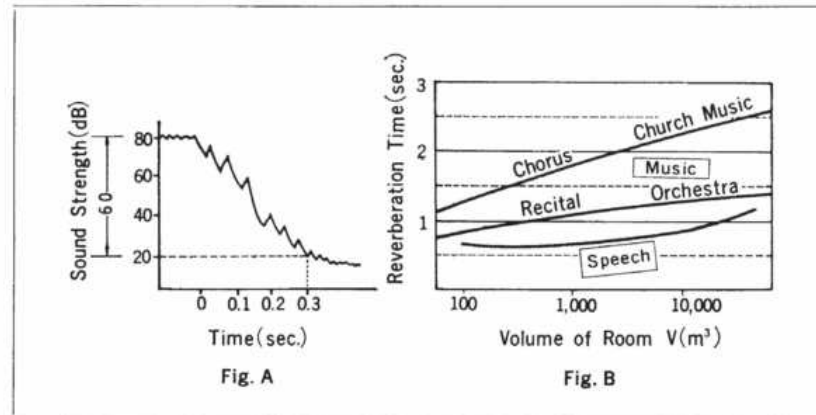
When the sound being produced in a room is stopped suddenly, the sound wave energy does not disappear immediately but reduces gradually while reflecting from the ceiling, floor, surrounding walls, etc.

The energy which remains after the original sound is made is called Reverberation.

Reverberation gives "depth" and "profoundness" to the sound. However, if it becomes excessive, its clearness is sacrificed.

Refer to "Reverberation Time".

Reverberation Time

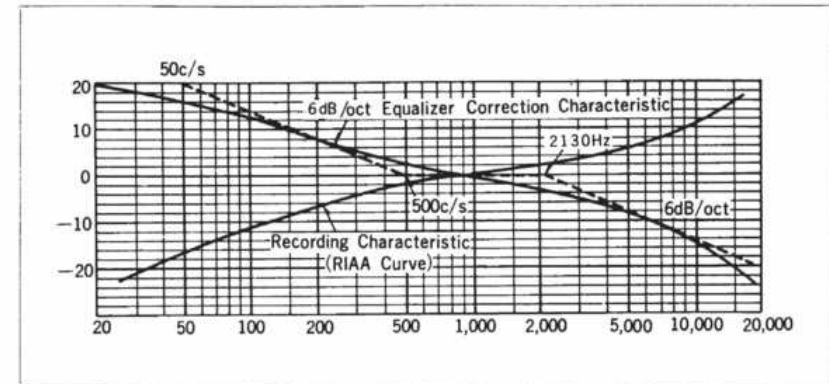


When sound is made in a room of a certain dimension, 60th echo and reverberation are heard. An echo enters the ears after one "bounce" off of a wall or similar object, separately from sound which comes out directly from the source, while reverberation is sound reflected by the walls, ceiling and floor repeatedly, becoming smaller and smaller.

Reverberation Time is the time elapse from when the sound stops to when the amount of sound remaining in the room decreases to -60 dB of the original level (1/1,000,000). Fig. A shows an example when the reverberation time is 0.3 sec.

Echo and reverberation are essential for hearing music or speech. But too much echo and reverberation are not desirable. The optimum reverberation time is shown in Fig. B.

RIAA



Record Industry Association of America.

LP disc recording uses constant amplitude recording. The RIAA provides the standard for this recording. The RIAA Curve is used for disc recording in all countries of the world.

When a recording is made by a tape recorder, it is not advisable to supply the output of a magnetic cartridge directly as input, because the high frequency range is then emphasized too much.

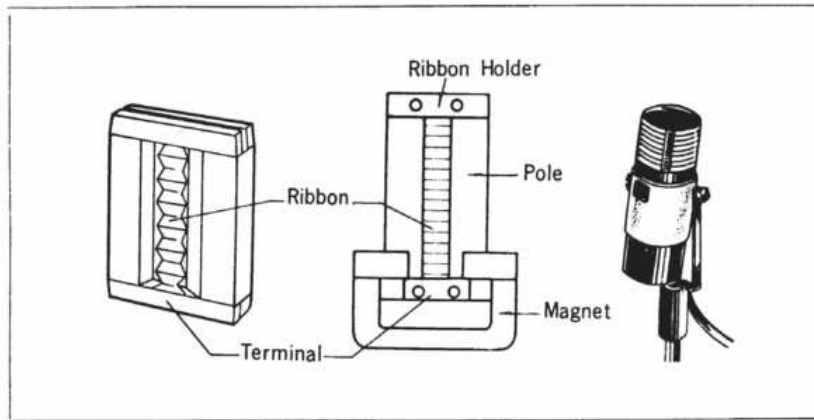
It is necessary to use the pre-amplifier which compensates the output of the magnetic pickup.

No such problem arises with crystal or ceramic pickups.

Ribbon Microphone

Also called a Velocity Microphone, it is a microphone having dual directional characteristics (front and back).

A Ribbon (light and thin aluminum foil 2~4 mm wide and 40~50 mm long, with pleats) is stretched loosely between the Magnetic poles.



When sound crosses the Ribbon, it vibrates due to the difference in pressure between the sound at the front surface of the ribbon and that at the rear and, on the same principles as a generator, voltage is produced. However, since it does not vibrate by sound pressure from the sides, it has dual directional characteristics.

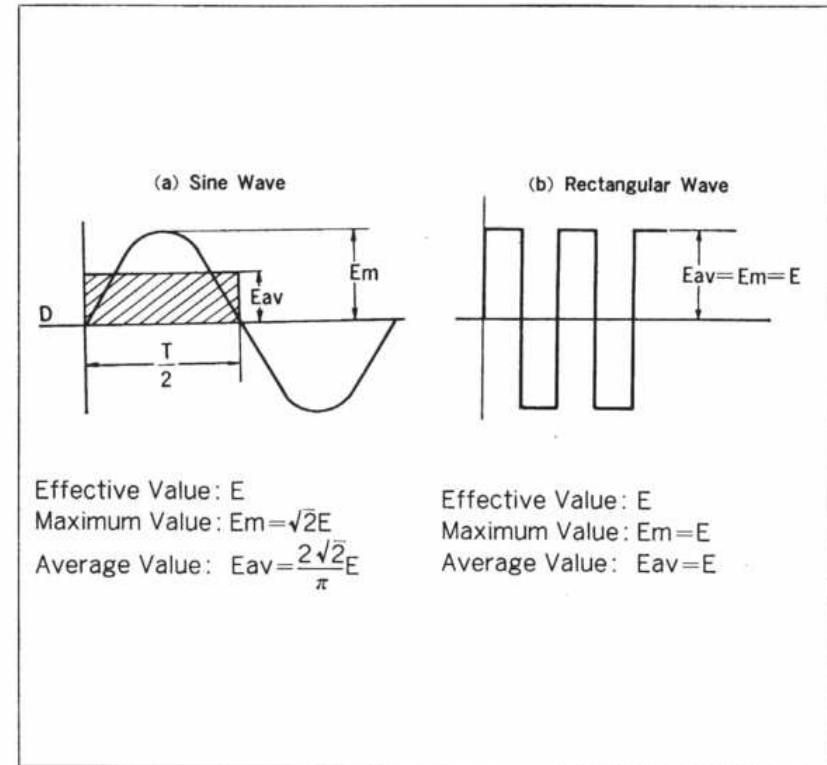
Because this Microphone is stable and directional, it prevents howling. But it cannot be used outdoors or where wind blows. Since its sensitivity is low, the Amplifier Gain must be raised. In addition, it is not resistant to vibration.

R.M.S. Value

AC voltage or current change in value and direction over a period of time. A method of indicating the effective value of this AC is stated in terms of the R.M.S. Value. R.M.S. Value is a more accurate indication than maximum or average values.

$$\text{R.M.S. Value} = \sqrt{\text{average of (instantaneous value)}^2}$$

The figure indicates the relationships between R.M.S maximum, and average values of a sine wave.



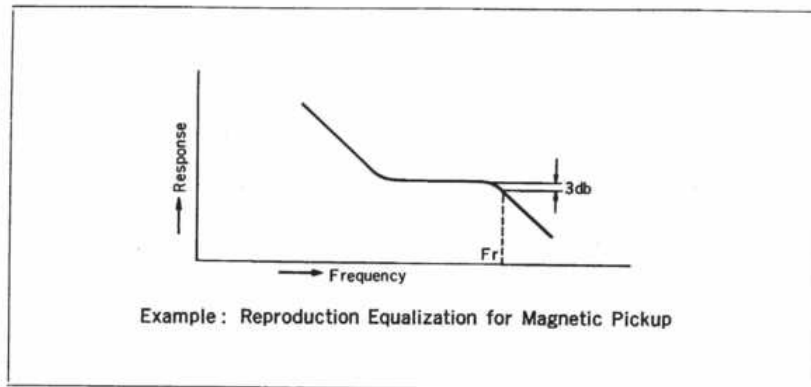
For example, if the power source voltage R.M.S. value is 100 V (AC), the maximum and average voltages are shown by the following relationships.

$$\text{Maximum Value} = E_m = \sqrt{2} \times 100 = 141.4 \text{ V}$$

$$\text{Average Value} = E_{av} = \frac{2 \times \sqrt{2} \times 100}{\pi} = 89.8 \text{ V}$$

Since Wow and Flutter of a Tape Recorder are due to continuous fluctuations of frequency, the fluctuations can be expressed in an R.M.S. Value.

Roll Off Frequency



R

When an LP disc record is reproduced by a magnetic pickup, it is necessary to use an amplifier having an equivalent circuit in order to make the output flat.

When doing so, frequency (F_r) begins working to lower the high frequency range. This frequency is called Roll Off Frequency.

R.P.M (Revolutions Per Minute)

The unit of rotational speed of a motor, representing the number of revolutions per minute. When the number of rotations is shown by N , the following formula is obtained.

$$N = \frac{120f}{P} \text{ r.p.m.}$$

Where, f : frequency at power source

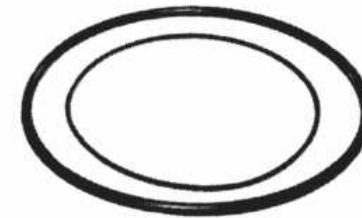
P : number of poles

For instance, in the case of a 2-pole motor,

$$\text{for } 50 \text{ c/s} \quad N = \frac{120 \times 50}{2} = 3,000 \text{ r.p.m.}$$

$$\text{for } 60 \text{ c/s} \quad N = \frac{120 \times 60}{2} = 3,600 \text{ r.p.m.}$$

Rubber Belt



Located at the rotary parts of tape recorder mechanisms. The Drive Belt conveys motor torque to the capstan to drive the tape. The Take-up Belt or Rewind Belt turns the reel table to take up the tape. The Counter Belt drives the tape counter. Each thus plays an important role to convey torque of the motor.

Belts of PANASONIC tape recorders are silicon rubber or neoprene rubber. Features of popular rubbers are:

1. Neoprene Rubber (CR)

It is generally black in color, and superior in anti-flex, elongation, strength and anti-ozone properties. Somewhat inferior in abrasion resistance. Lowest temperature range for use is $-5^{\circ}\sim-10^{\circ}\text{C}$.

2. Silicone Rubber (SIR)

It is specially excellent in temperature resistance, anti-flex property, etc. However, its drawback is that it has very low tearing resistance and if nicked, soon breaks.

3. Natural Rubber (NR)

It has overall rubber characteristics, but is inferior in abrasion resistance.

4. Nitrile Rubber (NBR)

High abrasion resistance and oil resistance. However, its molecules become crystallized at low temperature and cracking breakage may take place.

R

5. Polybutadiene Rubber (BR)

It has overall rubber properties, and is especially excellent in resistance to flex and abrasion. But its molecules are damaged by ozone which causes cracks. When torn, it breaks, a fatal defect for a belt.

6. Urethane Rubber (UR)

Although high in abrasion resistance and flex resistance, of its quality varies considerably. It cannot be used at temperatures lower than -10°C .

(The above are characteristics of various rubber belts and do not necessarily apply to the rubbers proper.)

R

SAA

Standard Association of Australia, or the Safety Standard enforced in Australia. Emphasis is especially placed on the human safety.

It is said that an electric shock accident in Australia is very rare due to the throughgoing standards in force.

Safety Standards

S

Specifications set forth to prevent occurrence of such accidents as fire, electric shock, etc. in use of domestic electric appliances.

A Safety Standard is enforced in each country and applied to the production, sale and import of electric appliances. In some countries, the sale of electric appliances is not permitted unless they meet the standard.

Safety Standard examples:

BSI Standard (England)	SAA Standard (Australia)
CEE Standard (Europe)	SABS Standard (Union of South Africa)
CSA Standard (Canada)	SEMKO Standard (Sweden)
DEMKO Standard (Denmark)	SEV Standard (Switzerland)
FINKO Standard (Finland)	UL Standard (U.S.A.)
KEMA Standard (Netherlands)	VDE Standard (Germany)
NEMKO Standard (Norway)	

Saturation Erasing

A method of DC erasing. The tape is magnetized to the saturation point. This is called Saturation Erasing.

It is accomplished by applying a strong DC to the Erase Head or by running the tape while one pole of a permanent magnet is in contact with the tape.

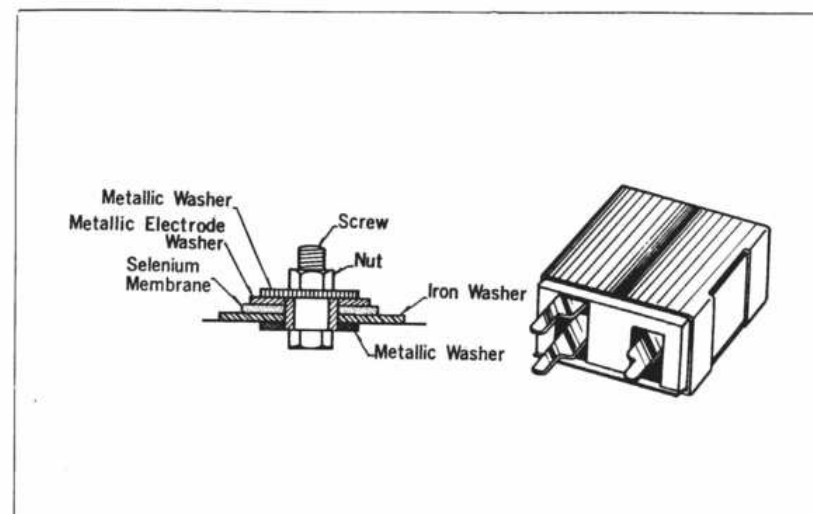
The method is simple and inexpensive, but it results in conspicuous erasing noise.

Self Demagnetization

When N poles and S poles of a long magnetizable material (such as magnet tape) are partially magnetized successively in that long direction, smaller signals are weakened by preceding or following signals or by larger signals. This phenomenon is called Self Demagnetization. It takes place conspicuously when:

1. Magnetic field is strong.
2. Both poles are close to each other.
3. Hc of magnetizable material is small.
4. Magnetizable material is thick.
5. Frequency is high.

