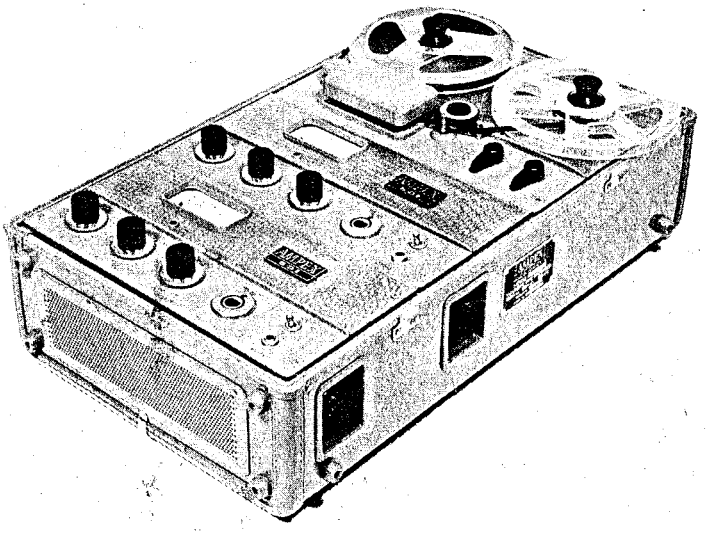
TM 1004

AMPEX

MODEL 601-2

Operation Maintenance Manual



AMPEX
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Description and Specifications

Description

The AMPEX Model 601-2 is a dual track magnetic tape recorder and reproducer intended for use in the professional field. It will record two track (stereophonic) or single (half) track, and will reproduce two track stereophonic and single (half or full) track tapes. It is packaged in a durable, luggage-type, portable carrying case.

This model is available to operate with either 60 or 50 cycle power (117 volt, single phase), at tape speeds of either 7½ or 3¾ inches per second (ips). The complete equipment consists of a tape transport and two electronic assemblies mounted in the portable case. Mating connectors are provided for all signal input and output receptacles.

Standard equipment includes a dummy plug which — when inserted in a receptacle on the electronic assembly — provides an input match for a high impedance microphone. A plug-in transformer unit — available as accessory equipment — will provide a convenient change to match a low impedance microphone; all that is necessary is to replace the dummy plug with the plug-in transformer after removing the assembly from the carrying case.

EQUIPMENT

UNIT	TAPE SPEED (ips)	LINE FREQUENCY (cps)	CAT. NO.
Complete Equipment	7½	60	30070-1
(in carrying case)	7½	50	30070-101
	3¾	60	30070-102
	3¾	50	30070-103
Tape Transport	7½	60	6200-1
	7½	50	6200-125
	3¾	60	6200-126
	3¾	50	6200-127
Electronic Assembly	7½ Master	....	17416-2
	3¾ Master	....	17416-101
	7½ Slave	....	17416-3
	3¾ Slave	....	17416-102
Carrying Case			7511-2
Power Cord			084-002
2 Mating Connectors (Mic. Input)			145-009
2 Miniature Phone Plugs (Line Input)			149-005
2 3-Circuit Phone Plug (Output)			149-004

Specifications

Tape Width:	¼ inch.
Reel Size:	7 inch, RETMA reel (maximum).
Tape Speed:	7½ or 3¾ ips.
Playing Time:	7½ ips — 32 minutes with 7-inch reel, 1200 feet. 3¾ ips — 64 minutes with 7-inch reel, 1200 feet.
Reproduce Timing Accuracy:	±0.2%, or an accuracy of ±3.6 seconds in a 30-minute recording.
Flutter and Wow:	7½ ips — Below 0.17% rms. 3¾ ips — Below 0.3% rms.
Starting Time:	The tape attains full speed in less than one-fifth second in either the play or record mode.
Stopping Time:	Less than one second.
Fast Forward Time:	90 seconds for full 1200 foot reel.
Rewind Time:	90 seconds for full 1200 foot reel.
Frequency Response:	7½ ips — 40 to 15,000 cps; ±2 db 50 to 10,000 cps. 3¾ ips — ±2 db 50 to 7500 cps.
Signal-to-Noise Ratio:	Over 50 db below peak record level. Peak record level is defined as the point of 3% total rms harmonic distortion, measured while using a 400 cps tone; and peak record level includes bias, erase and reproduce amplifier noise.
Record Inputs:	MICROPHONE: Each channel accommodates any high impedance microphone, and can be quickly converted for a low impedance microphone with the plug-in accessory transformer (Catalog No. 17331-1). LINE: 0.5 volt required for normal program level.
Reproduce Output:	1.23 volts rms into 600 ohms at program level.

SPECIFICATIONS cont'd.

Operating Controls:	PLAY — REC. RECORD SAFETY BUTTON REWIND — FAST FWD. MIC. REC. LEVEL (2) LINE REC. LEVEL (2) MONITOR SELECTOR (2) ON-OFF (power) (2)
Connectors:	The MICROPHONE input, a three-circuit connector, is conveniently located on the control panel for each electronic assembly. The PHONES output is a two-circuit jack, located on the front panel of each electronic assembly. The LINE INPUT connector is a two-circuit jack recessed into the right side of the equipment on each electronic assembly. The OUTPUT connector is a three-circuit jack also recessed into the right side of the equipment on each electronic assembly. Mating connectors are supplied (see Table 1-1).
Monitoring:	The MONITOR SELECTOR switch allows monitoring of program input, or reproduce output. A phone jack and illuminated v-u meter are on the front panel.
Head Assembly:	Separate two-track stereo record and stereo reproduce heads, and a full-track erase head are contained in a single housing.
Power Requirements:	117 volts, 50 or 60 cps; 0.9 ampere, 105 watts.
Accessories:	Maintenance Kit: 6392-1 Speed Conversion Kits to: 3¾ ips, 60 cps 7556-0 7½ ips, 60 cps 7556-1 3¾ ips, 50 cps 7556-2 7½ ips, 50 cps 7556-3

SPECIFICATIONS
cont'd.

Frequency Conversion Kit to:	
50 cps operation, 7½ ips	9738
60 cps operation, 7½ ips	9739
50 cps operation, 3¾ ips	9740
60 cps operation, 3¾ ips	9741
Adaptor for rack mounting	9684-1
Spare Parts Kits for:	
7½ ips, 60 cps machine	9742-1
7½ ips, 50 cps machine	9742-2
3¾ ips, 60 cps machine	9742-3
3¾ ips, 50 cps machine	9742-4
Minor Hardware Kits:	7802

See Section 7 for a complete parts list.

Section 2
Basic Principles Involved

Basic Principles of Magnetic Tape Recording

If a material capable of being magnetized is placed in the proximity of a magnetic field, the molecules of the material will be oriented according to the direction of the field. Any of several methods may be used to produce a magnetic field, but of most interest in magnetic recording is the field produced by a current flowing through a coil of wire. The current itself may be derived from a transducer (such as a microphone) which converts the mechanical energy of sound to electric current.

Magnetic recording tape consists of finely divided iron-oxide particles deposited upon a plastic backing. During the recording process, this tape is moved through a magnetic field in which the magnetizing force is alternating and the iron-oxide particles are aligned according to the instantaneous direction and magnitude of the field. (See Fig. 2-1).

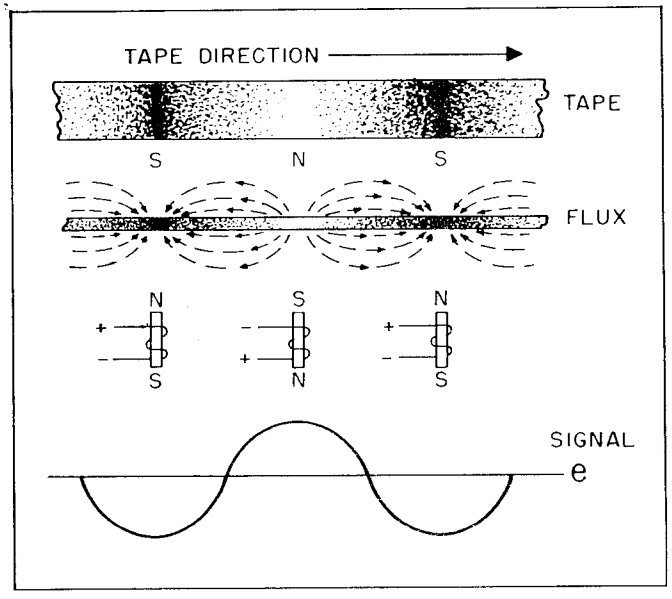


Fig. 2-1 Magnetization of Tape

The magnetic field is produced in the gap of a recording head (which is essentially an electromagnetic) over which the recording tape passes. The head consists of an incomplete ring of highly permeable material inserted in a coil of wire. The

discontinuity in the ring forms the gap and the ring itself is the core of the electro-magnet. The recording head and its gap thus constitute a series magnetic circuit. (See Fig. 2-2).

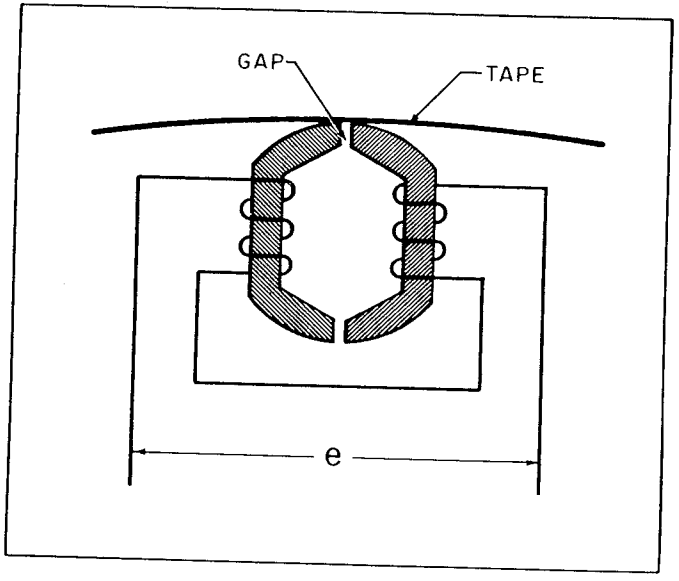


Fig. 2-2 Record Head

The magnetization curve of the iron-oxide used as the recording medium is similar to that shown as the heavy line in Fig. 2-3. At points near the origin, the curve is extremely non-linear and, without some corrective factor, the signal recorded on the tape would not be directly proportional to the signal applied to the head, resulting in a high degree of distortion when the tape was reproduced. This distortion is greatly reduced by applying a high-frequency constant-amplitude bias signal mixed with the signal being recorded. The bias frequency is generally selected to be at least five times the upper frequency limit of the recorder to prevent any beating between the bias frequency and harmonics of the recorded signal.