Selenium Rectifier

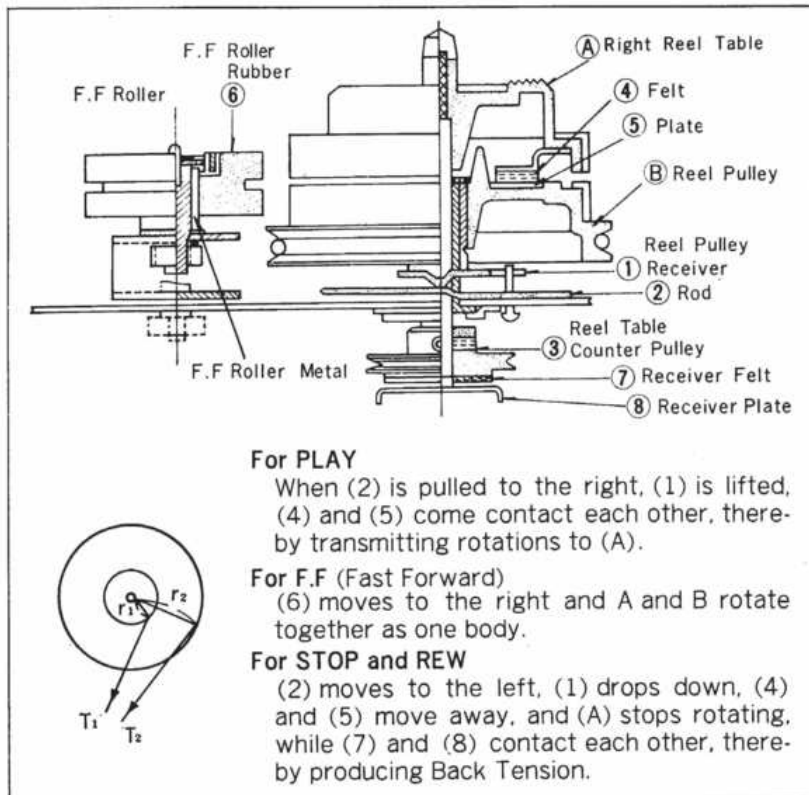


One of the parts to convert AC into DC. Its structure is shown in the above figure. Rectification takes place between the selenium layer and the surface electrode.

Features:

1. Current density in normal direction: $2 \times 10^3 \text{ A/m}^2$
2. Voltage drop: 1.0 V
3. Limit frequency: 1,000 Hz
4. Maximum temperature: 80°C
5. Reversed direction current: a little higher than that of silicon rectifier.
6. Self curing capacity:
When insulation is broken due to high voltage applied in the opposite direction, selenium is heated and molten by the breaking current. When it resolidifies, it again becomes an insulation material, and does not permit the current to pass. Thus breakage is cured.

Self Weight Controlled Reel System



The forward take-up tension (recording and playback) and back tension are kept constant regardless of the diameter of take-up tape, by utilizing the Reel Table, Reel and Tape weights. This is called Self Weight controlled Reel System.

Its function can be explained by the Self Weight Controlled Takeup-Reel Table as an example.

The Reel Table has a metal plate attached to the Reel Pulley, and a Felt to the Reel table so that the pressure will vary according to the weight of the Tape.

Suppose that the rotary power of the Reel Table is F. F is in proportion to the abrasion coefficient (μ) between the Reel Table and the Reel Pulley, and to the weight (M) of the Reel Table including that of the tape.

$$F = M \times \mu \dots\dots\dots 1$$

In addition, there is a relation

$$F = r \times T \dots\dots\dots 2$$

Where, T = Take-up tension

r = Tape diameter

At the beginning of take-up, the take-up tape diameter, reel weight and reel diameter are all at minimum.

$$M_1 \times \mu = r_1 \times T_1 \dots\dots\dots 3$$

• They become maximum at the end of take-up.

$$M_2 \times \mu = r_2 \times T_2 \dots\dots\dots 4$$

• Therefore, from formula 3, the take-up tension at the beginning of T_1 is obtained as follows:

$$T_1 = \frac{M_1}{r_1} \times \mu \dots\dots\dots 5$$

• Likewise, from formula 4, the take-up tension at the end of T_2 is obtained as follows:

$$T_2 = \frac{M_2}{r_2} \times \mu \dots\dots\dots 6$$

• Therefore, in consideration of $M_1 < M_2$ and $r_1 < r_2$,

$$T_1 \doteq T_2 \dots\dots\dots 7$$

The take-up tension is almost constant having nothing to do with the taken-up tape diameter.

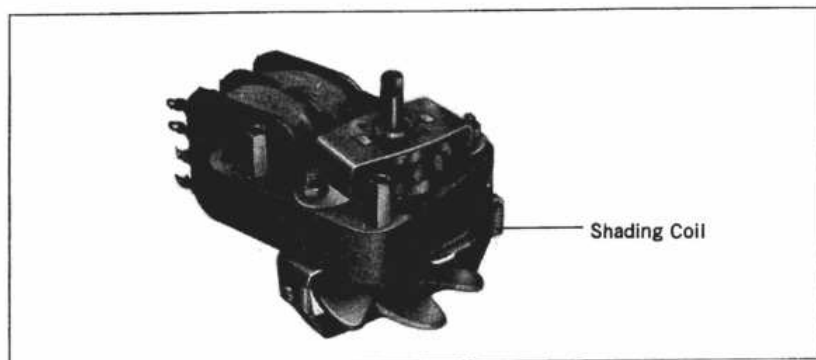
This mechanism is employed for horizontal type tape recorders, and not for vertical type.

SEMKO

Svenska Elektriska Materielkontrollan Stalten (Swedish Safety Standard)

Most electric appliances (except for industrial use and the like) must be subjected to inspection.

Shading Coil Induction Motor

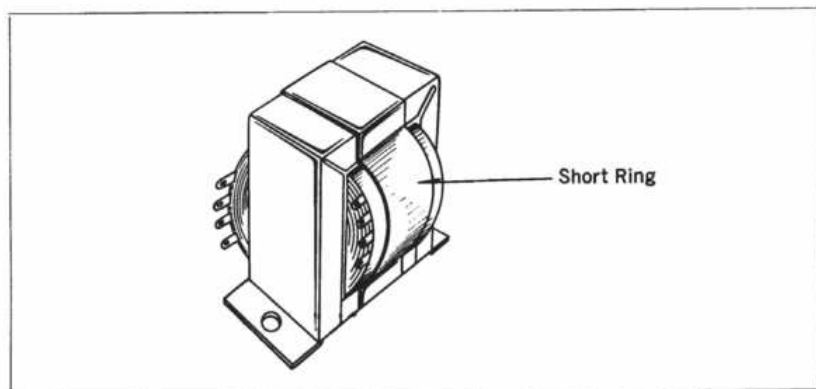


A type of Induction Motor using a Shading Coil for motor starting.

This motor is inexpensive and used in many popular Tape Recorders. The motor windings also act as a power transformer.

The Shading Coil is a Short Ring installed on the Magnetic Pole. A phase difference occurs between this Short Ring and the Magnetic flux of the main magnetic pole, producing the force required to start the Motor.

Short Ring



Leakage of magnetic flux always takes place from the Power Transformer and Motor. If the Head or Input Transformer picks it up, hum increases and S/N ratio worsens.

In order to minimize the leakage of magnetic flux, a Copper Band is wound around the coil core of the Power Transformer Motor. This Copper Belt is called a "Short Ring".

Signal to Noise Ratio (S/N)

A factor used to indicate Amplifier quality. It shows the relationship of signal strength to noise strength and is expressed in dB.

The higher the S/N, the better the characteristics of the Amplifier. In general, it may be 30~40 dB in normal use.

Silicon Diode



The Silicon Diode is a kind of rectifier (to change AC into DC), in which a silicon semiconductor is used as a rectifying element.

The Silicon Diode is usually used as the rectifier for PANASONIC Tape Recorders.

Features:

1. It can be used even at high ambient temperature.
(Element limit temperature: 150°C)
2. Its voltage resistance is several hundred volts.
3. It displays high efficiency in rectification.

Silicone Grease

Silicone grease consists of silicone oil and soap. It is a good lubricant since its characteristics, such as viscosity, show little fluctuation over a wide temperature range.

It is widely used as lubricant for the sections between mechanism chassis and rod, axis and bearing of PANASONIC Tape Recorders.

It is milky white in color.

Silicone Rubber

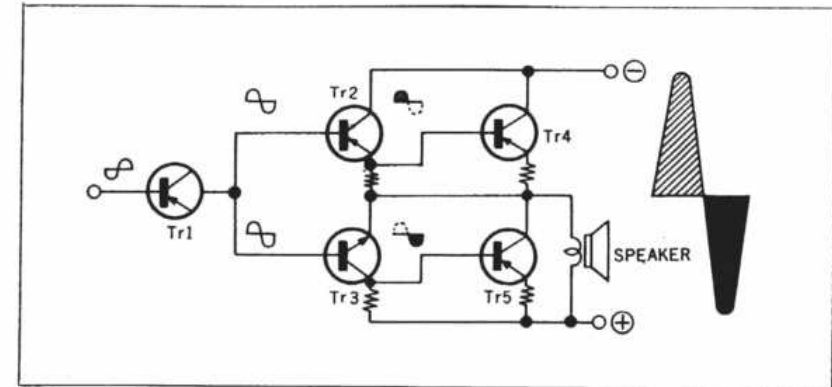
Unlike common rubber (-C-C-), the main chain of silicone elastomer rubber is made of siloxysan bond (-Si-O-Si).

This bond constitutes the fundamental molecular structure of rock-crystal or quartz. Since its bonding energy is stronger than that of (-C-C-), it is superior in heat resistance.

Features:

1. Physical properties vary little over a wide temperature range (-60°C~250°C). In particular, it does not lose its elasticity at low temperature.
2. Has excellent weather fastness and has considerable oil resistance.
3. Electrical properties do not change greatly in a wide frequency range.

For tape recorders, it is mainly used as the material of the belt which connects the motor pulley with the flywheel.

Single Ended Push-Pull (SEPP) System

The figure shows an SEPP and an OTL circuit. It functions as follows:

The output from Tr 1 is supplied in the same phase, to PNP transistor Tr2 and NPN transistor Tr3. Each transistor amplifies, but due to the circuit characteristics provides opposite phase signals. The outputs are amplified by Tr4 and Tr5 through the series emitter follower circuit. Tr4 and Tr5 are in series to the DC supply circuit, but the two AC signal outputs are superimposed and provide class B push-pull action.

Features

1. Frequency response in the low frequency range is excellent through use of the series emitter follower circuit. Feedback greatly improves the response.
2. Low loss, and large outputs can be obtained.
3. As for any push-pull circuit, even-order harmonics are cancelled reducing distortion. Very little switching distortion takes place.

Single Track

Also called a Full Track System. Recording is made on the full width of tape $\frac{1}{4}$ " (6.25 mm) in only one direction.

Features:

1. Large playback output can be obtained.
2. S/N ratio is better.

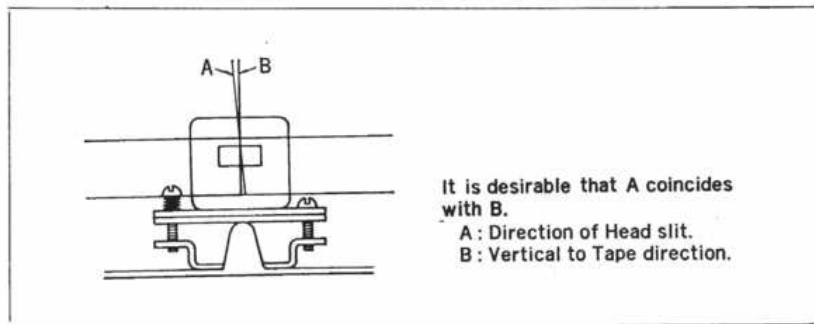
Drawbacks:

1. Since the recording and playback are made in only one direction, it is not economical.
2. Tape must be rewound whenever recording or playback is finished.

This system is therefore used today only for high class tape recorders, in particular, for professional use, and has little possibility of general use.

SKD

Semi Knock Down, a method of shipping an equipment in assemblies, to a partner in a technical assistance agreement, for final assembly in another place. For instance, a tape recorder is shipped as disassembled parts, viz., Amplifier, Mechanism, Cabinet, etc.

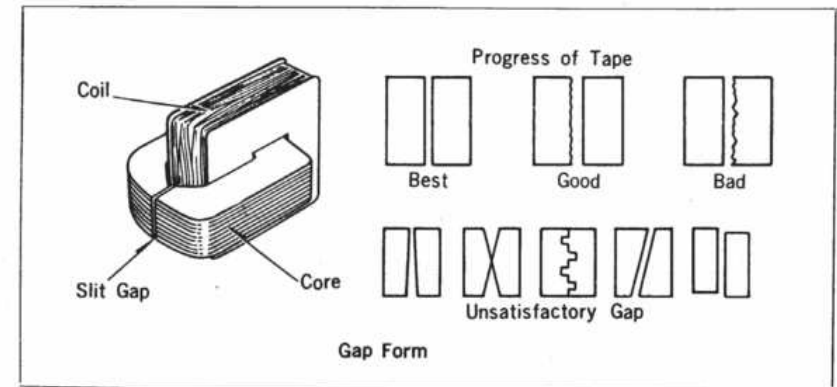
Slit Angle

The Angle of the Head Slit Gap section must be exactly perpendicular to the tape running direction. This Angle is called the Slit Angle. It is often referred to as the Deviation Angle between the accurately perpendicular line to the tape direction and the slit gap.

When this deviation angle is large, output lowers more conspicuously for the higher frequency range as the Head Core becomes wider.

Therefore, it is necessary to make the angle adjustment very carefully.

The adjustment of this angle is called Azimuth Alignment.

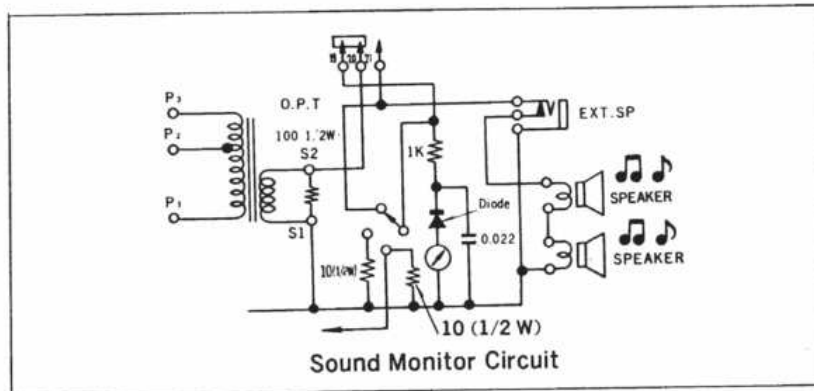
Slit Gap

A narrow gap made in front of the Head Core. A Magnetic Circuit is formed by winding the coil around the ring core. During recording and erasing, it is necessary to remove the magnetic flux of the core to the front of the core (the surface in contact with the tape). During playback, a section to pick up the flux leakage on the tape is necessary.

The Slit Gap, which is the most important part at the Head, is installed for this purpose. As shown in the figure, a thin plate of beryllium or phosphorus bronze is inserted in the thrust part of the core.

The Record Head Slit is about 10μ , while the Playback Head Slit and Record/Playback Head Slit are $2\sim 5\mu$ and the Erase Head Slit, about 200μ .

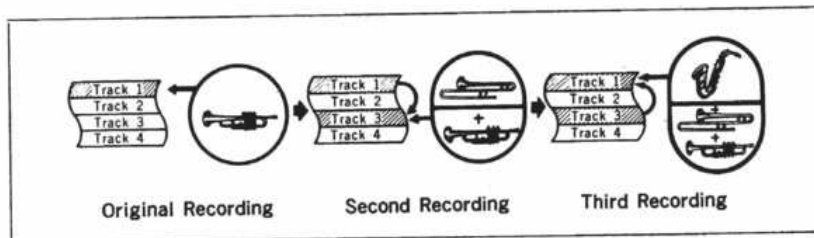
Sound Monitor



A very convenient method for recording one's own voice, music and many other sounds by a tape recorder while listening to the sounds (being recorded) through the speaker built in the tape recorder.

The Sound Monitor Method is found on most models of PANASONIC Tape Recorders. It is a unique system which enables one to monitor the sound being recorded. It may also be used as a Speaker, without mounting tape.

Sound on Sound

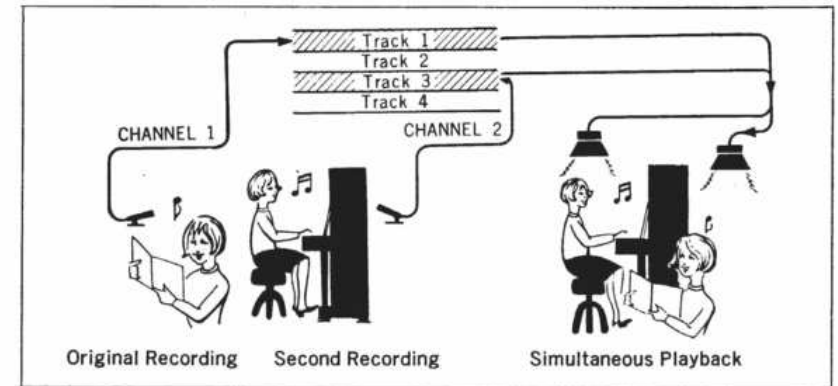


Sound on Sound is a way of recording in which sounds are recorded one after another on already recorded sound to obtain an effect as if multiple sounds were recorded at the same time.

The original recording is first made on Track 1, and when another sound is recorded on Track 3 corresponding to Track 1, the playback sound of Track 1 is superimposed on Track 3 simultaneously as recording input of Track 3.

Then the third sound is recorded on Track 1 corresponding to the two previous sounds recorded on Track 3, and at the same time, the two sounds on Track 3 are recorded over the former on Track 1. Thus, 4th, 5th and successive sounds are recorded one after another every time the recording track is changed.

Sound with Sound



As compared with a duet performed by two persons, Sound with Sound is a way of recording to perform a duet by one person.

First, the original sound is recorded on Track 1 and then, while listening to the recorded sound, another sound is recorded on Track 3. When these two sounds are played back at the same time, they sound as if they had been recorded simultaneously.

This method is often used for language study and produces very satisfactory results. Teaching material is recorded on Track 1. Then, while playing back the teaching material, one's own voice is recorded on Track 3.

Both of them are then played back at the same time so as to repeat the practice while making sure of the pronunciation, intonation, grammar, etc.

Space Loss

When the tape is not in close contact with the Head Surface, the output, particularly in the high frequency range, decreases. This can be caused by dirt or dust on either surface, and prevents the Head from picking up all recorded magnetism.

This is all the more conspicuous when the frequency is high. For instance, 5μ of dust will cause a deterioration in frequency response of about 1.5 db at 1 KHz, and about 14 db at 10 KHz. In order to prevent it, the following precautions should be observed:

1. Keep tape surface dust free.
2. Wipe dust and grease from tape by using a piece of gauze dipped in alcohol.
3. Maintain correct tape tension and pad pressure.

Speaker

Converts electrical variations into sound variations. Although many types are available, the dynamic speaker is the most common. To obtain best reproduction of all audio frequencies, speakers with special characteristics are used:

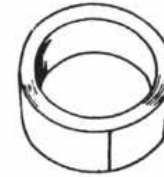
- | | |
|---------------------|----------------------------|
| 1. Double Cone Type | 4. Middle Range (Squawker) |
| 2. Composite Type | 5. Treble (Tweeter) |
| 3. Bass (Woofer) | |

A Woofer, Squawker, or Tweeter cannot work alone to provide full frequency response. A combination of Woofer and Tweeter are used in two-way Speaker systems, and a combination of Woofer, Squawker, and Tweeter are used in three-way Speaker systems.

Spindle Oil

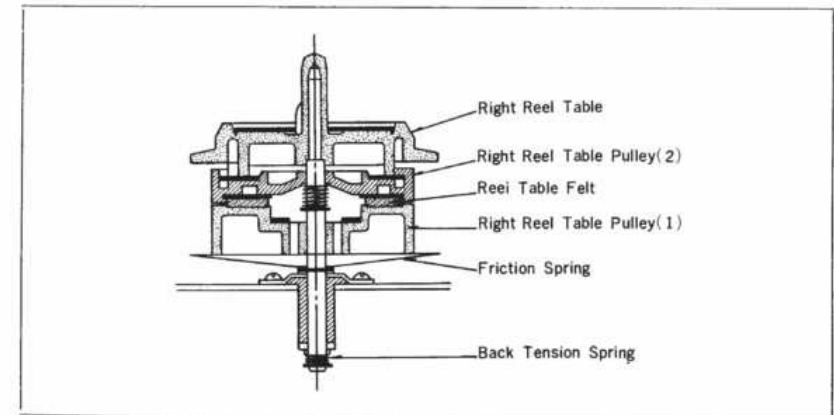
A kind of machine oil. Having good thermal resistance and low viscosity, it is suitable for light load high speed rotary parts and high precision equipment. For tape recorders, it is used at the motor shaft.

Splicing Tape



Used for repairing magnetic tape when it is broken, or when editing tapes. It has particularly strong bonding power and yet is not sticky.

Spring Controlled Reel System



The structure of a Takeup Reel Table with constant turning speed.

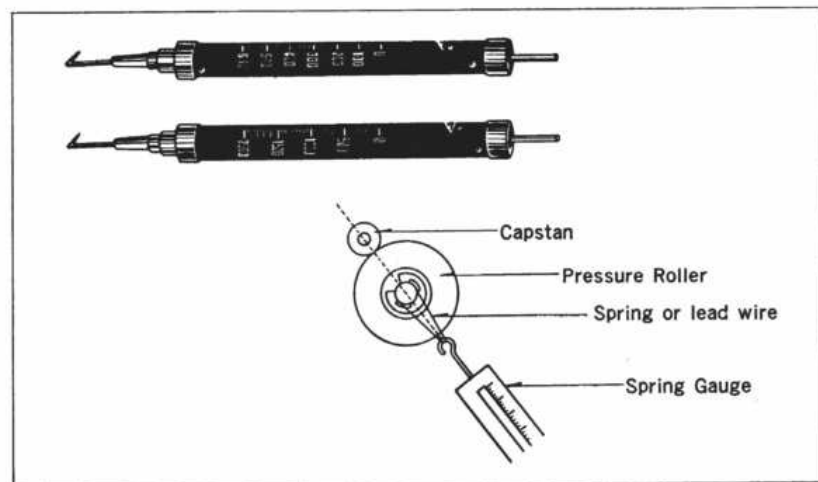
This Reel Table is employed for vertical type, horizontal/vertical type and portable type tape recorders.

The rotating power of the Reel Table is controlled by the spring mounted on the shaft of the Reel Table.

Therefore, the tape tension is stronger inside and weaker outside. This difference varies according to the Reel used.

To show the representative value of the tape tension, the largest reel for the set is used, and the taking-up power on its periphery is used to express the value.

Spring Gauge



Measures relatively high pressure like the pressing force of a pressure roller. There are various kinds of Gauges ranging in weight between 500g and 5 Kg.

Shown above is an example of how to measure the pressure of a pressure roller:

Pull the Spring Gauge on the center line between the Capstan Shaft and the Pressure Roller Shaft. Use a Spring Gauge of 200g~2 Kg.

Squawker

Used for high-fidelity reproduction of middle range frequencies (ca. 500 Hz ~ 3,000 Hz), in combination with the Woofer and Tweeter.

Squawkers of 6-1/2" and 8" diameters are generally used; specially designed squawkers are seldom used. They are selected from Single Cone Speakers.

There are 2 types, viz., the Cone Type and the Horn Type.

Stabilizer

Used for absorbing unevenness of back tension so as to send out the tape smoothly; used only for high class models.

Consisting of Tension Arm and Flywheel, it absorbs unevenness of back tension caused by:

1. Uneven torque of the motor
2. Slipping of tape on the reel
3. Looseness of tape on the reel

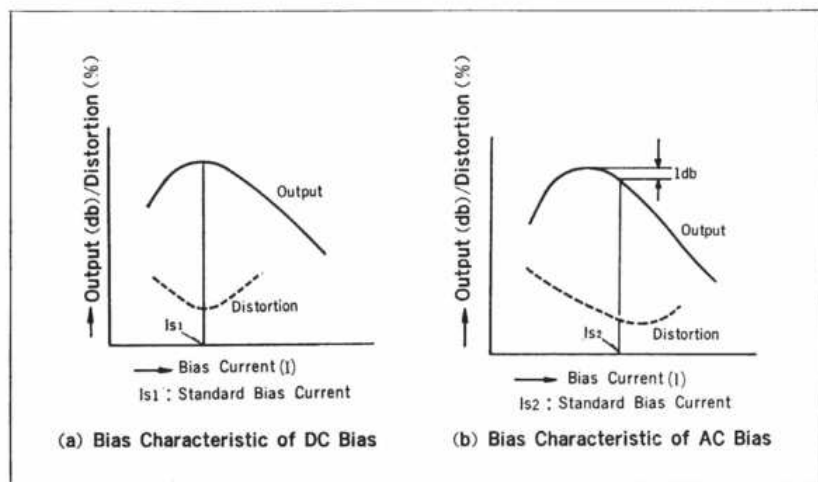
Stacked Head

Refer to "Inline Stereo Head".

Staggered Head

A Stereophonic Record/Playback Head in which the Head Element for CH-1 is mounted about one inch apart from that of CH-2. It is not used currently.

Standard Bias



The Bias value at which the record signal when played back shows high output without much distortion.

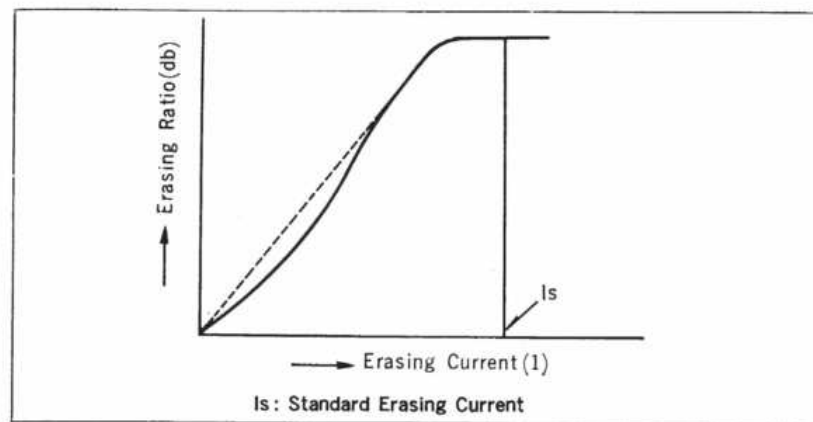
When a given frequency (1,000 Hz) is recorded at a given level while the bias is gradually varied, the output characteristic during playback of this tape becomes as shown in the above figure.

In a DC bias system, the point of maximum playback output corresponds to the point of minimum distortion. This point is called Standard Bias.

In an AC bias system, the point where distortion is minimum is the point where the bias current is increased to such an extent that the playback output is lowered by 1 dB from the highest point. This point is called Standard Bias.

Standard Erasing Current

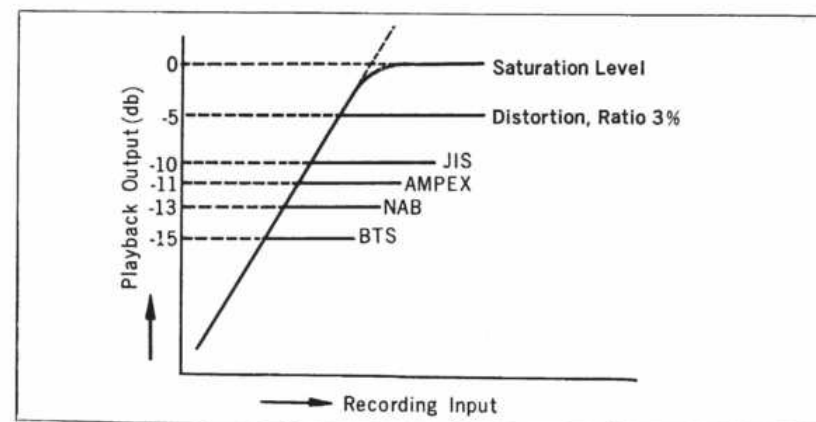
The most effective Current Value for erasing.



Variation of the erasing ratio to erasing current is shown by the curve above. When the erasing ratio reaches a certain level, the Head Core is saturated and the erasing ratio cannot be increased even if the erasing current is increased more.

The current value a little lower than the standard is called the Standard Erasing Current.

Standard Recording Level



The input level of the Record Head at which playback output lower by a certain constant than the saturated playback output of the tape with 500 Hz (or 1,000 Hz) is obtained.

At a certain level, it may be a little different by each standard but, in general, a point between -10 dB ~ -15 dB from the saturation point is adopted.

Standard Tape

1. This tape is 2 mil (55μ) thick compared to long play tapes such as Extra Tape (Golden Tape), Double Play Tape (Golden S Tape), Triple Play Tape, etc.
2. It is used for regulating the frequency response of the tape recorder amplifier just like the frequency record disc used for testing the pick-up.

The Amplifier of the tape recorder has an Equalizer Circuit to make up for the output characteristic of the Head. It is necessary to integrate the characteristic of this circuit so as to make the recording tape interchangeable.

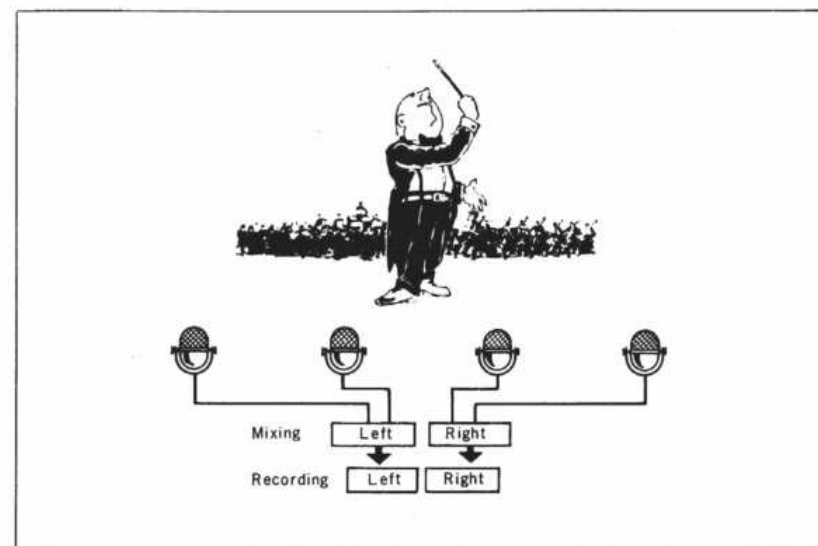
In general, the Playback Amplifier (including Playback Head) is adjusted by playing back the test tape, and then the Record Amplifier is adjusted on the basis of the adjusted playback system.