While the tape is in the recording gap, the bias causes the magnetization characteristics of the iron-oxide to follow the dashed line loops shown in Fig. 2-3 (known as the "minor hysteresis loops"). As the tape leaves the gap, the influence of the magnetic field created by the bias is reduced to zero and the tape assumes a permanent state of magnetization (known as "remanent induction") determined by the gap flux at that time.

After the recording process, there exists on the tape a flux pattern which is proportional in magnitude and direction to the signal recorded. If the tape is then moved past the gap of a reproduce (playback) head — which is similar in construction to the record head — the magnetic flux of the moving tape will induce a voltage in the coil of the reproduce head. This induced voltage is proportional to the number of turns of wire on the head and the rate of change of flux. This is expressed by the equation $E=N\ (d\phi/dt)$ where E is the induced voltage (in electromagnetic units), N is the number of turns of wire, and $d\phi/dt$ is the rate of change of flux.

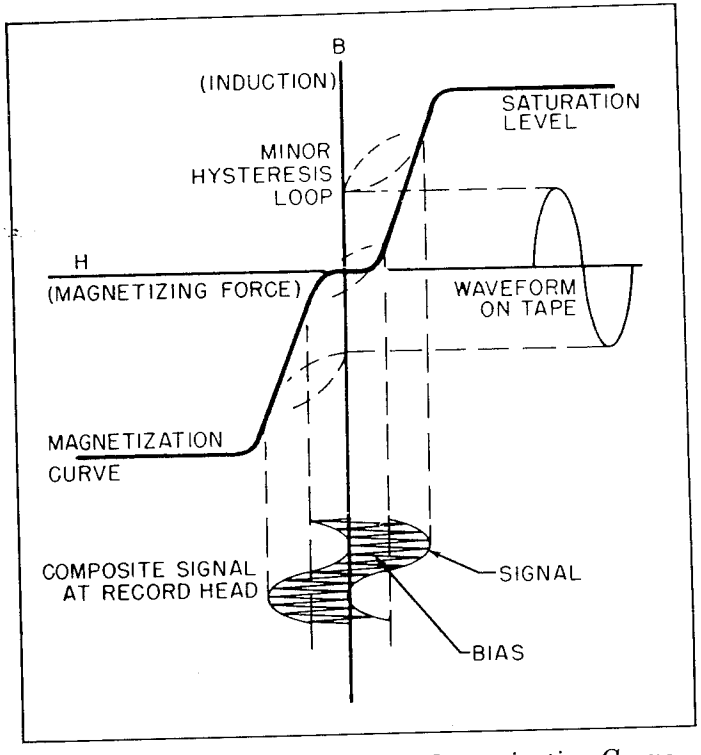


Fig. 2-3 Recording Medium Magnetization Curve

It is desirable that the gap in the reproduce head be as small as possible so it will intercept less than one wavelength of the signal on the tape at the highest frequency to be reproduced.

However, as the gap is made smaller, the induced voltage decreases, so there is a practical limit in decreasing the gap and still maintaining an adequate signal-to-noise ratio.

The voltage induced across the reproduce head during playback is computed by the equation $E=B_m V \text{ SIN } \pi\omega/\lambda$ where E is the induced voltage, B_m is the maximum flux density of the recording material, V is the velocity of the tape across the gap, ω is the gap width, and λ is the wavelength of the signal on the tape. From this expression it can be seen that the voltage across the coil increases directly as the velocity increases and as the wavelength decreases (frequency increases). If the tape velocity and gap width are assumed to be constant, the output voltage from the head is directly proportional to the frequency as long as the wavelength on the tape is large compared to the gap width.

This results in an output vs. frequency characteristic such as shown in curve A of Fig. 2-4. The voltage does not continue to rise indefinitely. As electrical losses in the core material increase and as the wavelength on the tape approaches the same dimensions as the reproduce head gap, the actual output resembles curve B of Fig. 2-4.

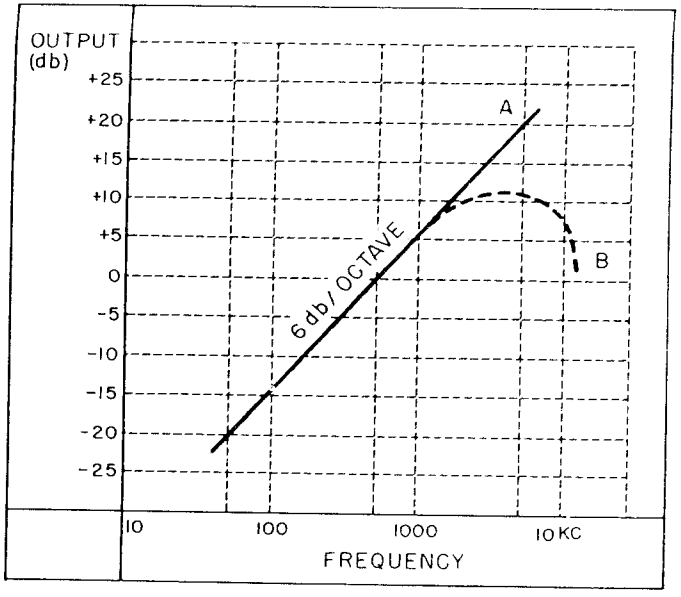


Fig. 2-4 Reproduce Head Characteristics

In order to provide an overall frequency response that is flat (see Fig. 2-5), an equalization circuit consisting of a series resistance and capacitance is inserted in one of the early stages of the reproduce amplifier. This equalizer has a high-frequency droop characteristic (curve B, Fig. 2-5) which is the inverse

of the reproduce head characteristic curve (curve A, Fig. 2-5). In order to extend the high-frequency response, additional equalization is included in the record amplifier in the form of a high-frequency boost circuit designed to compensate for the droop in record and playback head characteristics caused by core losses, self-demagnetization of the tape at short wavelengths, and the wavelength approaching the gap dimensions.

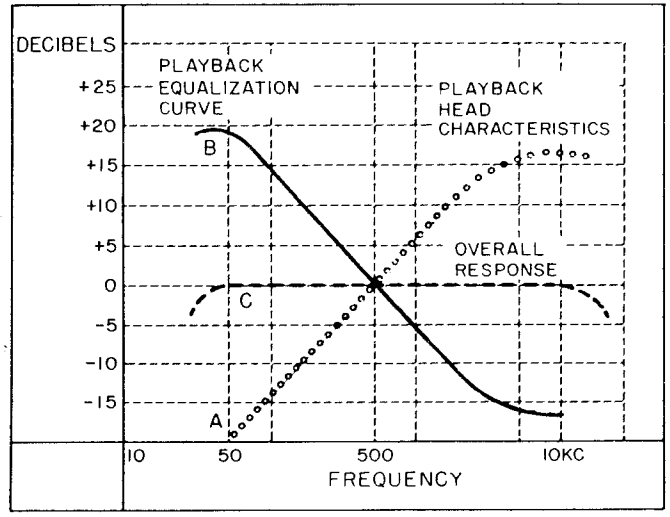


Fig. 2-5 Achieving Flat Overall Response

Basic Principles of Stereophonic Sound

It cannot be emphasized too strongly that stereophonic sound does not introduce a new concept of sound but simply is a means by which reproduced programs are imbued with the same audio perspective of direction and depth as are the normal everyday noises which our ears detect. Every person with normal hearing has the faculty for estimating very accurately the direction of a sound, and in the case of a continuous, moving, sound source the direction in which it is traveling. With less accuracy — and with a familiar sound such as that of an automobile engine — the observer can estimate the distance of the sound source from where he stands.

Directional aural sensing is accomplished by the brain, interpreting slight differences in arrival time (or intensity) of an individual sound wave at one ear as compared to the other ear in terms of direction. The natural impulse is to turn toward a sound source to locate it, and it is possible to achieve a directional accuracy of 1 or 2 degrees, corresponding to arrival

time differences of less than 20 microseconds (millionths of a second). It is not possible for a person deaf in one ear to distinguish these short time intervals and such a person is lacking a normal audio perspective sense.

This sense of audio perspective is graphically illustrated in Fig. 2-6. Here the sound waves radiate outward from a single point of origin toward an observer, with each individual wave striking the observer's left ear after traveling a distance equal

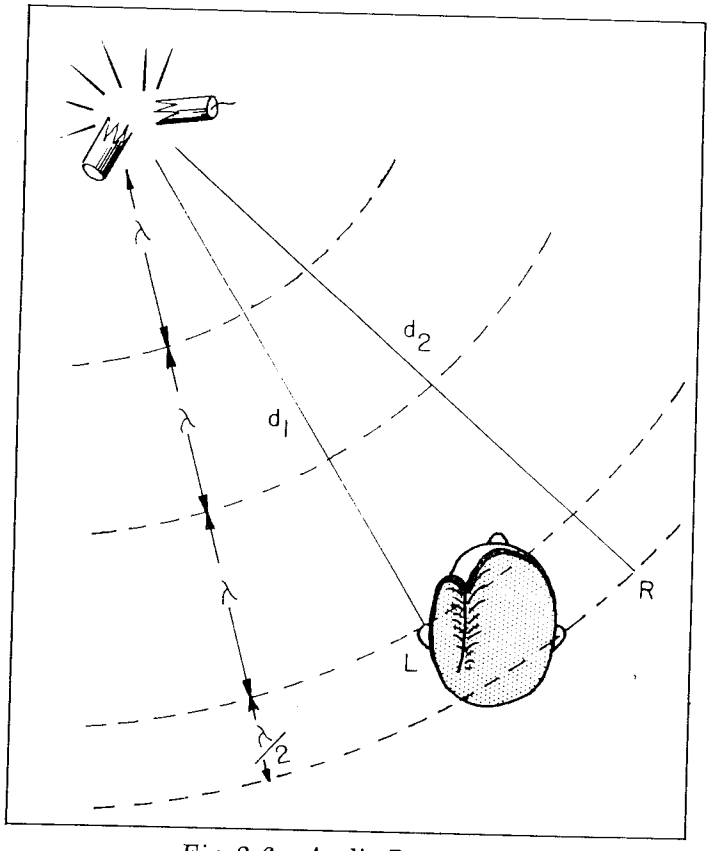


Fig. 2-6 Audio Perspective

to d1 and completing three cycles. The same wave will reach the observer's right ear after traveling a distance equal to d2 and completing three and one-half cycles. As sound energy is dispersed as the wave travels through the air, the slight difference in arrival time results not only in a difference in phasing at each ear (½ cycle in this instance) but also in a difference in sound intensity at each ear. Thus each ear hears the same

sound in a slightly different manner, and years of experience have conditioned our brains to interpret this difference in terms of direction.