There are test tapes available which meet NAB or DIN standards.

Stereophonic Recording System

A system to record sound on two independent channels so that when played back the effect of depth or spacing is obtained.

For example, when recording an orchestra performance, recording is made separately through independent electronic circuits, of the right and left sides.



Many microphones can be placed in the orchestra at individual instruments and the sounds can be mixed into two channels for 2-channel stereo sound.

Stereophonic Sound

Sound which has the feeling of direction, depth, movement, and width.

We hear many everyday examples of stereophonic sound; for example, a live concert by an orchestra, an automobile approaching and then departing, an airplane flying overhead, etc.

Stereo Tape Recorders and Stereo Disc Records are used to record these effects.

Refer to "Stereophonic Recording System".

Stereo Tape



Tape recorded in the stereo mode. Many tapes of this kind are currently on sale.

There are the following types: 2-Track Stereo, 4-Track Stereo, 8-Track Stereo, and Cassette 4-Track Stereo. The most popular is the 4-Track Stereo type.

Refer to "Stereo Recording System".

Stroboscope

It is possible to check the number of rotations by the combination of intermittent light and a striped disc.

This disc is called a stroboscope.

It is generally used for measuring the number of rotations of a motor, capstan shaft, etc.

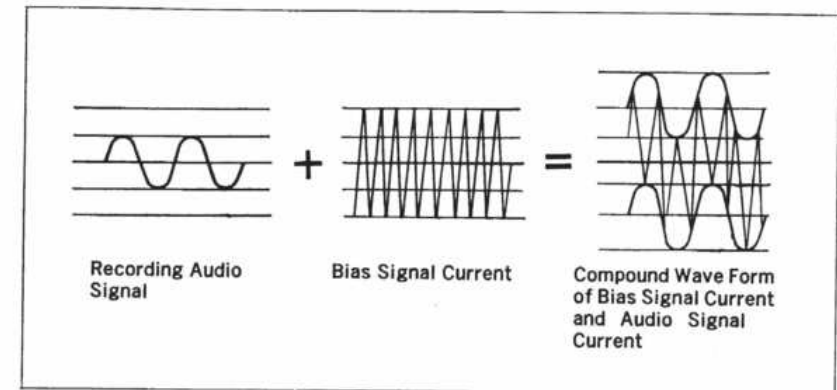
When a fluorescent lamp is used, the number of stripes of the stroboscope can be calculated by the following formula:

$$N = \frac{2 \times 60f}{n} \quad \text{where, } N = \text{number of stripes}$$

$$n = \text{number of rotations}$$

$$f = \text{frequency}$$

Superimposed Current



The current made by superimposing different currents. For instance, when the wave of recording current which passes the Head is analysed, current consisting of bias current and signal current (as shown in the above figure) can be observed.

There is also a wave of amplitude modulation which is similar to superimposed current. However, it is basically different from the latter. For details, refer to "Amplitude Modulation".

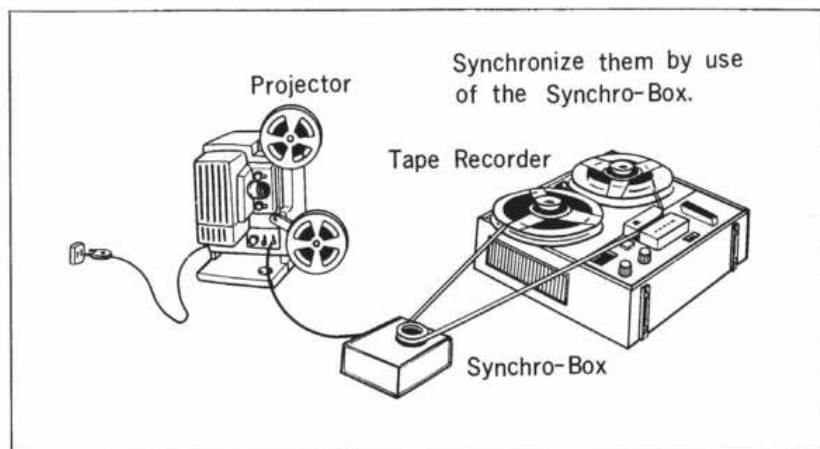
Supply Reel

The reel placed on the Supply Reel Table (usually, the left side reel).

A fresh tape before recording (or a recorded tape for playing back) is placed on the Supply Reel.

Synchronizer

A device installed between a movie projector and Tape Recorder to keep sound and picture together.



Refer to "Eight (8-mm) Synchronizer"

S

Synchronous Motor

A motor which rotates at a synchronized speed under normal operating conditions.

As compact synchronous motors, there are hysteresis type and induction start-up permanent magnetic type motors. Most of the synchronous motors used for tape recorders are of the former type.

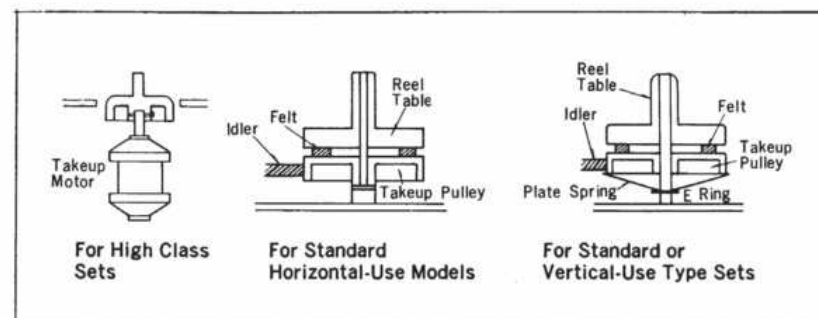
Refer to "Hysteresis Synchronous Motor".

The relation between rpm of the synchronous motor and N (synchronous speed), is shown below.

$$N = 120 f/p \text{ (rpm)}$$

where p represents the number of poles and f, the power frequency.

Take-up Reel Table



The Take-up Reel Table takes up the tape with appropriate tension during forwarding and fast forwarding of tape, and provides rewinding back tension.

Roughly speaking, there are three varieties of Reel Tables: 3-motor type, Self-weight type and Spring type. Refer to the specific terms for details.

T

Take-up Tension

Torque for taking up the tape onto the reel is called Take-up Tension. Take-up Tension can roughly be divided into two, viz., take-up tension for playback and recording, and take-up tension for fast forwarding and rewinding.

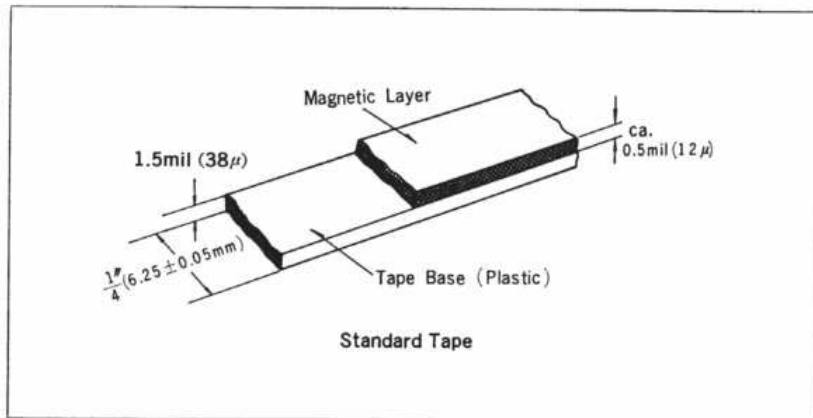
1. During playback and recording:

It is necessary to take up the tape with appropriate tension when it is sent out by the Pressure Roller and Capstan. By slipping at the reel table, adequate torque is applied.

2. During fast forwarding and rewinding:

It is necessary to take up the tape at high speed. Accordingly, the take-up tension becomes higher than the tension at the time of playback. The mechanism is so designed that the Reel Table is prevented from slipping by the Roller, etc.

Tape Base



The base is made into Magnetic Tape by coating the surface with magnetic membrane. It must resist pulling, show little elongation or shrinkage by temperature, and not become deformed.

Until recently it was usually made with acetate cellulose base. Currently, it is being replaced by polyester base which has better properties.

The way to distinguish acetate base from polyester base is as follows:

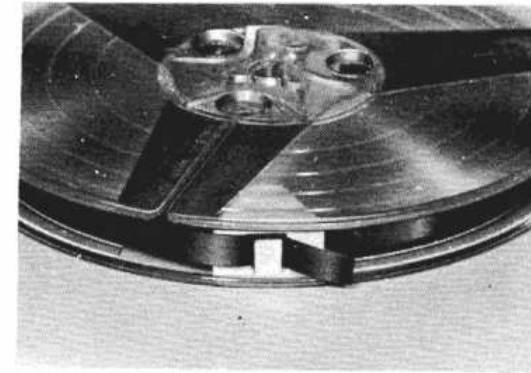
When the tape is pulled, if it breaks without stretching, it is acetate base and if it breaks after stretching, polyester base.

Tape Counter

Connected to the Rotary Shaft of the Tape Deck to indicate the amount of tape driven. There are two types: the Digital System and the Clock System. (Refer to specific terms.)

PANASONIC Tape Recorders employ the Digital System Tape Counter. If the indication of the tape counter is noted, any desired point on the tape can be located easily.

Tape Clip



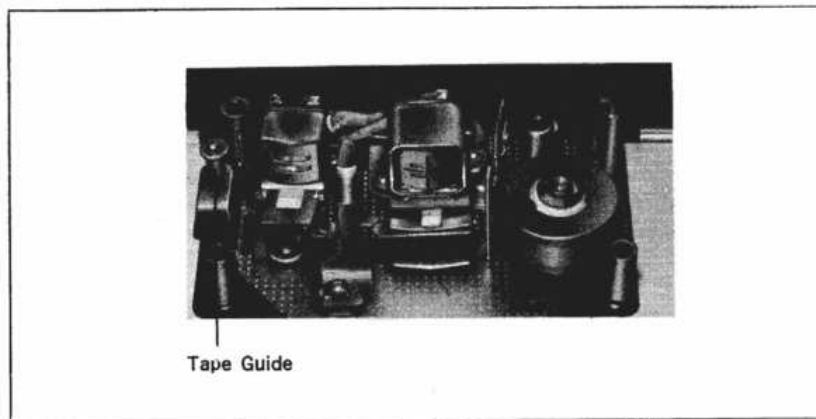
A clip to hold the end of the taken-up tape so that it will not loosen.

Tape Deck

A mechanism used for recording and playback which, because it has no speakers and amplifier of its own, must be connected to an amplifier and separate speakers. Tape Decks can be classified roughly as follows:

1. According to the power source :
 - a. AC system
 - b. Battery system
2. According to the internal mechanism-1
 - a. 1-motor system
 - b. 2-motor system
 - c. 3-motor system
3. According to the internal mechanism-2
 - a. One-direction system
 - b. Manual reverse system
 - c. Automatic reverse system
4. According to the operational mechanism
 - a. Lever system
 - b. Push-button system
 - c. Change lever system
5. According to the head
 - a. 1-head system
 - b. 2-head system
 - c. 3-head system

Tape Guide



S

Prevents vertical movement of the tape so that the tape driven by the capstan is kept in the proper track position on the head surface. For this purpose, Guides are installed at both ends of the Head.

Without the tape guides, the tape may move about and cause such troubles as (1) level fluctuation, (2) crosstalk between tracks, (3) deterioration in sound quality due to deviation of angle, etc.

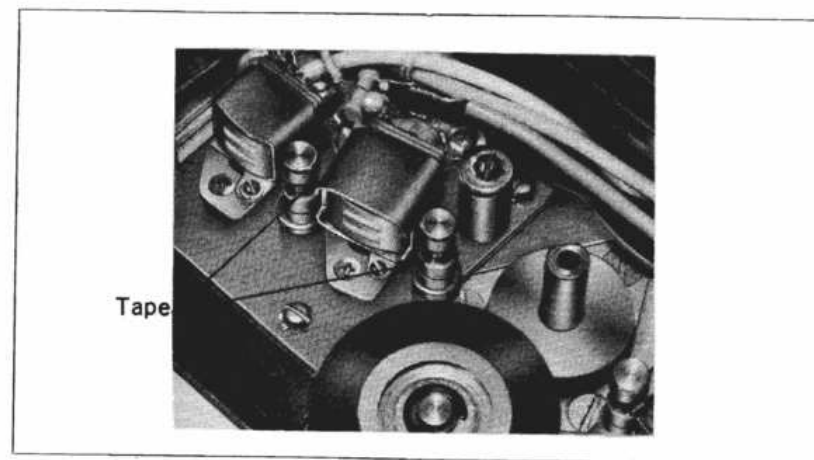
The tape Guide serves to prevent these troubles.

Another important role of the Tape Guides is to guide the magnetic tape from the Supply Reel to the Take-up Reel smoothly via the Head.

Tape Index Counter

Usually called Tape Counter. Classified into Digital Tape Counter and Clock Type Tape Counter. Refer to the specific terms.

Tape Limiter



A metallic piece installed close to the Head to prevent the tape from getting out of position on the Head due to vertical vibration, etc.

Regarding the troubles caused by vertical vibration of the tape, refer to "Tape Guide".

T

Tape Mechanism

Refer to "Tape Deck".

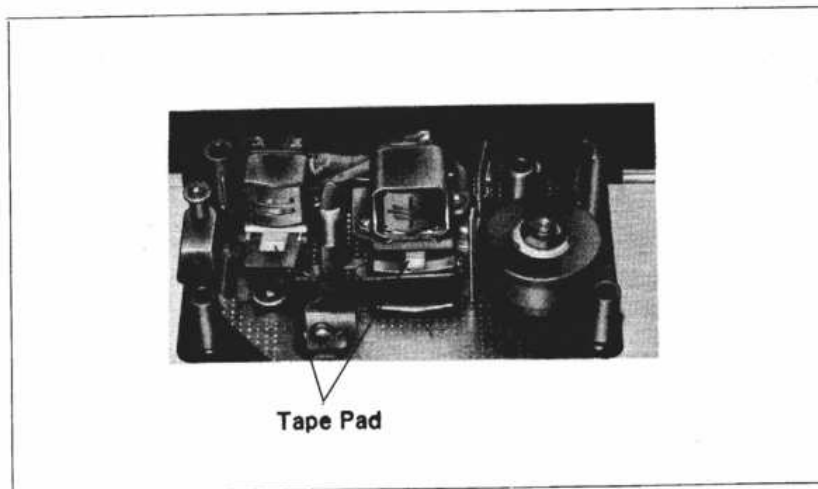
Tape Noise

The playback noise heard when a tape on which no recording has been made is played back.

This occurs when the magnetic surface of the tape is not smooth or when erasing is not done completely. In order to reduce it, make the tape surface smooth. AC erasing causes less tape noise than DC erasing.

When the frequency component is higher than 5 Kc, the noise level does not fluctuate according to the frequency, in other words, the noise level remains the same.

Tape Pad



Tape Pad

The device to bring the tape in close contact with the head surface during recording and playback. It consists of highly permeable plate (of such as permalloy) and felt or moltiprene pasted to each other.

It not only presses the tape against the head surface, but serves as the Head Hum Shield. (When the Playback Head picks up the leakage flux of the transformer or motor, the leakage flux becomes hum.)

When the contact between the Tape and Head is not satisfactory, the recording magnetization and playback output become extremely weakened. The Pad Pressure should therefore be kept normal constantly.

Pad pressure differs from one model to another, but it is 5~20 g for small models, and 15~50g for large models.

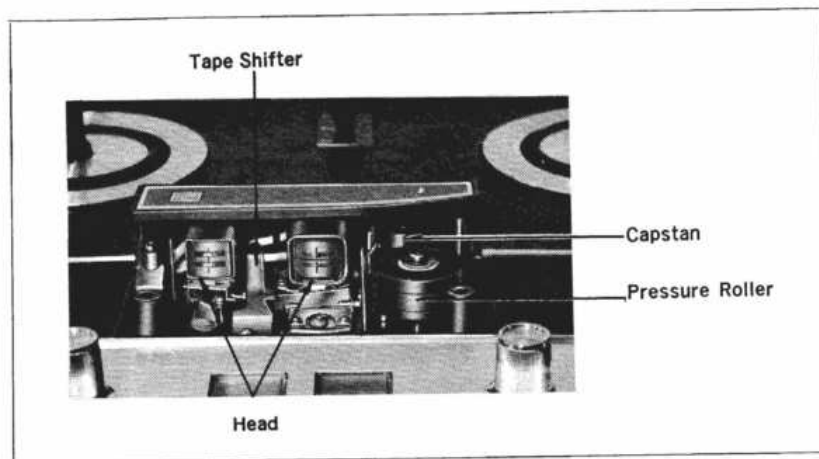
Tape Reel

Item	Parts No.	Length	Thick-ness	Recording Time (both ways)		
				7½ ips	3¾ ips	1½ ips
No.7 Standard Tape	RT-7	1200 ft (370m)	50μ	1 hr.	2 hrs.	4 hrs.
No.5 Standard Tape	RT-5	600 ft (185m)	50μ	30 min.	1 hr.	2 hrs.
No.4 Standard Tape	RT-4	400 ft (124m)	50μ	20 min.	40 min.	1 hr. 20 min.
No.3 Standard Tape	RT-3	200 ft (62m)	50μ	10 min.	20 min.	40 min.
No.7 Golden Tape	RT-7G	1800 ft (555m)	38μ	1 hr. 30 min.	3 hrs.	6 hrs.
No.5 Golden Tape	RT-5G	900 ft (277m)	38μ	45 min.	1 hr. 30 min.	3 hrs.
No.4 Golden Tape	RT-4G	600 ft (185m)	38μ	30 min.	1 hr.	2 hrs.
No.3 Golden Tape	RT-3G	300 ft (92m)	38μ	15 min.	30 min.	1 hr.
No.2 Golden Tape	RT-26G	200 ft (62m)	38μ	10 min.	20 min.	40 min.
No.3 Golden S Tape	RT-3S	400 ft (124m)	28μ	20 min.	40 min.	1 hr. 20 min.
Cassette Tape	RT-80	300 ft (90m)	18μ	—	—	1 hr.

The spool upon which Magnetic Tape is wound. Various diameters are 2½", 3", 4", 5", 6", and 7". The large 10" reel is used for high quality, particularly broadcasting models.

Tape Shifter

At times other than recording or playback (for instance, fast forward or rewind), the tape is separated from the head surface to avoid abrasion of the Head.



The movable metallic device for this action is called Tape Shifter.

Tape Speed

The speed of the Tape running in front of the Head during recording and playback. For interchangeability of recording tape, Tape Speed is standardized by the IEC, and this standard of tape speed is adopted by each country.

The principle Tape Speeds are:

15 inches per second	=	38 cm per second
7-1/2 inches per second	=	19 cm per second
3-3/4 inches per second	=	9.5 cm per second
1-7/8 inches per second	=	4.8 cm per second

Tape Speed Accuracy

Shown by percentage of the difference (allowance) between the rated speed (7½ ips, 3¾ ips, etc.) of the tape recorder and its actual tape speed.

If the Speed Accuracy is within $\pm 3\%$, there is no practical difficulty. But, for a tape speed of 7½ ips (19 cm/s) or for high grade Tape Recorders, an accuracy of $\pm 2\%$ or less is desirable.

It is simple to measure the Tape Speed Accuracy with a Timing Tape. For details, refer to "Timing Tape".

Tape Speed Fluctuation

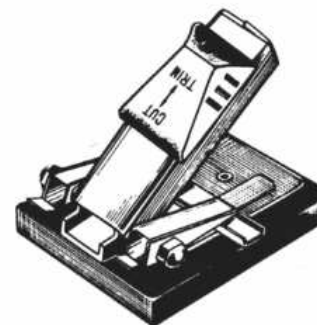
The percentage of difference between the maximum speed and the minimum speed in the range from the start to the end of the taken-up tape as against the rated speed.

It is ideal that the speed fluctuation ratio is zero, in other words, that the tape speed is constant at every point. However, since the take-up tension varies according to the amount of tape taken up around the Reel, there is inevitably a certain variation in speed.

Usually, there is no problem if the fluctuation ratio is within 2%.

PANASONIC's Standard in this respect is 1.0~1.5%, which is more rigid than the above.

Tape Splicer



When recorded tape is to be edited, or when broken tape is to be joined, the Splicer is used.

Tape Squeal

When abrasion between the contact surfaces of the tape is too big, the tape skips and vibrates. If the vibration is audible, it is heard as tape squeal. The cause of increasing abrasion is the coating material on the tape (magnetic powder, binder, etc.) deposited on the contact surface of the Tape, Tape Guide, Head or Pad Felt.

To avoid tape squeal, it is important to keep the tape surface always clean.

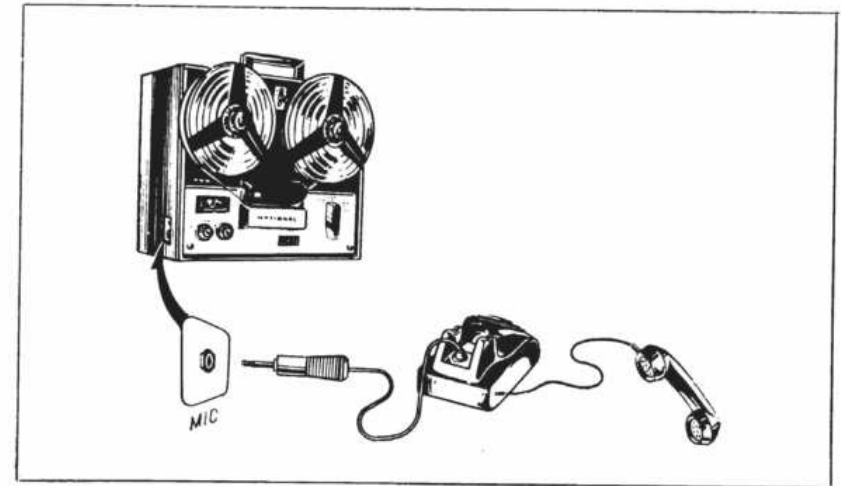
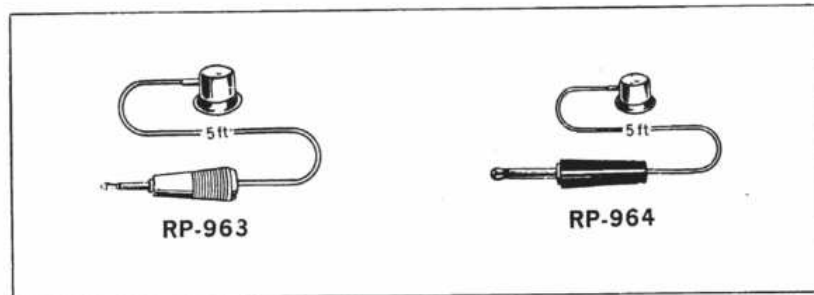
Tape squeal is apt to occur:

1. When the tape is thin.
2. When the tape speed is slow.
3. When the back tension is too high or too low.
4. When temperature or humidity is high.
5. When the tape is used very often.

Tape Transport Mechanism

Synonym for Tape Deck. Refer to "Tape Deck".

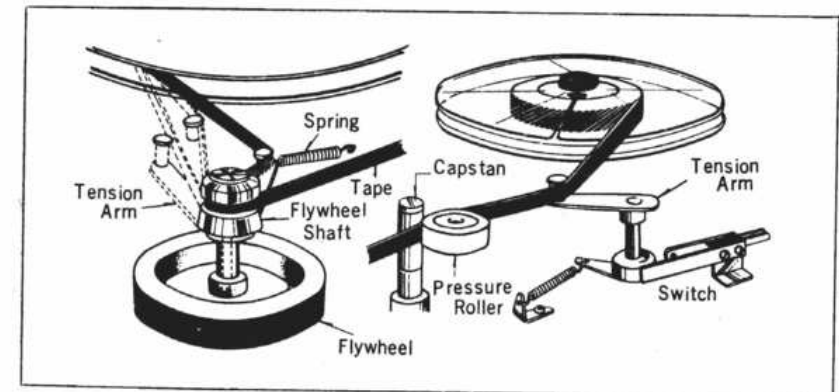
Telephone Pickup



Used for recording a telephone conversation. It is made of iron core with a coil at which inductive voltage is produced by the magnetic flux leaking from the telephone.

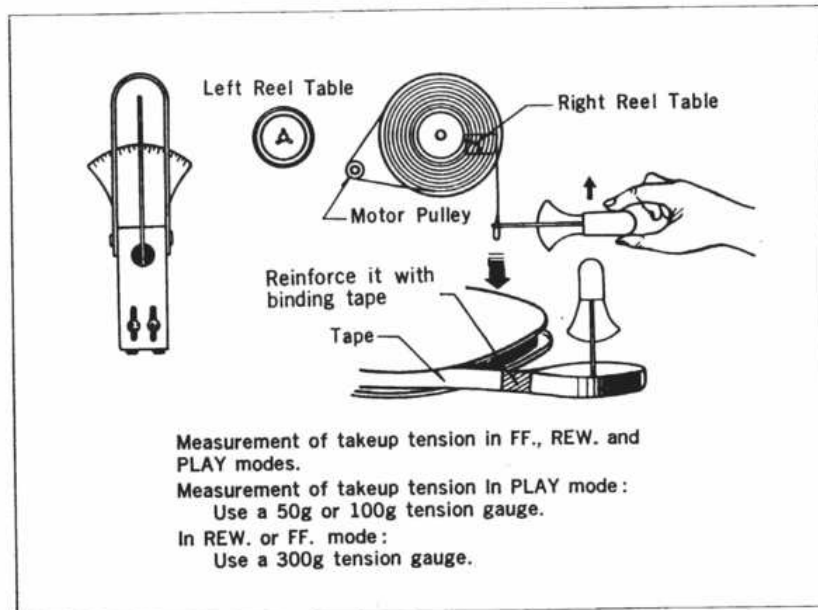
It is connected to the MIC Input Jack of a tape recorder.

Tension Arm



1. Used for applying necessary tension to the tape, and for absorbing instantaneous transient phenomena due to the inertia or mechanical time lag on the Take-up Reel Table while the Capstan forwards tape at a constant speed.
2. Some Tension Arms interlock with the Switch so as to stop the tape recorder automatically when the tape is finished or broken, and others return the operation mechanically to the stop mode.

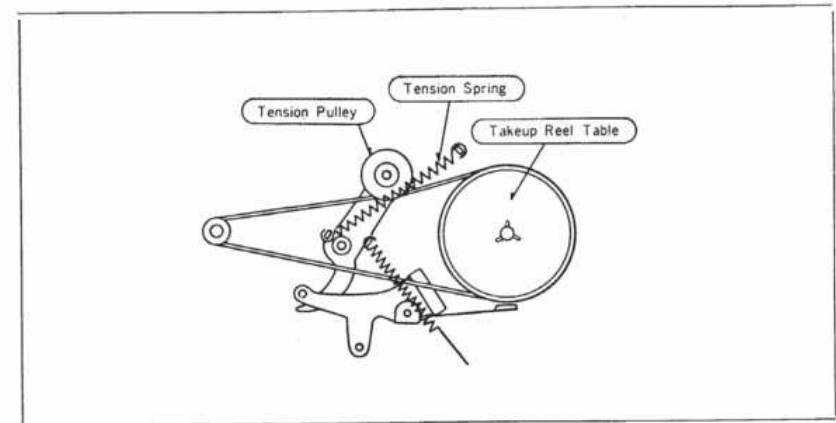
Tension Gauge



A spring gauge for measuring relatively low tension such as tape takeup tension, pad pressure, etc. There are several kinds of tension gauges used for tape recorders: 10g, 50g, 100g, 150g, 200g, 300g.

The above figure shows how to measure takeup tension.

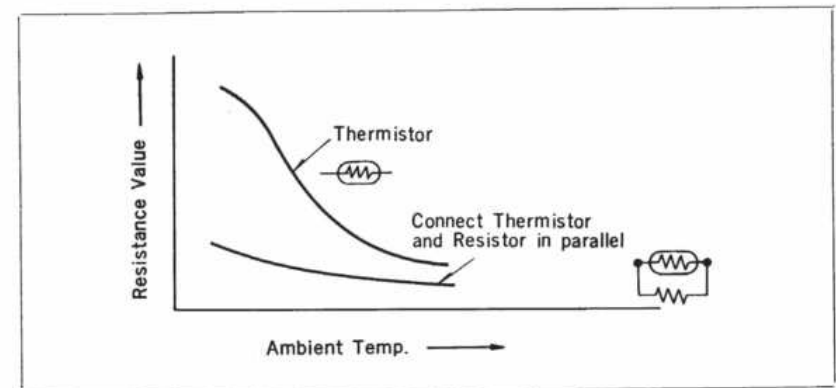
Tension Pulley



A pulley to apply tension to the Belt and to vary the tension. Usually, a special cloth belt is used.

The figure shows an example of Takeup Reel Table driven by the Tension Pulley.

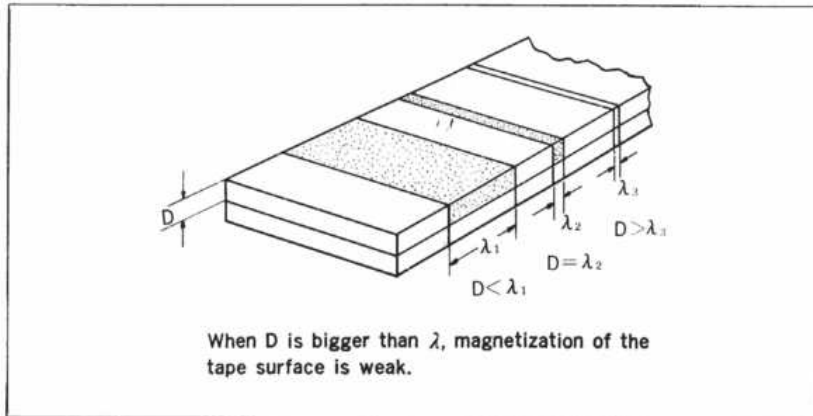
Thermistor



A commercial name of a semi-conductor which varies largely in resistance value to temperature and whose resistance value becomes lower when the ambient temperature rises. When it is used in the Bias Circuit of the transistor circuit:

1. Its resistance lowers as the temperature rises, so that the bias voltage decreases.
2. When the temperature lowers, the resistance increases to raise bias voltage. Thus, the collector current can be kept at the best condition. Usually, Thermistor and Resistor are connected in parallel, being adjusted for thermal property of the transistor.