Determining the distance of a sound source involves either comparing the loudness of the sound with a mental image of what it should be at its source, or (where reverberations are present) detecting the ratio of direct to reverberent sound. Neither is precise and the aural determination of distance is much less accurate than the aural directional sense. Everyone probably has had the experience of badly misjudging the distance of a sound heard for the first time, but having no difficulty in determining its direction.

Thus, all the sounds we hear in a normal day have direction and depth, *except sounds recorded and reproduced through conventional means for our entertainment.* Stereophonic recording and reproducing are the means by which our entertainment media are enriched with the normal audio perspective to which we are accustomed.

In the case of a source of sound from a single point recorded in the conventional manner (using one microphone), the sound waves impinge on the diaphragm of the instrument and generate an electric current which varies in the same manner as the original sound waves. However, the one microphone can detect only sound intensity, which is a function of the orginal intensity of the sound and its distance from the microphone. The microphone is "hearing" with one ear and since "difference" is meaningful only in comparing one quantity with another, neither intensity difference nor phase difference exist.

When the sound source is not at a single point but is a combination of a number of sources spread out in various directions in front of the recording microphone, the various intensities and phase angles of all the sounds are still being picked up by only one instrument. Since this instrument is completely lacking in any directional sense, the intensity of each individual sound is merely recorded in inverse proportion to its distance from the microphone. Phase differences for each individual sound do not exist at the single microphone.

When reproduced through a loud speaker, the system can convey only what the microphone has "heard." The aural directional sense of the listener comes into play when he listens to the output of loudspeaker but it only serves him in locating the position of the loudspeaker.

Now let us consider the case of a moving source of sound recorded in the conventional manner. Fig. 2-7 graphically represents the relative intensities of a source of sound moving from

left to right in front of a recording microphone. As the distance between the source and the microphone decreases, the sound intensity at the microphone increases. Thus, at point A, the sound has a certain level of intensity; at B the intensity is greater; and at C the intensity is greatest. At D the intensity has decreased to the same level as at B; and at E it has decreased to the same level as A. The microphone has picked up a sound which has risen from a certain level to a maximum level and then dropped to its original level. But a person listening to the reproduced recording cannot determine whether the sound

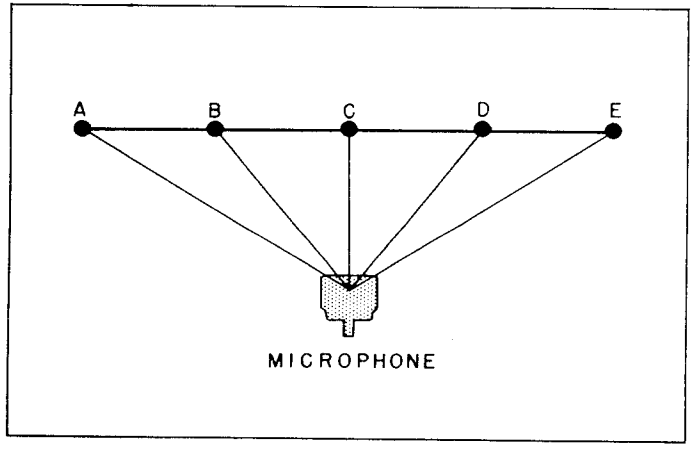


Fig. 2-7 Moving Sound Source Recorded With One Microphone

source crossed the microphone from left to right or from right to left, or if approached from a head-on direction, stopped, and receded along the same line. In each case, the microphone would pick up the same sequence of relative sound intensities. As far as the single microphone is concerned, the lateral component of direction is missing. We know by listening to the reproduced output that the sound has approached us and then receded from us. We have no way of knowing from what direction, because the single microphone has no way of detecting that direction. The result is conventional sound reproduction with no effect of audio perspective, likened to listening to normal sound funneled through a hole in the wall.

When the limitations of single-microphone recording are grasped, a natural impulse is to ask why stereophonic sound cannot be produced simply by recording from more than one microphone. It is true that if two or more microphones were used, both sound intensity differences and phase differences

would be detected, as each microphone would "hear" the same sound in a slightly different manner. But if the outputs of the microphones were mixed in a one-channel system and fed to one output, the stereophonic effect would be lost in the mixing process. The effect would not be stereophonic to the listener, as he would hear only one output whether this output were connected to one speaker or to many speakers. The general effect will be fuller but — just as in single microphone recording — there will be no sense of audio perspective. Thus, a true stereophonic system requires more than the simple addition of one or more recording microphones.

Let us now see how true stereophonic sound overcomes the limitations of conventional recording. When sound is recorded stereophonically, two or more recording microphones are used. In two-channel stereophonic recording, two microphones are positioned a distance apart usually equal to approximately one-third the width of the recording room as shown in Fig. 2-8. With this arrangement, each microphone picks up a point source of sound in a different manner, much the same as the observer's ears in Fig. 2-6. Both intensity differences and phase differences are detected, and when the signal from each microphone is recorded on a separate track of the magnetic tape, these relationships are preserved side by side on parallel tracks of the tape. If the output from each track is reproduced through a separate amplifier and loudspeaker, we will hear two different versions of the same sound being reproduced. When the speakers are properly positioned in the listening room, the acoustic characteristics of the original program are essentially re-created and the result is true stereophonic sound.

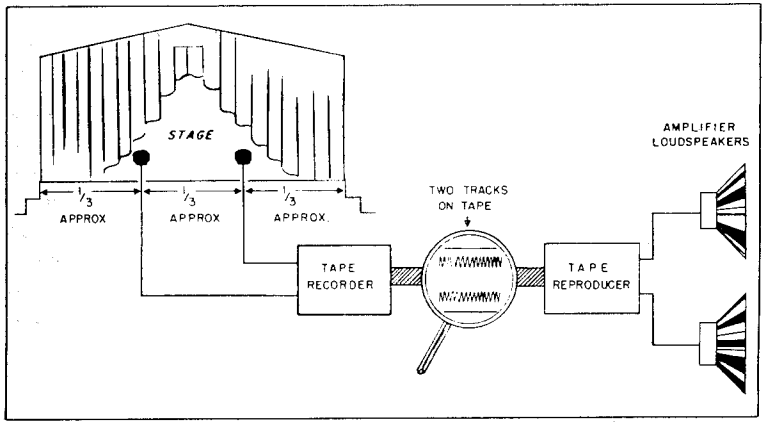


Fig. 2-8 Producing Two Channel Stereophonic Sound

When the total sound recorded is a combination of a number of sources, such as the different instruments in an orchestra, each individual sound source (except those centered directly between the two microphones) is picked up differently at each microphone. When listening to the reproduction of this recording through the two loudspeakers it is possible to distinguish the location of each individual sound. Thus in a musical selection the locations of the various instruments in the orchestra are seemingly apparent.

Now let us consider our moving source of sound recorded and reproduced stereophonically. This situation is represented

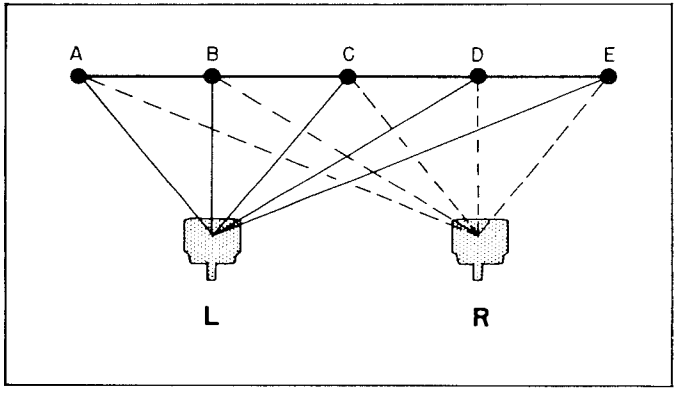


Fig. 2-9 Moving Sound Source Recorded With Two Microphones

in Fig. 2-9, L and R being the two recording microphones. Because of the difference in sound travel time when the source is at point A, it is picked up with a certain level of intensity at L and with a lower level of intensity at R. The difference in distance also causes each microphone to pick up the sound at a different point in its cycle; that is, phase difference is introduced. As the sound source moves from left to right, it is thus picked up by each microphone with varying intensities and phase relationships, depending on the instantaneous position of the sound source on the line AE. In other words, each microphone "hears" the same sound in a slightly different manner as the source moves from left to right. When the impressions of both microphones are fed through a two-channel system to two separate loudspeakers, so arranged that the left loudspeaker reproduces the impressions of the left microphone and the right loudspeaker the impressions of the right microphone, the

intensity differences and phase relationships of the actual sound are essentially preserved and reproduced in the listening room. Where the original sound was to the left, the reproduced sound will appear to be from the left. Where the original sound was to the right, the reproduced sound will appear to be from the right. At every point along the path AE, the apparent direction of the reproduced sound matches the direction of the original sound. To the listener, there remains no question as to whether the sound source crossed from left to right or from right to left. He can actually hear the sound moving from left to right.

The normal feeling of direction and depth in stereophonic sound reproduction has resulted in a startling increase in the realism of the reproduced sound. It has been said that the stereophonic system transports the sound source to the listener's room.