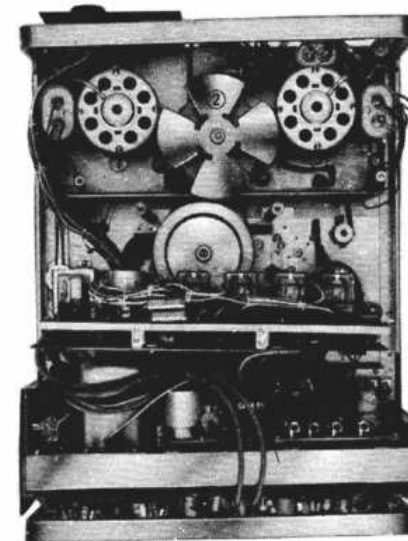
Thickness Loss



The phenomenon when the magnetization of the tape surface weakens due to thickness of the magnetic layer of the tape.

This loss increases when the recording wave length (λ) on the tape becomes smaller than the tape thickness (D). In other words, the higher the frequency range, the more the loss.

Three Motor System



To use each independent motor for the Capstan, Takeup Reel Table and Supply Reel Table, respectively.

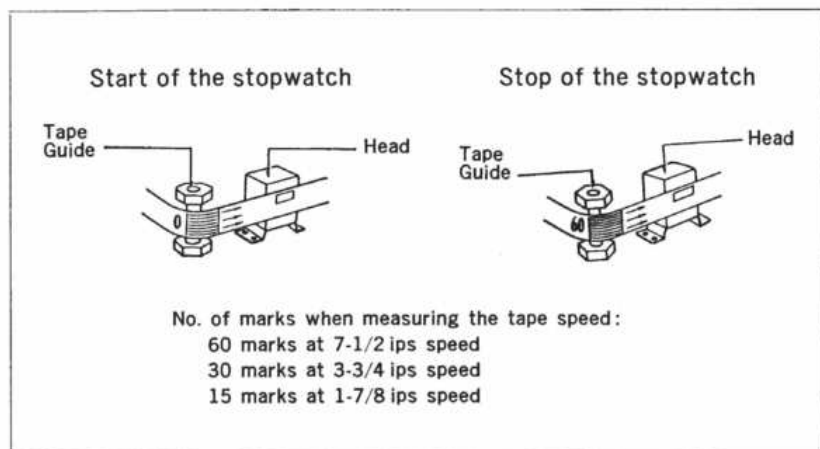
Features:

1. It is operated lightly by one touch of the Push Button with the Micro Switch for electric circuit to energize the relay plunger.
2. Its mechanism is simple, and there occurs little wow and flutter.
3. Tape speed can be changed easily by selecting the number of poles of the motor.
4. Time for FF or REW is short.
5. All operations can be performed by Remote Control.

For independent 3 motors, the following are most generally used:

- Capstan Motor Hysteresis Synchronous Motor (4 or 8 poles)
- Takeup Reel Table Motor Induction Motor
- Supply Reel Table Motor Induction Motor

Timing Tape



Play back the speed measuring tape (timing tape having more than 60 marks at the beginning, the middle and the end of the takeup tape, respectively). At the "0" mark, start the stopwatch. At a tape speed of 7-1/2 ips, stop the stopwatch at the "60" mark. After reading the time, the percentage is calculated by the following formula:

$$\text{Tape speed accuracy (\%)} = \frac{60 \text{ sec.} - \text{Measured Value}}{60} \times 100$$

Example of calculation:

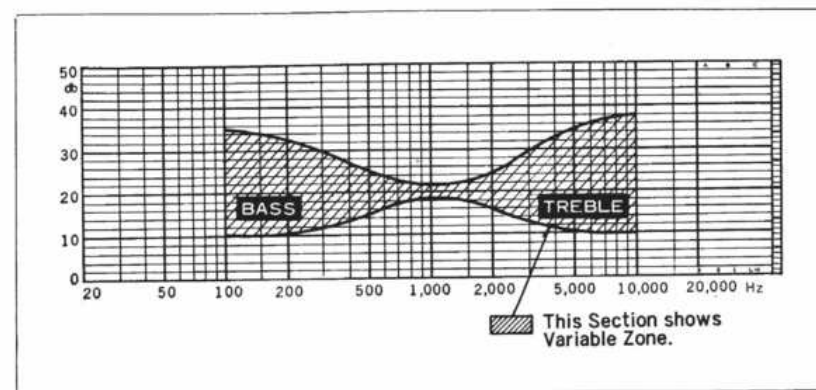
When the measured time is 59 sec.,

$$\frac{60-59}{60} \times 100 = +1.7(\%) \quad \text{That is, 1.7\% faster.}$$

When the measured time is 61 sec.:

$$\frac{60-61}{60} \times 100 = -1.7(\%) \quad \text{That is, 1.7\% slower.}$$

Tone Control



Used to intensify or attenuate the low or high frequency ranges.

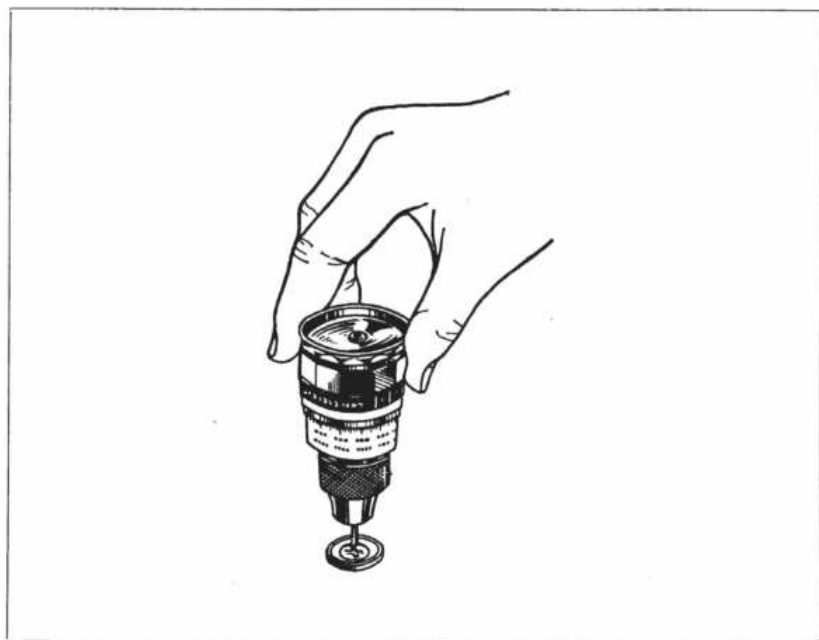
Simple Tape Recorders have a tone control which attenuates the treble (high frequency range).

The kinds of Tone Controls and their purposes are:

1. Treble intensification
Used to compensate for treble attenuation in speaker characteristic or to compensate treble at low volume levels. Refer to "Fletcher-Munson's Curve".
2. Treble attenuation
By narrowing the range in which noise is normally heard, the sound is made more pleasant.
3. Bass intensification
Used to compensate for poor bass characteristics of loudspeaker or to correct bass loudness when volume is decreased. Refer to "Fletcher-Munson's Curve".
4. Bass attenuation
Used to improve clarity when the speaker damping factor is poor or room acoustics are bad. Also used to reduce hum or motor noise when using a record player.

The figure shows the effect of using Bass and Treble Tone Controls.

Torque Meter



Mainly used for measuring take-up tension and rewinding tension of cassette tape recorders. By holding its dial, its point is connected directly to the Reel Table Hub to take the measurement.

Measurement can be made by the Torque Meter for rotation of 270° in both directions. Torque meters of $10\sim 90$ cm/g or $20\sim 150$ cm/g are very easy to use for this purpose.

Features:

1. Being light and compact, it can be handled by one hand. It can measure in any direction, upward, downward, or horizontally.
2. The measurement graduation is shown not only on the front dial but also on the outer circumference of the handle.

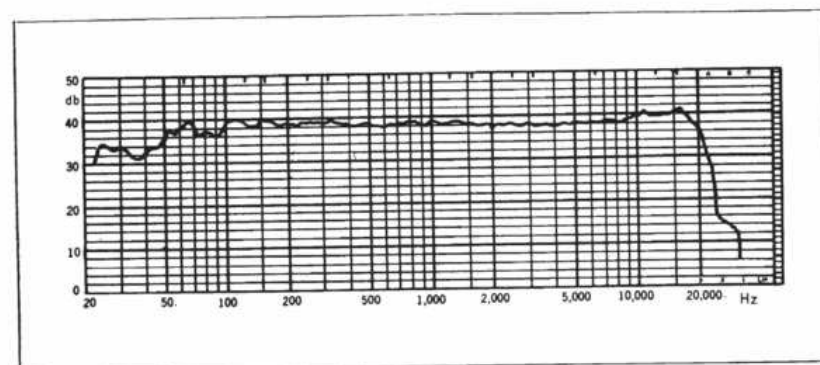
Torque Motor

The one motor system is most popular for tape recorders, but some higher class tape recorders use the 3-motor system. Besides the motor exclusively used for the capstan, the motors directly connected to the Supply and Take-up Reel Tables are called Torque Motors (Wind Motors).

Torque motors, in which starting torque is strong and torque decreases as the speed increases, are generally used.

Fast Forward and Rewind times are very short and Take-up Tension and Back Tension are kept constant.

Total Frequency Response

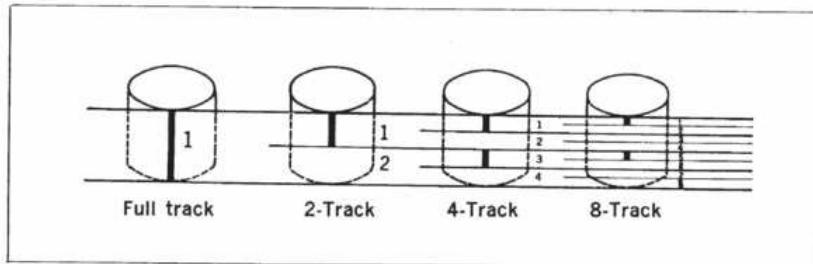


Total Frequency Response is the overall frequency characteristic through recording and playback. For tape recorders, it indicates the electric characteristic from the recording input terminal to the playback output terminal, excluding the microphone and speaker.

To measure the frequency characteristic, select a recording level lower by about 10 dB than the standard recording level (where the tape is saturated). Then make a recording of each frequency, play it back and measure the output voltage at each frequency by connecting a VTVM to the output terminal.

Because the extent of beat noise and distortion cannot be discerned by the VTVM, observe (at the same time) the wave form by use of an oscilloscope. This is convenient for clear distinction of the signals. It is desirable that the Total Frequency Response be as flat as possible over the entire frequency range.

Track



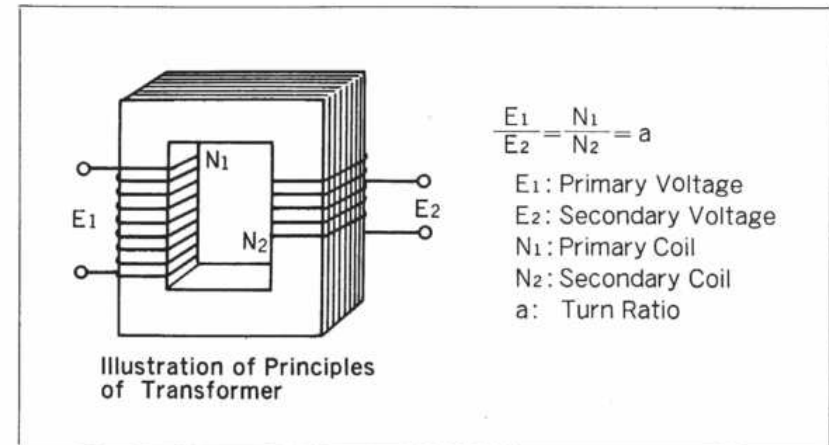
The recording width of a tape is determined by the core thickness of the recording head. The tape is magnetized for recording in the width equal to the core thickness of the recording head. This width is termed the Recording Track.

There are the following kinds of Tracks:

1. Full Track Recording is made on the full width of the tape.
2. 2-Track When the tape moves from left to right (seen from the other side of the magnetic surface of the tape), the Upper Track is called Track 1, and the lower one, Track 2.
3. 4-Track From the Upper Track, there are Tracks 1, 2, 3 and 4.
4. 8-Track From the Upper Track, there are Tracks 1 to 8.

Full-Track System is also called Mono Track or Single Track. The 2-Track System is also called Half Track, Double Track, Twin Track or Dual Track. The 4-Track is also called Quarter Track.

Transformer



A device consisting of an iron core and a primary coil and one or more secondary coils wound around an iron core, and insulated from each other.

AC energy applied to the primary coil produce an AC voltage in the secondary coils in accordance with the ratio of the number of turns in the secondary to the number of turns in the primary. The frequency remains unchanged.

The transformer has a wide range of applications; for example, electric power, communications equipment, audio frequency amplifier, etc.

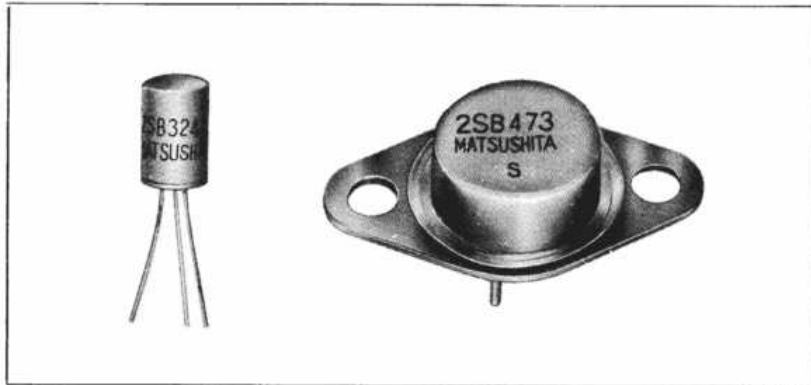
The following varieties are commonly used in Tape Recorders:

1. Power Transformer: For raising or lowering voltage.
2. Input Transformer: For voltage amplification and impedance matching.
3. Output Transformer: For impedance matching and lowering or raising voltage.

Transformerless

Refer to "Power Transformerless".

Transistor



Just as for a vacuum tube, output current varies in proportion to the level of input signal (current or voltage), thereby amplifying low input into high output. Also used for detection, modulation, oscillation, frequency conversion, etc.

In Vacuum Tubes, the flow of electrons is utilized, while for Transistors, the function of an electron or hole in a solid (called Semiconductor) is utilized.

Features:

1. Small and light in weight.
2. Long Service life and high resistance to mechanical shocks.
3. No heater power is required.
4. Power consumption is small, working voltage is low, and therefore insulation is easier.
5. Due to the fewer number and good quality of circuit parts, assembly is simple and reliability is improved.