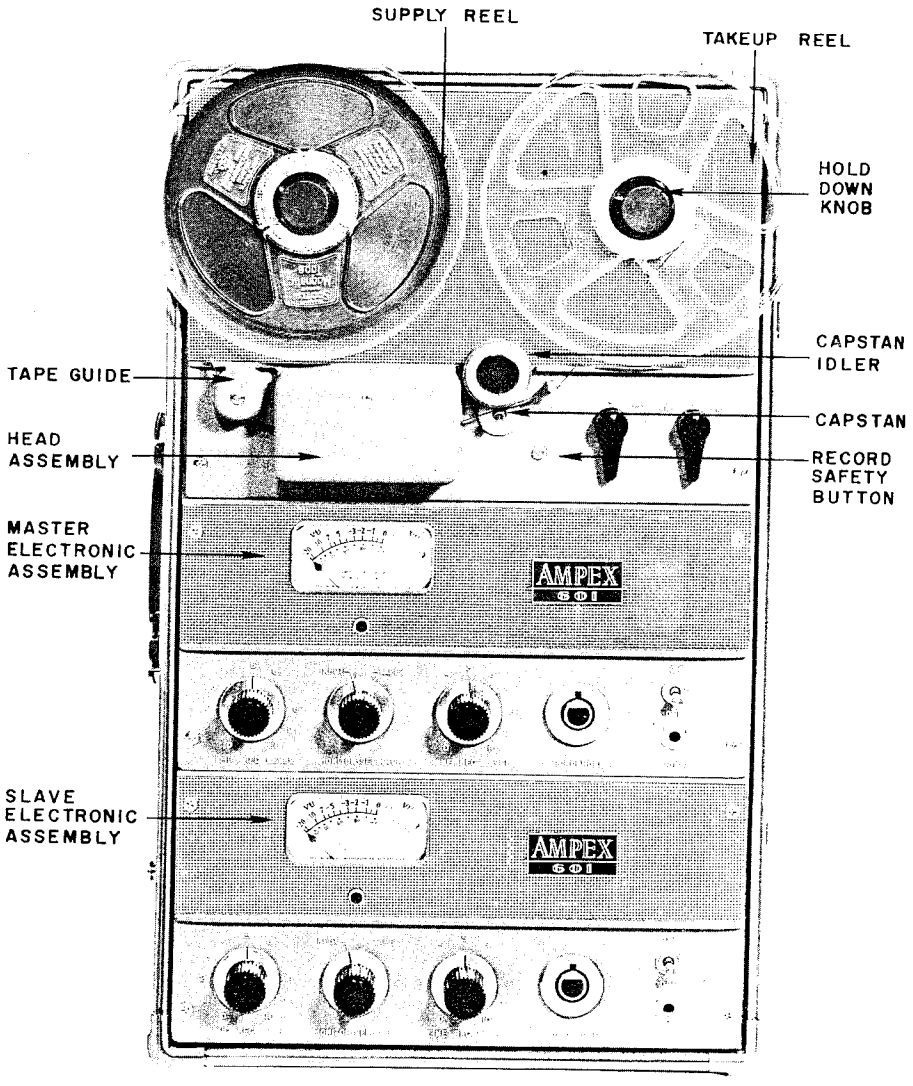


Fig. 3-1. Identification of Top Panel Components

Section 3
Installation

General

This machine can be operated in either the horizontal or vertical position. Installation consists only of making up and connecting the required cables (see "Connectors" in this section).

Power

The power requirements are 117 volt a-c, 50 or 60 cps, 0.9 ampere, 105 watts. A name plate on the bottom of the case adjacent to the aperture for OUTPUT, LINE INPUT and 117 v. a-c indicates the proper line frequency.

Line Input

The line inputs are unbalanced bridging inputs of 100,000 ohms. A signal of at least 0.5 volt should be available at the LINE INPUT connectors when recording from consolettes, mixers or other tape recorders.

Microphone Input

The recorder is wired for a high impedance microphone, but provision is made for an accessory plug-in transformer which immediately makes possible use of low impedance microphones. To make this conversion, remove the four screws on the front panel of the electronics assembly. The panel and assembly can then be removed.

A. High Impedance—a dummy plug J107P shown on the schematic diagram must be plugged into socket J106S for high impedance operation.

B. 150 Ohm to 250 Ohm—remove the dummy plug J107P. Accessory transformer AMPEX Catalog Number 17331-1 (shown as T103 on schematic diagram) plugged into J106S matches impedance in the range of 150 ohms to 250 ohms.

C. 30 Ohm to 50 Ohm—install transformer T103, and rewire J106S as shown in Note 8 on the schematic diagram.

Reproduce Output

The outputs of the machine match a 600 ohm unbalanced line. When high impedance lines must be used, terminate the OUTPUT connectors with 600 ohm resistors and bridge the resistors with the high impedance circuits. A three circuit OUTPUT plug is supplied. A two circuit plug can be used, but it will automatically unbalance the line. If AMPEX amplifier/loudspeakers are used plug them into the PHONE jacks to obtain the correct impedance match.

Interconnecting

Regardless of application observe the requirements under "Line Input" and "Reproduce Output" when interconnecting the machine with any other piece of equipment.

Connectors

Power cables and matching plugs for the MICROPHONE (J101S), LINE INPUT (J102S), and OUTPUT (J104S) connectors are supplied with the equipment.

Shielded, low-capacity cable is recommended for input and ouput cables. Make such cables as short as possible; refer to the schematic diagram to determine correct pin connections.

Balancing Stereophonic Speakers

It is important that both amplifier/loudspeakers in a stereophonic system be adjusted so that their outputs are identical for identical signals. This process is known as "Balancing". It is important to realize that when two amplifiers are used the same numerical setting on the controls may not indicate equal volumes.

In this equipment the easiest procedure to follow in balancing is to reproduce a full track recording using both electronic assemblies, and adjusting each amplifier/loudspeaker to give the same acoustic output level.

Phasing Stereophonic Speakers

Stereophonic speakers must be in phase—that is for a given signal both cones on the speakers must move in the same direction at the same time. The easiest procedure to follow is to place the two speakers approximately 4 to 6 inches apart and facing each other. Reproduce a full track tape, using both electronic assemblies and note the sound level. Reverse the leads to one speaker; if the sound level increased the speakers

PHASING STEREOPHONIC SPEAKERS cont'd.

are now in phase, if it decreased the original connection should be restored. AMPEX Amplifier/Loudspeakers are manufactured and tested to assure in-phase operation.

Placing Stereophonic Speakers

The speakers can be spaced as close as 3 feet if each is mounted at a slight outward angle (from 12 to 15 degrees outward from a line between the speakers). They can also be placed flat against the wall and spaced a distance equal to approximately ⅓ the wall length (3 or 4 feet each side of the center of an 18 foot wall). Personal preference and the acoustics of the area will actually determine speaker placement. They should never face inward (toward each other); corner enclosures are *not* recommended.

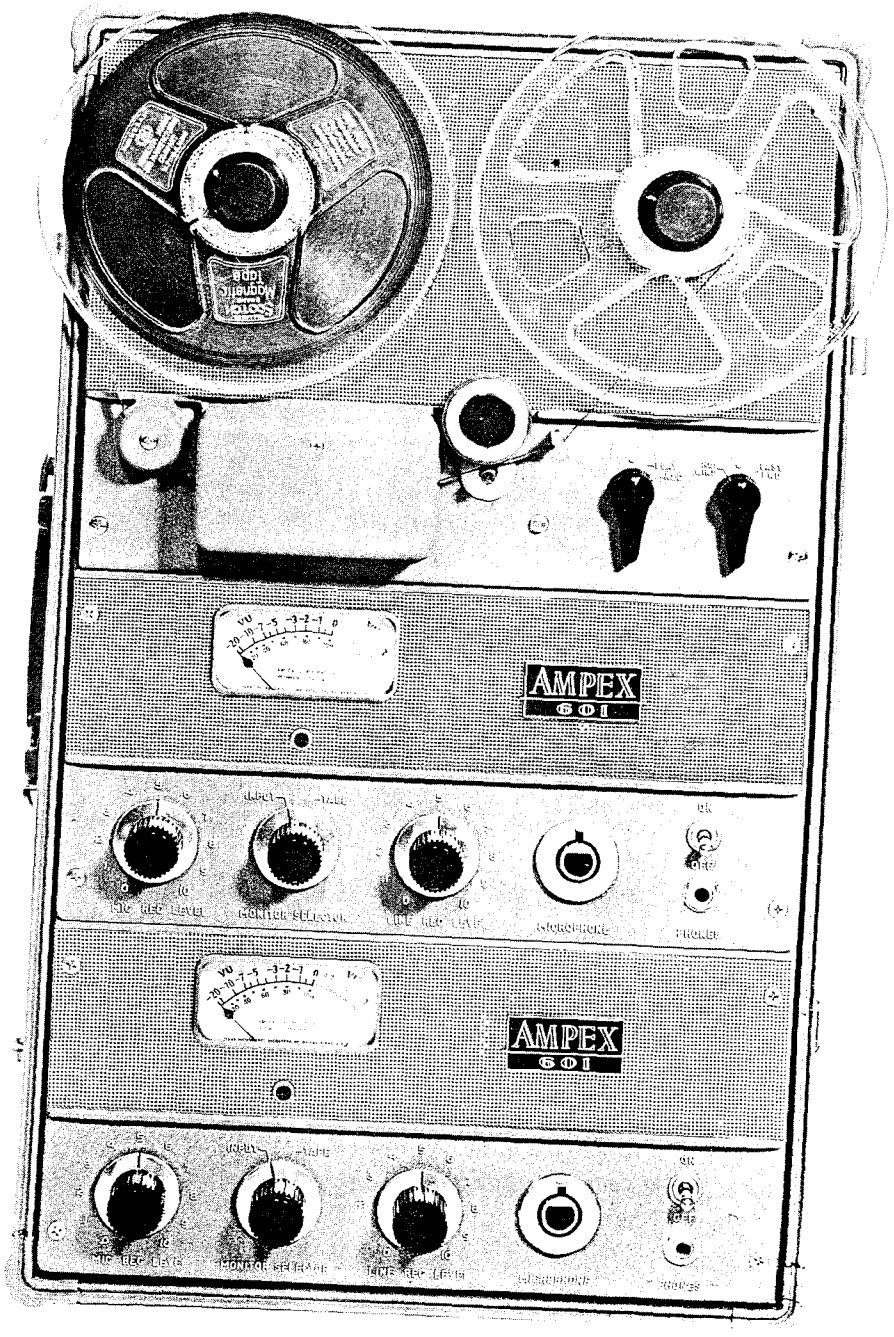


Fig. 4-1. Operating Controls

Section 4
Operation

Operating Controls and Indicators

Control	*No.*	*Location*	*Function*
PLAY-RECORD	1	Tape Transport	Controls tape motion in reproduce (play) or record mode. Places electronic assemblies in the play or record mode. Interlocked with Rewind - Fast Fwd. control.
REWIND—FAST FWD.	1	Tape Transport	Controls tape motion in fast winding modes in forward or reverse direction. Interlocked with Play-Record control.
RECORD SAFETY BUTTON	1	Tape Transport	Safety feature to prevent equipment being accidentally placed in record mode. Must be pressed while simultaneously turning PLAY-RECORD control to its Record position.
V-U METER	2	1 on each electronic assembly	Provides visual monitoring of record or reproduce level.
MIC REC LEVEL	2	1 on each electronic assembly	Adjusts Record level when recording from the microphone input.
MONITOR SELECTOR	2	1 on each electronic assembly	Provides selection of monitoring actual program (INPUT) or the recorded program off the tape (TAPE). Must be in TAPE position during reproduce mode.
LINE REC LEVEL	2	1 on each electronic assembly	Adjusts record level when recording from the line input.
ON - OFF	2	1 on each electronic assembly	Controls power to electronic assemblies and drive motor. Switch on master assembly overrides that on second assembly.

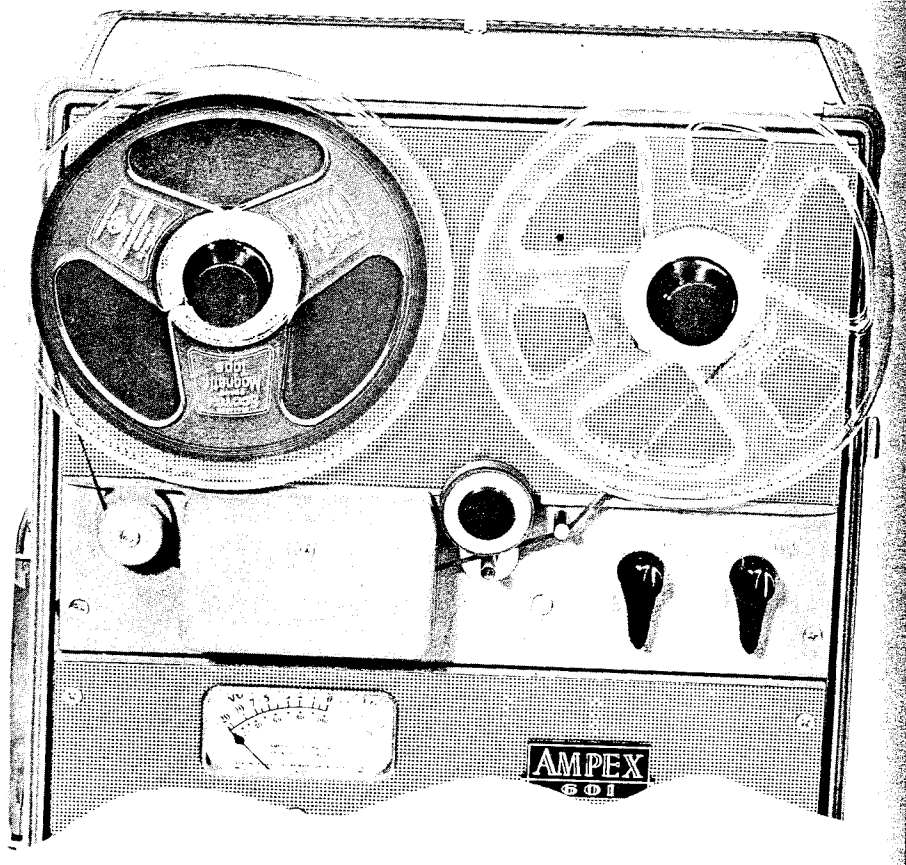


Fig. 4-2. Tape Threading Path

Tape Threading

Step 1: Place a reel of tape on the left-hand turntable, and an empty reel on the right-hand turntable, making certain that the pins around the base of each spindle engage corresponding slots on the reel hubs.

Step 2: Press a reel hold-down knob in place on each spindle.

Step 3: Thread the tape as indicated. Make sure the oxide or dull surface is against the heads.

Step 4: Anchor the tape in the slot on the empty reel hub if desired, but a full tape turn counterclockwise around the reel hub is usually sufficient.

RECORDING

General

Two types of recording can be made on this equipment—two track stereophonic or single (half) track. In stereophonic recording the master electronic assembly is connected to the sound source which is to the left when facing the recording area, and the second electronic assembly is connected to the sound source to the right. In single track recording the master electronic assembly is the only one used, with the power switch on the second assembly being left in its OFF position. Half track tapes can be recorded only in one direction, as the full track erase head would erase the first run while the second (reverse) run was being made.

Track 1 on the tape (on the upper half of the tape when it it threaded on the transport) is recorded and reproduced by the master electronic assembly, while track 2 (the lower half of the tape) is recorded and reproduced by the second electronic assembly.

Recording Two Track Stereophonic

Step 1: Connect the sound source on the left (when facing the recording area) to the appropriate input connector (microphone or line) on the master electronic assembly and the sound source on the right to the other electronic assembly.

Step 2: Thread a tape on the equipment.

Step 3: Place the MONITOR SELECTOR switch on each electronic assembly in its INPUT position.

Step 4: Place the ON-OFF toggle switch on each electronic assembly in its ON position. Allow a 20-second warm-up period.

RECORDING cont'd.

Step 5: Use rehearsal music or a test script to set the recording level. (It is not necessary to start the tape in motion). Depending upon which input is being used, adjust the MIC REC LEVEL or the LINE REC LEVEL on each electronic assembly so that the v-u meter indicates approximately zero v-u on the most intense signal peaks of the program material. (If both inputs are being used on one or both electronic assemblies, adjust both record level controls so that the mixed signal results in a zero v-u peak indication. Always turn the record level control for any *unused* input full counterclockwise).

Step 6: When recording is desired, press the safety button and simultaneously turn the PLAY-RECORD control on the tape transport to its RECORD position. Tape will start in motion and the recording process on both tape tracks will be functioning at the preset level.

Step 7: If necessary, readjust the record level controls.

Step 8: To obtain a comparison of the actual program and the recording on the tape, insert the plug on a set of high impedance headphones into the PHONES jack. Positioning of the MONITOR SELECTOR control will determine whether the headphones will monitor the input program (INPUT position) or the actual recording of that program on the tape (TAPE position). Switch back and forth between these two positions to obtain a continuous comparison. This comparison must be made for each electronic assembly.

Step 9: To stop the recording process, and tape motion, turn the PLAY-RECORD switch to its neutral (upright) position. It is not necessary to press the record safety button.

Recording Single (Half) Track on Upper Tape Track

Step 1: Connect the sound source to the appropriate input connector (microphone or line) on the master electronic assembly.

Step 2: Place the MONITOR SELECTOR switch on the master electronic assembly in its INPUT position.

Step 3: Thread a tape on the equipment.

Step 4: Place the ON-OFF toggle switch on the master electronic assembly in its ON position. Place this switch on the second electronic assembly in its OFF position. Allow a 20-second warm-up period.

RECORDING cont'd.

Step 5: Use rehearsal music or a test script to adjust the recording level (it is not necessary to start the tape in motion). Depending upon which input is being used, adjust the MIC REC LEVEL or the LINE REC LEVEL on the master electronic assembly so the v-u meter indicates zero v-u on the most intense peaks of the program to be recorded. (If both inputs are used, adjust both record level controls so that the mixed signal results in a zero v-u peak indication. If one input only is used, turn the other record level control full counterclockwise).

Step 6: When recording is desired, press the record safety button and simultaneously turn the PLAY-RECORD control to its RECORD position. Tape will start in motion and the recording process on the upper track will be functioning at the preset level.

Step 7: If necessary, readjust the record level.

Step 8: To obtain a comparison of the actual program and the recording on the tape, insert the plug of high impedance headphones into the PHONES jack on the master electronic assembly. Positioning of the MONITOR SELECTOR switch on the master electronic assembly will determine whether the headphones will monitor the input program (INPUT position) or the recording of that program on the tape (TAPE position). Switch back and forth between these two positions to obtain a continuous comparison.

Step 9: To stop the recording process, and tape motion, turn the PLAY-RECORD switch to its neutral (upright) position. It is not necessary to press the record safety button.

CAUTION

Do not attempt to record the lower half of the tape after recording on the upper half. The full track erase head will erase the first run while the second run is being recorded.

Recording Single (Half) Track on Lower Tape Track

Half track recording is normally made on the upper tape track as previously described. However, it is possible to record on the lower tape track by a procedure similar to that used when recording on the upper track.

RECORDING cont'd.

Step 1: Connect the sound source to the appropriate input connector (microphone or line) on the second electronic assembly.

Step 2: Place the MONITOR SELECTOR control on this electronic assembly in its INPUT position.

Step 3: Turn both record level controls on the *master* electronic assembly full counterclockwise.

Step 4: Thread a tape on the equipment.

Step 5: Place the ON-OFF toggle switch on *both* electronic assemblies in their ON position.

Step 6: Proceed as in Steps 5, 6, 7, 8, and 9 under Recording Single (Half) Track on Upper Tape Track, using the controls and adjustments for the second electronic assembly.

CAUTION

Do not attempt to record the upper half of the tape after recording the lower half. The full track erase head will erase the first run while the second run is being recorded.