6. Printed wiring can be made easily.
7. High efficiency.

However, since it is susceptible to heat and liable to break by electric shock, it is necessary to increase its stability to temperature when designing it.

Each Transistor has an identification name to indicate its polarity and use.

The first (number) is 2

The second (letter) is S

The third (letter) shows polarity and use, viz.,

- A PNP high frequency use
- B PNP low frequency use
- C NPN high frequency use
- D NPN low frequency use

The fourth (number) is a series number starting from 11.

For instance, 2SB-324 means PNP low frequency use transistor.

Transparent Tape

Tape consisting of the base material only. (Ordinary recording tape from which iron powder is removed.)

Mainly used for adjusting the Head position by making sure of the contact dimension between the tape and Head by the naked eye.

Treble

Refer to "Bass-Treble Control".

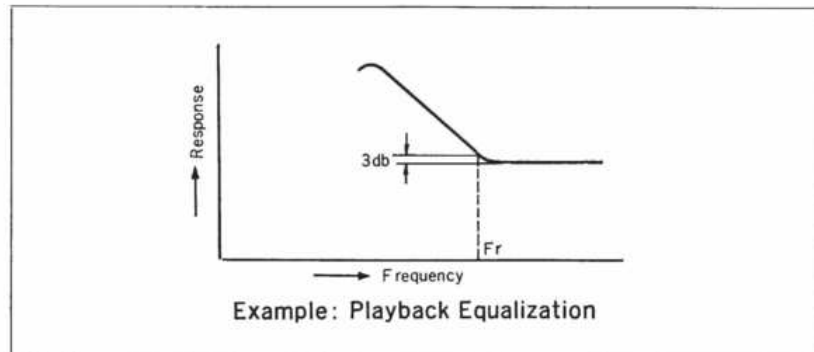
Triple Play Tape

It is 200% longer than the standard tape and yet can be taken up on the same reel. Its base is thinner than the standard tape; the former is 18μ thick while the latter is 55μ thick ($55/1,000$ mm).

The lengths of Triple Play Tape are:

- 3600 ft for 7" reel (Standard tape 1,200 ft)
- 1800 ft for 5" reel (Standard tape 600 ft)
- 600 ft for 3" reel (Standard tape 200 ft)

Turn Over Frequency



When a recorded tape is played back by a magnetic head or when an LP disc record is reproduced by a magnetic pickup, it is necessary to use an amplifier having an Equalization circuit in order to provide the output with a flat characteristic.

In this Circuit frequency (F_r) begins working to raise the low frequency range. This frequency is called the Turn Over Frequency.

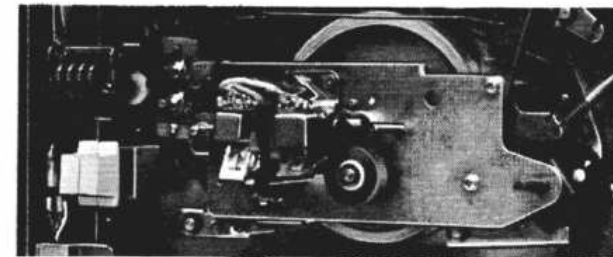
Tweeter



A speaker for reproducing Treble frequency (higher than 3,000 Hz) with fidelity, and used in combination with a Squawker and Woofer, or with a Woofer.

The speaker diameter is usually less than 5", and the Speakers can be classified into 2 types, viz., the Horn Type and the Cone Type.

Two Head System



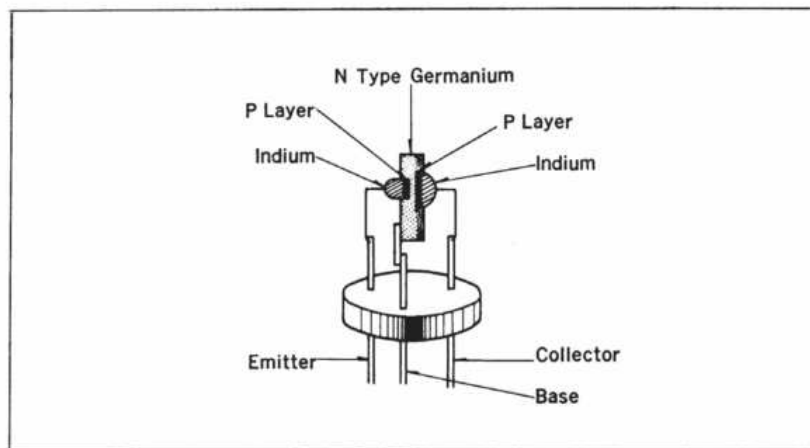
There are three kinds of heads, viz., Recording Head, Playback Head, and Erase Head. In some high-class tape recorders, each of these 3 heads is used independently. In ordinary tape recorders, the 2-head system is generally adopted, with one head used for both recording and playback.

U.L.

Underwriters Laboratories Incorporation, or the Safety Standard of the U.S.

This standard has been established mainly to assure the prevention of electric shock and fire accidents. In some States, the sale of electric apparatus is prohibited if the product bears no approval mark. Even in other States, the UL approval is often required for the sale of electric apparatus.

Ultra Linear Type Transistor



An alloy type low frequency transistor developed by PANASONIC's unique technology.

Through a special manufacturing process, the surface of the PN junction is made completely parallel and the electric current characteristic in amplification, almost uniform for a wide range. Consequently its current amplification degree and cut-off frequency are high and its noise index, small. It is therefore suitable for Hi-Fi systems, recording and playback amplifiers of tape recorders, high sensitivity receivers, etc.

As shown in the above figure, a thin pellet is made by cutting and grinding a single crystal of N type germanium, on each side of which a small ball of indium is put. When these are heated in an oven, the indium melts and penetrates the germanium to form a thin P layer in contact with the N germanium. A lead wire is connected to each element and thus the alloy type transistor is prepared.

Undistorted Power Output

The continuous Power Output at 10% distortion when a single frequency input is applied to the Amplifier.

It is calculated as follows:

$$P = \frac{E^2}{R}$$

Where: P= Power (watts)
E= Voltage (volts)
R= Output impedance (ohms)

Some manufacturers rate Undistorted Power Output with 5% or 3% distortion.

Refer to "Power Output"

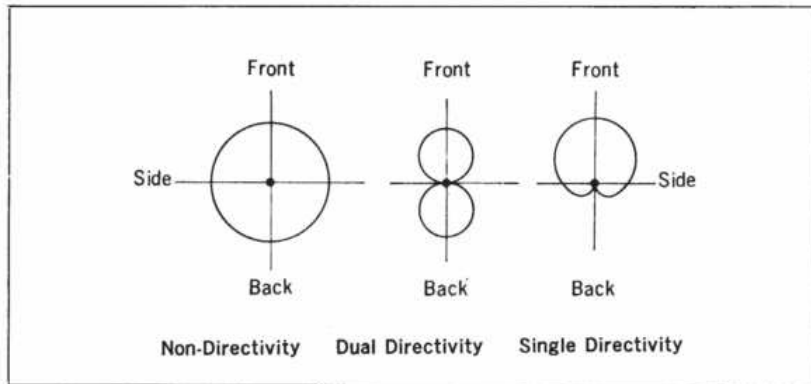
Uni-Directional Microphone

A microphone having high sensitivity in only a certain direction. Its characteristic is shown in the figure below.

The sensitivity characteristic varies according to frequency.

At a low frequency, its direction is undiscernible, but the higher the frequency, the sharper the directional sensitivity.

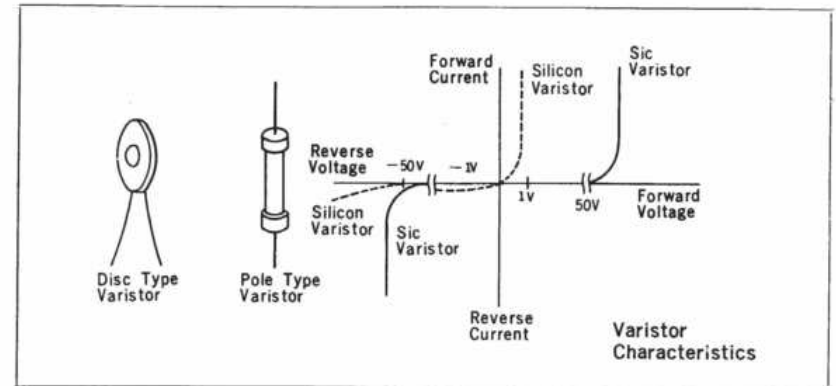
This Microphone is used when directivity is required for stereo recording, or to prevent howling when the Microphone is used near the speaker, or to pick up a certain sound in a place where there are many surrounding noises.



In regard to its construction, it might be a combination of a bi-directional ribbon microphone with a non-directional dynamic microphone to make it uni-directional.

U

Varistor



Means variable resistor but has characteristics similar to the ordinary diode.

In the forward direction, current increases rapidly but not linearly. Resistance value varies according to the voltage applied, consequently the name Varistor.

Varistors are used for temperature compensation of a Transistor Amplifier. As the temperature increases, the voltage between the Emitter and Base decreases.

When voltage at both ends of a Varistor, to which a constant current is applied, is utilized as the Base bias, the Collector current is prevented from increasing.

The varistor has a very high non-linear coefficient (∞) and it is thermally stable. It resists high voltage and it exhibits no time lag for voltage changes.

V

Video Tape Recorder



The picture (video signal) of a TV set or video signal converted by an ITV camera is converted to a magnetic signal by a highly efficient video head and recorded on magnetic tape. The principles are the same as for tape recorders.

For an audio signal, it is satisfactory that recordings be made in the frequency range of 20 Hz~20 KHz. However, for a video signal, it is necessary to record on the tape in about 200 times as wide a frequency range as that of an audio signal, and accordingly the relative speed between the tape and head must be increased.

In this connection the following methods are currently used:

1. Rotating Head System: Resolution is good.
2. Fixed Head System: Mechanism is simple, but resolution is poor.
3. Field Skip System: Long recoding is possible, but resolution is poor.

PANASONIC uses the rotating head system, with an FM video signal, and a relative speed of head and tape as high as 12 m/s.

This design makes it possible to produce pictures with good resolution and little noise. It is operated by the push-button system and handled easily.

Voice Control Microphone



A voice sound causes a relay contained in the Microphone to be energized. The Motor circuit is then switched ON by a control circuit. When the sound stops, the motor is switched OFF.

This Microphone is a portable type and can be used in remote-controlled Recorders in which the Motor Power Source is switched ON and OFF.

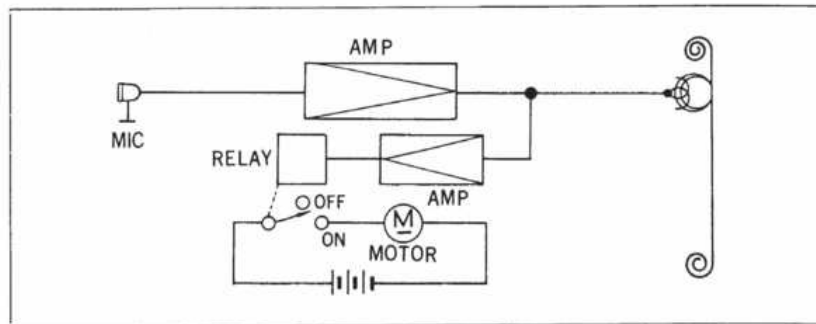
Refer to "Voice Operation".

Voice Matic

Refer to "Easy Matic".

Voice Operation

Operates by using a voice-activated relay and control circuit that operates as weak and strong signals are picked up by the microphone.



Signals from the Microphone are applied to the Recording Amplifier and part of the signal is applied to the Control Amplifier. The currents, corresponding to the strength of the audio signals, are amplified and flow through the Relay coil. When a current, which is stronger than the minimum current at which the Relay is set to operate, flows through the coil, the Relay is energized and switches the motor ON.

About 0.5 second elapses from the time the signal is picked up by the Microphone and the Relay is energized. The Motor does not operate during this time.

After the Motor starts rotating, and the Microphone signal stops, the Motor switch is set to OFF approximately 3 to 6 seconds later, and the motor stops.

The Relay characteristic is such that one value of current is required for operation and a smaller current is required for release.

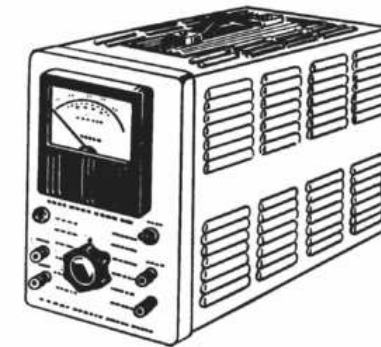
Volt

The unit for potential difference, abbreviated V.

When a current of one ampere is applied to a resistor of 1 ohm, the difference of potential produced between the two ends of the resistor is one volt.

According to MKS standards, the potential difference between the two points, where the energy required to move one coulomb is one joule, is one volt.

VTVM (Vacuum Tube Volt Meter)



A voltmeter operated by vacuum tubes to provide a high internal resistance. There are AC and DC VTVMs.

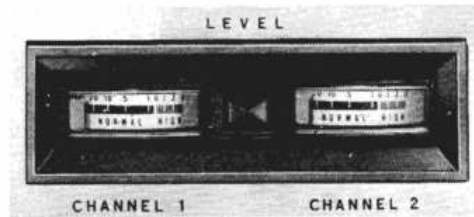
Although a Tester can be used to measure DC voltages, the measurements are not accurate due to the low internal resistance, approximately 20 K Ω per volt for the higher internal resistance types.

When measuring AC voltages, the input capacity of the voltmeter becomes a problem particularly at higher frequencies. A higher input impedance is then required.

The VTVM is characterized by an internal resistance of approximately 10 M Ω . A moving coil meter indicates the voltage.

In Tape Recorders, the VTVM is used for measuring voltages in Amplifier circuits, bias and recording currents of Recording Heads, and also Erase Head currents.

VU Meter



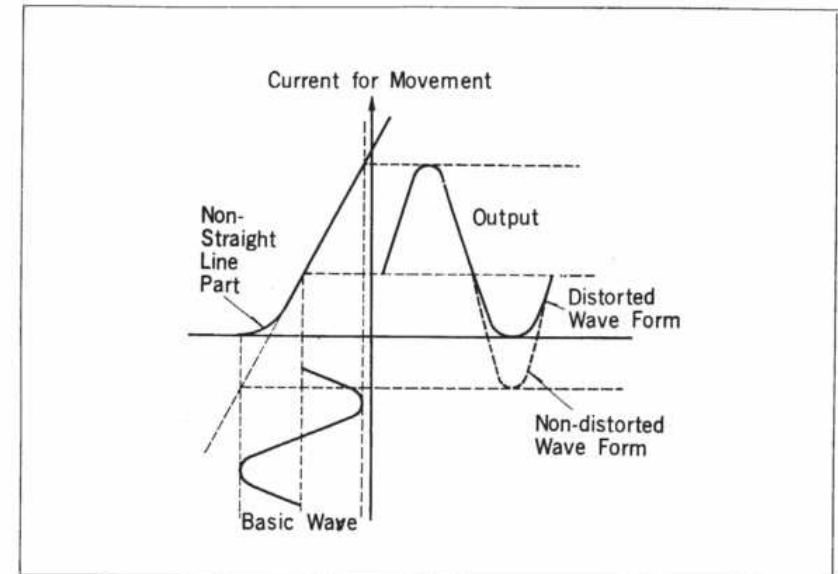
A level meter for measuring and monitoring the audio level during recording. If the recording level is too high, the sound is recorded distorted. On the contrary, if too low, the sound cannot be heard clearly, because, in addition to its weakness, it is hampered by tape noise, hum and other noises. It is, therefore, necessary to watch the level meter all the time during recording.

The unit of sound measured by the VU Meter is not dB but VU (Volume Unit), established by the CBS Broadcasting Corporation and Bell Telephone Research Institute in the United States.

0-VU is equivalent to -4dB .

V

Wave Form Distortion



For good quality sound reproduction the recording and playback amplifiers must have good linearity. When the linearity is good the output wave is an exact reproduction of the input wave, and wave form distortion is therefore low.

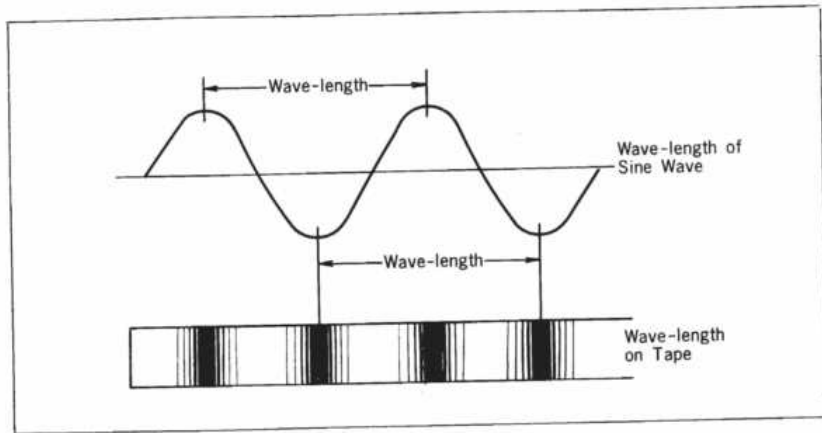
If an input voltage is too large, it causes operation on the non-linear portions of the vacuum tube or transistor characteristic curves. As shown in the figure, this produces distortion, known as wave form or amplitude distortion.

Refer to "Harmonic Distortion".

W

Wave Length

Electric Waves are transferred through the air as dense and thin waves of electric force lines whose direction and size vary constantly.



An Electric Wave is also a kind of electromagnetic wave, and can be expressed by the flat wave shape shown above.

The length from one peak to another or from one bottom to another is called the wave Length.

1. The relation between wave length, electric wave velocity and frequency is as follows:

Wave Length = electric wave velocity / frequency

where electric wave velocity is
187,500 miles (300,000 km) / second

Examples of Wave Length

100 Hz	1,875 miles (3,000 Km)
1,000 Hz	187-1/2 miles (300 km)
10,000 Hz	18-3/4 miles (30 km)

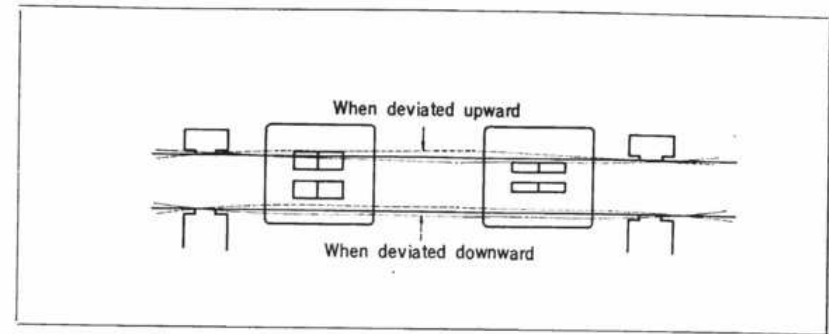
2. The relation between the frequency recorded on the tape and wave length is as follows:

Recorded Wave Length = tape speed / recorded frequency

Examples of Wave Length at a tape speed of 7-1/2 ips

100 Hz	80 mil (1,900 μ)
1,000 Hz	8 mil (190 μ)
10,000 Hz	4/5 mil (19 μ)

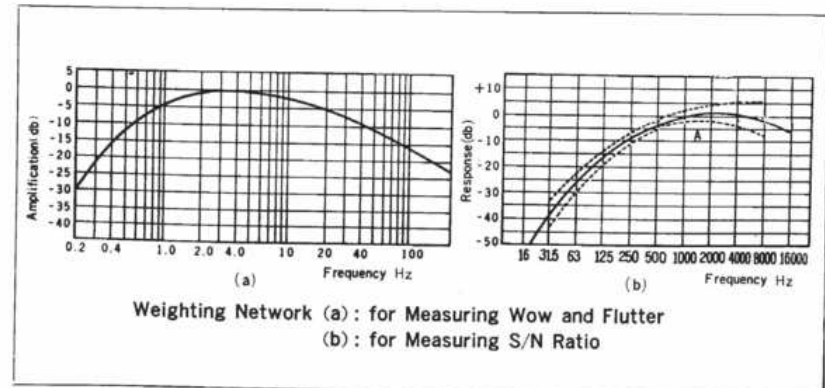
Weaving



The phenomenon that the Tape deviates upward or downward while it is running on the Head. For 4-Track and 8-Track Tapes, it causes sensitivity variation, crosstalk and fluctuation of high frequency range level due to vertical deviation.

The causes of weaving are inadequate parallelism between the pressure roller and capstan, uneven pressing power, unstable back tension, deformation of reel, etc.

Weighting Network



1. A filter network used to provide a measurement of Wow and Flutter in relationship to the effect on the ear.

The apparant effect of Wow and Flutter on the human ear differs for different frequencies and wave forms of the Wow and Flutter. The filter incorporated in the measuring equipment is called "Weighting Network". See Fig. a.

2. It is also the filter used for measuring S/N ratios. The relationship between sound frequency and sound intensity as they effect the Ear is shown by Fletcher-Munson's Curve. Noise in Tape Recorders is significant as it affects the Ear. Therefore, measurements are made after passing the noise through an audio correction network (Curve A in Fig. b). The audio correction network is called a Weighting Network.

White Noise

White Noise is evenly distributed over the entire range of the amplifier. As the temperature of resistor material goes up, the thermal movement of the interior electron becomes more active. At this time Thermal Agitation Noise is produced. In addition, there is Shot Noise which is caused by irregular "springing out" of electrons from the cathode of the vacuum tube and the route through which electron reaches the plate. Because they resemble white light, they are called White Noise.

W

Wind Motor

Refer to "Torque Motor".

Wireless Microphone



Used on a stage or in TV broadcasting where performers move frequently. Signal is transmitted wirelessly from the microphone unit to the amplifier.

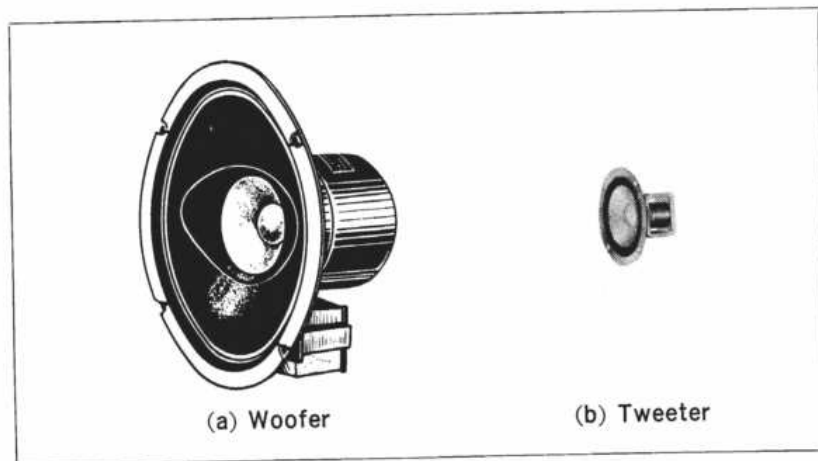
It consists of a Transmitter and a Receiver. The Microphone and Transmitter are housed in the same compact case to which an antenna of 1~3 ft is attached. FM (frequency modulation) is used for transmission. Usually, a Condenser Type Microphone Unit is used.

The transmission frequency is 40.68 MHz. Ca. 80 MHz has also been used recently. Distance of transmission is ca. 100 m. max. 80 MHz can be received by an FM radio set.

When the Receiver is connected to the tape recorder, they constitute a wireless tape recorder.

W

Woofers



A Speaker for reproducing the Bass frequency (lower than ca. 3,000 Hz) with fidelity, and used in combination with a Tweeter or with a Squawker and Tweeter.

Most Woofers are more than $6\frac{1}{2}$ " in diameter, and all of them are the Cone Type.

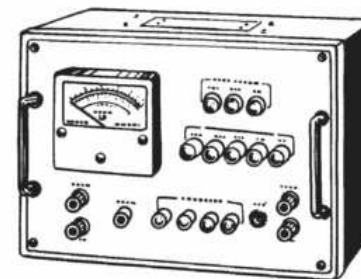
Working Bias

Refer to "Standard Bias".

Wow

Refer to "Wow and Flutter".

Wow Meter



Used for measuring Wow and Flutter of tape recorders. It is designed to be used at 3,000 Hz so that Wow and Flutter can be detected easily. The following two methods are used for measurement.

1. Make a recording at 3,000 Hz, play it back through the same tape recorder, and take the measurement.
2. Make a recording at 3,000 Hz with a tape recorder whose Wow and Flutter are negligible; play it back and take the measurement.

Method No. 2, above, is generally used at present.

Principles of the Wow Meter :

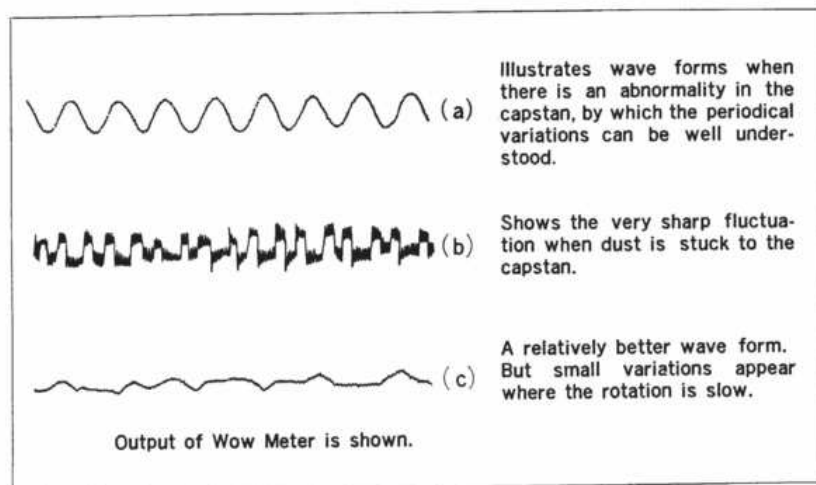
The signal of 3,000 Hz from the tape recorder is connected to the input terminal. After keeping the amplitude constant by the limiter circuit, detect the FM by the ratio detector circuit. Pass its output through the weighting network and measure the value with a VTVM.

The weighting network is designed to match the sensitivity of the human ear and uses a circuit which has the characteristics shown in the figure, above.

Wow and Flutter Tape

Standard Tape for measuring Wow and Flutter when playing back the tape recorded at 3,000 Hz (at each speed) without any distortion or level fluctuation.

Wow and Flutter



Fluctuations in tape speed in front of the Head produce Wow and Flutter. The sound is caused to fluctuate high and then low producing a frequency distortion sound. For example, in the case of a 3,000 Hz sound played back with a $\pm 1\%$ sound fluctuation, the heard frequency range is from 3,030 Hz (+1%) to 2,970 Hz (-1%).

If the phenomenon occurs at a relatively slower period it is called Wow, and if the period is at a faster rate, it is called Flutter. The former gives a feeling of vibration to playback sound, thereby making the sound disagreeable, while the latter causes obscured sound.

Wow and Flutter are caused by the rotational parts in a Tape Recorder:

1. Eccentric deviation of Capstan, Flywheel, Impedance Roller, Motor Pulley, etc.
2. Deformation and eccentric deviation of rubber rollers used for Idler, Pressure Roller, etc.
3. Lack of lubricant at bearing parts, fouling of frictional surfaces of rotating parts, etc.

In particular, high precision finish of the Capstan is required, since eccentric deviation of the Capstan is a prime cause of Wow and Flutter.

Degrees of Wow and Flutter, expressed in a percentage, are shown in effective (R.M.S.) value. Either the R.M.S. Value is stated or the value after the measured voltage passes through a Weighting Network (W.R.M.S. Value) is shown.

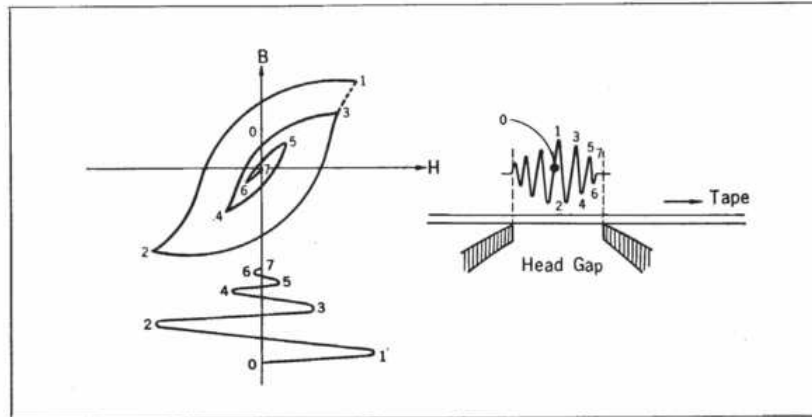
The table shows various recording sources, the percentages at which Wow and Flutter are first noticeable, and the permissible allowances applicable in general to the respective recording sources.

Recording Source	Percentage at which Wow and Flutter are first felt	Permissible Allowance
Piano Solo	0.1% W.R.M.S.	0.3% W.R.M.S.
Music in general	0.4% W.R.M.S.	0.6% W.R.M.S.
Human voice	0.8% W.R.M.S.	1.2% W.R.M.S.

The relationship between Tape Speed and Wow/Flutter is, in general, as follows (Conforming to JIS):

7-1/2 ips (19 cm/s)	0.25% or less W.R.M.S.
3-3/4 ips (9.5 cm/s)	0.4% or less W.R.M.S.
1-7/8 ips (4.8 cm/s)	1.0% or less W.R.M.S.

Zero Erasing



The method used to erase magnetized tape by applying high frequency AC to Erase Head.

It is also called AC erasing. As compared with the Saturation Erasing Method, less noise remains on the tape. Most of high class tape recorders employ this system.

When the magnetic field at the center of the Erase Head is made strongest at a value sufficient to saturate remaining signals on the tape, powder coated on the tape forms a saturated hysteresis loop. It is reduced by gradually reducing the AC magnetic field until the residual magnetism at the time when the tape leaves the center of the Head returns to the original zero point. 30~100 KHz is used as high frequency AC.

PANASONIC TAPE RECORDER TECHNICAL TERMS

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