Other Recording Possibilities

It is possible to record two separate programs simultaneously — one on the upper track and one on the lower track. Simply proceed as in recording stereophonically, with one program connected to the upper channel and the other program connected to the lower channel. Note that editing the resultant tape will be difficult, if not impossible.

REPRODUCING

General

This equipment can reproduce two track stereophonic recordings, half track (upper track, lower track, or both tracks in different directions) recordings, or full track recordings. Half track tapes will reproduce through 1 channel only, full track tapes can be reproduced through either or both channels.

Reproducing Two Track Stereophonic Recordings

Step 1: Be sure the associated equipment (amplifier/loudspeakers, studio lines, etc.) are correctly phased and balanced. (See Section 3, Installation.) If commercially recorded stereophonic tapes are to be reproduced they must have been recorded for "in-line" heads, *not* "staggered" heads.

REPRODUCING cont'd.

Step 2: Connect the associated equipment to the OUTPUT jacks on each electronic assembly so that the master assembly is connected to the equipment to the left when facing the equipment and the second electronic assembly is connected to the equipment to the right.

Step 3: Thread the recorded tape on the equipment.

Step 4: Place the ON-OFF switch on each electronic assembly in its ON position. Allow a 20-second warm-up period.

Step 5: Place the MONITOR SELECTOR switch on each electronic assembly in its TAPE position.

NOTE

The individual reproduce output of each track is dependent on placing its corresponding MONITOR SELECTOR switch in the TAPE position as in Step 5.

Step 6: To start the reproduce function, place the PLAY-RECORD control in its PLAY position. Both tracks on the tape will be reproduced.

Step 7: To stop the reproduce mode, return the PLAY-RECORD switch to its neutral (upright) position.

Step 8: Rewind the tape on the supply reel before removing it from the equipment.

Reproducing Single (Half) Track Tapes

Half track tapes recorded on this equipment will be recorded on the upper track of the tape or the lower track of the tape, but not on both tracks. Commercially recorded half track tapes are normally recorded on the upper track, then turned over and recorded on the other track in a direction reversed to that of the first run, thus doubling the amount of playing time available. This equipment will reproduce any of these three types.

Recorded Upper Track Only, or in Both Directions:

Step 1: Connect an amplifier/loudspeaker, studio line, etc., to the OUTPUT jack on the master electronic assembly only.

Step 2: Thread the recorded tape on the equipment.

Step 3: Place the ON-OFF switch on the master electronic assembly in its ON position. Leave this switch on the second electronic assembly in its OFF position. Allow a 20-second warm-up period.

REPRODUCING cont'd.

Step 4: Place the MONITOR SELECTOR switch on the master electronic assembly in its TAPE position. No reproduce output will be available if this switch is not in its indicated position.

Step 5: To start the reproduce mode, place the PLAY-RECORD switch in its PLAY position.

Step 6: To stop the reproduce mode, return the PLAY-RECORD switch to its neutral (upright) position.

Step 7: When reproducing programs recorded on only the upper track, rewind the tape on the supply reel before removing it from the equipment. To reproduce the second track on a commercially recorded tape proceed with Steps 8, 9, and 10.

Step 8: To reproduce the second track on a commercially recorded half track tape, let the tape continue in Forward motion until it is completely wound on the takeup reel (use Fast Forward if desired).

Step 9: Remove the full reel from the takeup turntable and place it on the supply turntable in the correct position for normal tape threading. Place the empty reel from the supply turntable on the takeup turntable. The tape is now correctly oriented to reproduce the second half of the tape.

Step 10: Thread the tape in the normal manner and reproduce the second half of the tape by repeating Steps 4, 5, and 6. When the reproduce mode is stopped let the tape continue in Forward motion until it is completely wound on the takeup reel (use Fast Forward if desired). Do not rewind the tape—simply take the full reel off the takeup turntable—as the tape is now correctly oriented to play the first run.

Recorded Lower Track Only (a special, non-standard condition).

Step 1: Connect an amplifier/loudspeaker, studio line, etc., to the OUTPUT jack on the second electronic assembly.

Step 2: Thread the recorded tape on the equipment.

Step 3: Place the ON-OFF switches on each electronic assembly in their ON positions. Allow a 20-second warm-up period.

REPRODUCING cont'd.

Step 4: Place the MONITOR SELECTOR switch on the second electronic assembly in its TAPE position. No reproduce output will be available if this switch is not in the indicated position.

Step 5: To start the reproduce mode place the PLAY-RECORD control in its PLAY position.

Step 6: To stop the reproduce mode and tape motion, return the PLAY-RECORD switch to its neutral (upright) position.

Step 7: Rewind the tape on the supply reel before removing it from the equipment.

Reproducing Full Track Tapes

Full track tapes may be reproduced using one piece of associated equipment such as an amplifier/loudspeaker or studio line (in which case the reproducing procedure is the same as that employed in reproducing half track recordings recorded on the upper track); or using two pieces of associated equipment (where the procedure is the same as that employed in reproducing stereophonic recordings) using both electronic assemblies. In amplifier/loudspeaker use the procedure which gives a seemingly fuller effect is that using both electronic assemblies and two amplifier/loudspeakers.

Rewind and Fast Forward

To rewind or move tape forward rapidly, place REWIND—FAST FWD switch in the position desired. The tape moves at approximately 800 feet per minute in either direction, and can be shuttled back and forth between REWIND and FAST FWD positions without waiting for the tape to decelerate or stop. Thus, cueing and editing can be accomplished at high speed with no danger of tape breakage.

The REWIND—FAST FWD and PLAY—REC controls are mechanically interlocked, making it impossible to turn either unless the other is in its neutral position. This safety feature guards against tape breakage which would occur if the machine were switched directly from either of the high speed modes to the play or record modes.

CAUTION

Always return the REWIND—FAST FWD control to its neutral position, and wait until tape motion stops before switching to PLAY or REC to prevent stretched or broken tape.

Operation

Erase

To erase a previously recorded tape, turn all of the record level controls full counterclockwise and run the tape in the record mode.

Mixing

Because microphone and line recording circuits for each electronic assembly are independent, each governed by its own level control, simultaneous recording from two sources on each tape track can be made without an external mixer.

Section 5
Tape Transport Assembly

General

The tape transport mechanism incorporates a single-speed synchronous motor and a system of pulleys, belts, and clutches to drive the capstan and the turntables. Three modes of tape motion (PLAY, REWIND, and FAST FORWARD) are determined by two controls located on the top panel of the tape transport. (The neutral position for each control is marked by a dot.)

The bracketed numbers in this section refer to parts shown in Fig. 5-1, Fig. 5-4, and in the parts list at the end of this manual. For greatest facility in following the discussion below, it is suggested that Fig. 5-4 be opened fully for ready reference.

Standby Operation

Power is applied to the drivemotor (63) when the POWER switch on the front panel of the electronic assembly is turned to the ON position. The capstan (42) begins to rotate immediately, being driven by a nylon belt (68) which runs between the motor pulley (61) and the capstan flywheel. A second belt (69) running in a groove in the capstan flywheel drives the play takeup pulley (40). The shock relief brake rollers (2) are engaged against the rubber-tired fast forward and rewind clutches (16 and 31). Both turntables are motionless, and the machine is in standby condition.

Since the capstan is in motion when the machine is in the standby condition, the tape will accelerate to full play speed almost instantly when the PLAY switch is operated, thus producing a wow-free start.

Play Mode

When the PLAY control is energized the following mechanical sequence occurs:

1) The play takeup pulley (40) and belt (69) are brought to bear on the play takeup clutch (19).
2) The shock relief brake roller (2) on the play takeup side is released from the fast forward clutch tire (16).
3) The capstan idler (79) engages the capstan (42), which drives the tape, pulling it from the tape supply turntable (i.e., the rewind turntable) and feeding it to the takeup turntable, which now begins to rotate. It is especially important to understand that when the machine is operating normally in the play mode, in which the tape is clamped against the capstan by the capstan

PLAY MODE cont'd.

idler, the turntables are effectively isolated from each other. The takeup turntable, as its name implies, does nothing more than take up the tape fed to it by the capstan. It does not pull the tape from the tape supply turntable.

4) The shock relief brake roller (2) on the rewind side remains engaged against the rewind clutch tire (31), and slippage occurs between the clutch and disc assembly (30). The friction produced in this slippage, and the friction produced by the rewind holdback brake (37) operating on the bakelite drum (35) provide the required holdback tension.

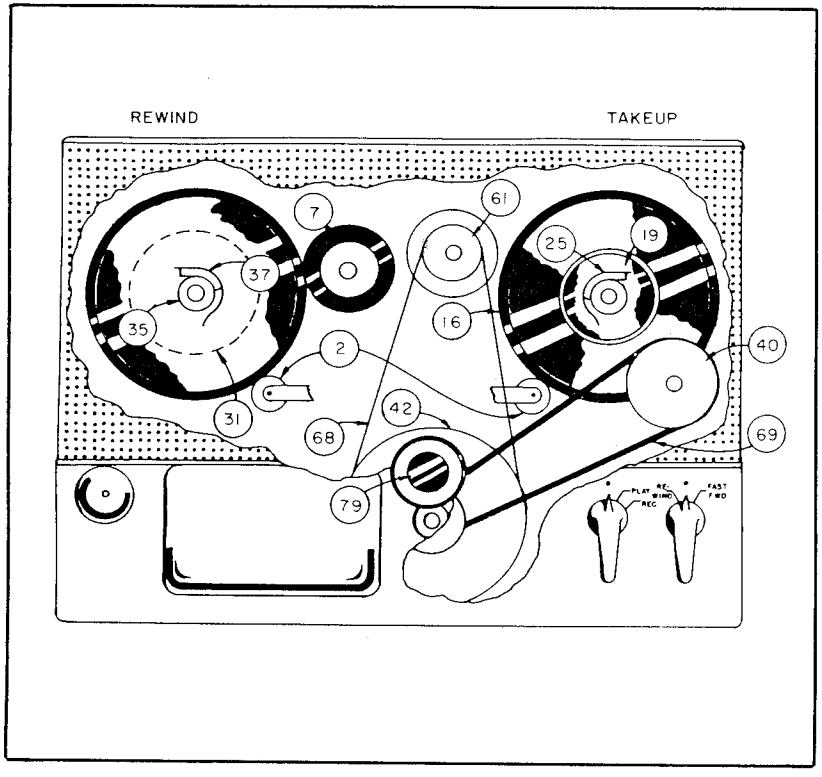


Fig. 5-1. Mechanical Operation Simplified

Rewind Mode

The REWIND - FAST FORWARD control cannot be operated unless the PLAY control is in neutral. When the REWIND-FAST FORWARD control is turned to REWIND:

1) Both shock relief brake rollers (2) are released.
2) The rewind idler (7) is clamped between the motor pulley (61) and the rewind clutch tire (31) and the rewind turntable is driven.
3) Holdback tension is provided by the holdback brake (25) on the takeup assembly as tape is pulled from the takeup turntable.

Fast Forward Mode

When the REWIND-FAST FORWARD control is turned to FAST-FORWARD:

1) Both shock relief brake rollers (2) are released.
2) The rubber-tired fast forward clutch (16) is brought to bear on the motor pulley (61) and drives the takeup turntable.
3) Holdback tension is produced by the holdback brake (37) on the rewind assembly.

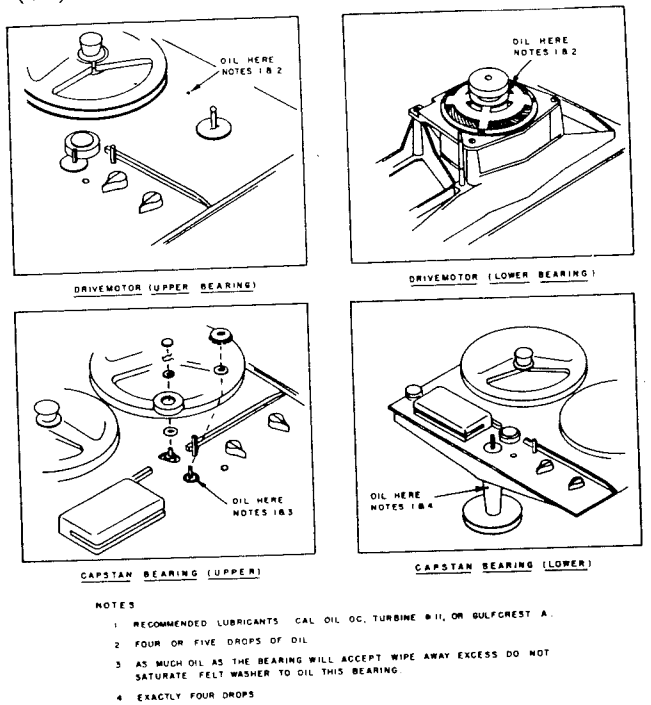


Fig. 5-2. Routine Lubrication

Routine Maintenance

Cleaning

Routine maintenance of the tape transport mechanism consists primarily of periodic cleaning and lubrication.

Cleanliness of all parts of the tape drive mechanism is required for consistent optimum performance. Most tape manufacturers lubricate their tapes; this lubricant will gradually form a coating on the head assembly and the idler wheels and may cause loss of positive drive at the capstan. Therefore, periodic cleaning of both the head assembly and all parts of the tape drive mechanism is particularly important. The recommended agent for cleaning Ampex Head Assemblies is a mixture of Xylene, 2% Carbon Tetrachloride and 0.1% Aerosol. (Ampex Catalog No. 087-007.) To clean any head assembly simply wind a clean, lintless cloth on a swab-stick and moisten with this mixture. Swab the heads periodically to remove all dirt and oxide which may have accumulated from the tape.

Clean all parts except the head assembly with a clean, lintless cloth moistened with denatured alcohol.

CAUTION

Do not use any other solvents as there are some which may damage the adhesive used to hold the head laminations together.

Lubrication

The recommended standard lubricant for the four places which require periodic lubrication (motor and capstan) is Caloil No. OC-11. (Ampex Catalog No. 087-005.)

The upper and lower bearings of the drive motor should be lubricated after every 500 hours of operation. The upper oil hole of the motor is accessible through a hole in the tape transport grille slightly above and to the left of the takeup turntable. For access to the lower oil hole, located in the side of the motor end bell, remove the tape transport from the case (see Fig. 5-2).

Four or five drops of the recommended lubricant is sufficient. Care should be taken to avoid over-oiling or spills. Any such excess should be wiped away with solvent.

The capstan may require oiling about once for every four oilings of the drive motor. For access to the upper bearing, the

LUBRICATION cont'd.

capstan idler must first be removed (see Fig. 5-2). Remove the rubber cap on the idler. Remove the hairpin retainer and lift the idler off its shaft, taking care not to lose the washers associated with it. The aluminum plug-bottom over the capstan shaft may now be pried off and the felt washer beneath it removed to expose the upper capstan bearing. Use as much of the recommended lubricant as the bearing will accept, wipe away any excess, and reassemble.

CAUTION

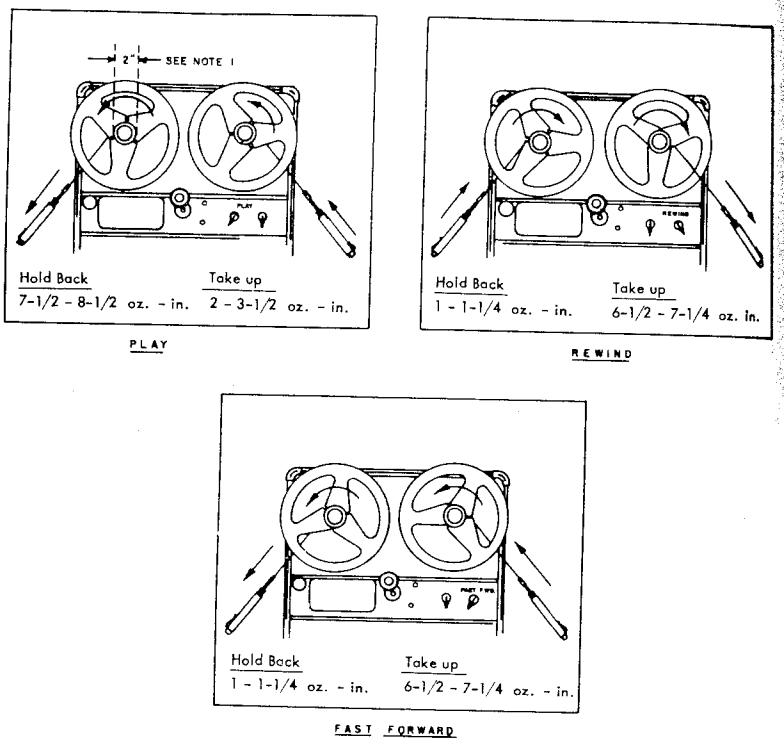
Do not oil the felt washer which serves only as a dust protector and to keep oil from working its way up the capstan.

For access to the lower bearing, remove the tape transport from the case. The oil hole is located in the bearing housing as shown in Fig. 5-2. *Use exactly four drops of oil — no more.*

Do not oil any other parts of the tape transport mechanism. All other bearings and moving parts are lubricated for life.

Mechanical Troubleshooting

It may be said in general, that most of the difficulties that will normally be encountered in the tape transport mechanism will be traceable to contamination of belts, pulleys, bearings, and other friction surfaces, whether due to carelessness in routine lubrication, or to the gradual accumulation of dirt and other foreign material to be expected over a reasonable length of time. Correction of these difficulties will usually be a matter of careful disassembly and cleaning, rather than readjustment of the mechanism. The normal torques (and hence, tape tension) in this mechanism are, in fact, fixed within strict design specifications, and are not adjustable. The measurement of these torques will frequently provide a rapid means for isolating the source of mechanical troubles.



NOTES:

1. IF REEL HUB DIAMETER IS LARGER OR SMALLER THAN 2 INCHES, MULTIPLY SPRING SCALE READING BY HUB RADIUS TO OBTAIN OZ-IN READING.
2. PULL SCALE WITH STEADY MOTION WHEN MEASURING HOLDBACK TENSIONS. ALLOW SCALE TO MOVE IN TOWARD REEL WHEN MEASURING TAKEUP TENSIONS. TAKE ALL READINGS WHILE SCALE IS IN MOTION.

Fig. 5-3. Tape Tension Measurements

Torques and Tape Tension

The measurement of torques requires the following equipment:

1) A light-movement spring scale (e.g., Post-A-Let, 0 to 8 oz., Exact Weight Scale Co., Columbus, Ohio).
2) A measuring hub. A standard RETMA plastic reel may be used. If the hub diameter is exactly 2 inches, the spring scale will read directly in ounce-inches. Reels with smaller hubs can be brought up to 2-inch diameter by winding on sufficient tape. If a reel of greater than 2-inch hub diameter is used, multiply the spring scale reading by the hub *radius* to obtain the ounce-inch reading.

3) A piece of string, approximately 30 inches long, with a small loop tied at one end.

Torques measured on the driven turntable in any mode, (i.e., the turntable on which the tape is being wound) are a measure of *takeup tension*. Torques measured on the turntable from which the tape is pulled in any mode are a measure of holdback tension. (See Fig. 5-3.)

Takeup Tension

Step 1: Place the measuring hub on the driven turntable.

Step 2: Wind a few turns of string around the hub in the direction of normal tape wrap, and attach the spring scale to the loop at the end.

Step 3: Start the machine in the appropriate mode and, as the string is wound on the hub, allow the scale to move in with it, taking the reading while the scale is in motion. Normal torques are as follows:

Fast Forward	6-1/2 - 7-1/4	oz. - in.
Rewind	6-1/2 - 7-1/4	oz. - in.
Play	2 - 3-1/2	oz. - in.

Holdback Tension

Step 1: Place the measuring hub on the turntable from which the tape is pulled in the mode in operation.

Step 2: Wind the string on fully in the direction of normal tape wrap, and attach the spring scale.

Step 3: Start the machine in the appropriate mode, and pull the scale slowly in the direction in which tape is normally pulled from this reel, taking the reading while the scale is in steady motion. Normal torques are as follows:

Fast Forward	1 - 1-1/4	oz. - in.
Rewind	1 - 1-1/4	oz. - in.
Play	7-1/2 - 8-1/2	oz. - in.

These values listed above for both takeup and holdback tensions may be close to the lower limit when the machine is new, and will usually move up toward the upper limit after the first 10 or 12 hours of operation.

Malfunctions in Play Mode

Nearly all malfunctions in the play mode will be reflected as flutter and wow in excess of specifications. A quick check of takeup and holdback tensions, discussed in the previous section, may lead directly to the source of trouble. Possible causes of flutter and wow are suggested in the following check list.

The word "contaminated," as used here, may indicate either the presence of oil where it is not wanted, or accumulations of dirt and other foreign matter on pulleys and belt. In either case, carbon tetrachloride is recommended as the cleaning agent. After cleaning a contaminated part, clean any other part with which it normally comes into contact whether or not that part shows any immediate evidence of contamination. Bracketed numbers refer to parts shown in the exploded view of the mechanical assembly, Fig. 5-4, which should serve as a guide for any necessary disassembly and reassembly.

Malfunctions in Rewind or Fast Forward Mode

Rewind and fast forward malfunctions will usually be reflected as an apparent loss of power in those modes, loose tape wind, erratic tape motion or slippage, and, possibly no rewind or fast forward at all. The first step is to make a quick check of rewind or fast forward takeup and holdback tensions as described previously. The malfunctions discussed below apply to either mode, the turntables, associated components, and tape directions being opposite of each other.

Starting, Stopping and Shuttling Malfunctions

Starting, stopping, and shuttling malfunctions will be evidenced by the throwing of tape loops and, in extreme cases, by tape breakage. These troubles are usually associated with low takeup tension or brake malfunctions produced primarily by tampering or misassembly, or contamination due to careless oiling or accumulation of dirt.

Assembly and Construction Notes

The following section covers some adjustments, critical clearances, and alignment which must be maintained in reassembling parts of the tape transport mechanism that may have been disassembled for servicing. Two general precautions should be observed in any required disassembly:

1) Always note the number, type, and location of washers

in an assembly very carefully. Should washers, retainers or other small hardware be lost or damaged in servicing, a kit containing an assortment of such hardware (Ampex Catalog No. 7802) is available.

2) To remove the sub-plate (1), a preliminary to any further disassembly of parts under the top plate casting, remove only the three elastic stop-nuts that hold it, and clevis pin that links the slide lever (13) to the lower yoke of the rewind/fast forward actuator (48). It is unnecessary to remove the adjustment screws (70 and 71) for the capstan thrust and the motor thrust. If the settings for these screws are changed, they must be carefully readjusted as described in the following subsections. The thrust discs (65) beneath these screws, being coated with grease, will usually stay in place when the sub-plate is removed. It is advisable, however, to be sure that they do not fall out. It will generally be found easiest to re-install the sub-plate after servicing, if the PLAY control is energized.

The tape transport incorporates rubber shock mounts on the screws retaining the motor mounting plate to the top plate casting. These shock mounts provide automatic centering of the drivemotor and no adjustments are necessary.

Drivemotor Thrust

The drivemotor thrust is a hardened steel ball (60) against a nylon disc (65). The capstan thrust is adjusted by a set-screw (70). End play of .010 in. to .015 in. is required, and is obtained as follows:

Step 1: Coat the nylon thrust disc liberally with wheel bearing grease and drop it through the threaded hole in the sub-plate (1) over the capstan shaft.

Step 2: Insert the set-screw, and tighten down until it is felt to bottom on the thrust disc.

Step 3: Grasp the capstan flywheel (42) between the thumb and index finger.

Step 4: While maintaining a slight downward pressure on the head of the set-screw with the screwdriver (to simulate the pressure that will later be applied by the locking screw) start backing the screw off slowly, and work the capstan flywheel up and down until an audible click at the ends of its travel indicates the

DRIVEMOTOR THRUST cont'd.

presence of end play. This will usually occur when the set-screw has been backed off approximately ¼ of a turn. At this point, end play should be in the required range.

Step 5: Tighten the locking nut on the set screw, then recheck end play.

Turntable Height

Turntable height (the distance measured from the top surface of the turntable (78) to the perforated metal grille) should be .125 in., ±.008 in. This height is determined by the replacement of lamicoid washers between the bottom of the turntable pivot (24 or 36) and the hairpin retainer on the shaft through the pivot. Difficulties in tape tracking traced to improper turntable height may be corrected by increasing or decreasing the number or thickness of these washers.

Play Takeup Clutch

The play takeup clutch assembly consists of a felt-lined aluminum disc (18), and a bakelite clutch (19) which is spring-loaded to the disc. When the machine is in the play mode, the clutch is driven by the rubber belt (69) on the play takeup pulley (40). Location of the felt-lined aluminum disc is critical—a clearance of .015 in. being required between the end of the oilite bearing (21) which goes through the bakelite clutch (19), and the bottom of the aluminum disc (18). This clearance, which cannot be measured directly with a gauge because of the physical arrangement can be set quite accurately by the following indirect method:

Step 1: Insert a removable .015 in. shim or feeler gauge between the thrust washer that rides on the inner race of the lower ball bearing (22) of the takeup turntable pivot (24) and oilite bushing (21).

Step 2: Assemble the conical spring (20), the bakelite clutch (19), and the felt-lined aluminum disc (18) (in that order) on the turntable shaft (29).

Step 3: Guide the end of the oilite bushing through the hole in the center of the bakelite clutch, and press the aluminum disc down until it bottoms firmly on the end of the bushing.

Step 4: Holding the disc plate in place, tighten the set screw in its hub.

PLAY TAKEUP THRUST cont'd.

Step 5: Remove the shim or gauge. The expansion of the conical spring will then force the oilite bushing back off the aluminum disc, thus creating the required .015 in. clearance.

Rewind and Fast Forward Clutch Alignment

The rubber-tired rewind (31) and fast forward clutches must line up with the shock relief brake rollers (5) so that the rollers engage the full width of the tires. In addition, the rewind clutch (31) should be aligned for full-width contact with the rewind idler (7) and the fast forward clutch (16) for full width contact with the motor pulley (61).

Capstan Speed

The capstan speed will not vary, since the capstan is driven by a non-slipping nylon belt and synchronous motor. No adjustment of the capstan speed will be necessary. If it is desired to check the capstan speed, use a pre-recorded 5000 cycle tape, that has been recorded on a machine of known accuracy, and an electronic frequency counter.

TABLE 4-1

Troubleshooting PLAY Mode Malfunctions

Trouble	Probable Cause
Excessive or Erratic Holdback Tension	1. Contaminated rewind clutch felt (30).
	2. Contaminated rewind clutch tire (31).
	3. Rewind clutch spring (32) too stiff. This actually indicates tampering or carelessness in reassembly. It is advisable to replace the spring rather than to attempt makeshift readjustment.
Excessive Takeup Tension	1. Contaminated play takeup clutch felt (18).
	2. Oilite bearing (21) bottoming on aluminum clutch disc (18). Minimum clearance should be .015".
	3. Takeup clutch spring (20) too stiff.

Tape Transport Assembly

CAPSTAN SPEED cont'd.	*Drivemotor Out of Synchronism*	1. Line voltage below 105 volts a-c. 2. Excessive play takeup tension. See trouble above. 3. Nylon drive belt (68) tension excessive. 4. Belt tensioning idler (55) dragging. 5. Drivemotor thrust misadjusted. 6. Defective drivemotor starting capacitor. 7. Dry bearings in drivemotor (63), capstan (42), or capstan idler (79). See lubrication instructions. 8. Defective drivemotor (63).
	Flatted or Dented Capstan Idler Tire	1. If the capstan idler (79) is left engaged over an extended period when the machine is not operating, the idler tire may become dented. If running the machine in the play mode for several hours does not restore the tire to normal, the idler must be replaced.
	Defective or Improperly Installed Nylon Drive Belt (68)	1. Belt spliced improperly. 2. Belt installed with splice joint toward pulley. 3. Belt worn because misaligned motor pulley (61) causes the belt to track against one of the capstan pulley flanges (42).
	Rewind Idler (7) Not Disengaging From Motor Pulley (61)	1. Contaminated rewind idler guide (8).
	Reels Misaligned With Respect to Tape Guides	1. This will usually cause tape scrape which may or may not be audible but will generally appear as flutter.

TABLE 4-2

Troubleshooting REWIND and FAST FORWARD Mode Malfunctions

Trouble	Probable Cause
Takeup Tension Low	Clutch leaf spring (17 and 32) too weak, usually caused by tampering. Replace. Never attempt to increase rewind takeup tension to offset other problems.
Excessive Holdback Tension	1. Contaminated holdback wipes (25 or 37). 2. Bakelite drum (23 or 35) on which wipe operates has been roughened.
Brake Shock Relief Roller (2) Not Releasing From Fast Forward Clutch (16)	Evidence of bent or misassembled parts. Check exploded view, Fig. 5-4.
Rewind Idler (7) Not Engaging Motor Pulley (61) Bind in Rewind Idler Bearing (Part of 7)	Bind in idler guide (8) caused by contamination.
Malfunctioning Turntable Pivots (24 or 36)	Bind in turntable centering detent (77).

CAPSTAN SPEED cont'd.

TABLE 4-3

Troubleshooting Starting, Stopping, and Shuttling Malfunctions

Trouble	Probable Cause
Tape Loop Thrown on Starting in Play Mode (Low Play Takeup Tension)	1. Play takeup belt (69) contaminated. 2. Nylon drive belt (68) contaminated. If either the play takeup belt or the nylon drive belt is contaminated with oil, an overoiled motor or capstan is indicated. Clean all affected parts thoroughly with carbon tetrachloride. 3. Slippage between play takeup belt (69) and clutch (19) due either to weak play takeup arm spring (41) or bind in play takeup pulley bearing (part of 40). 4. Bind in turntable shaft bearings (22 or 24) due to contamination. Clean and lubricate with two or three drops of medium weight oil. 5. Play takeup brake release (14) inoperative due to bind, weak or unattached spring (11) causing shock relief roller (2) to drag on fast forward clutch tire (16).
Tape Loop Thrown on Stopping or Shuttling	1. One or both brake shock relief actuators (2) binding. 2. One or both brake shock relief springs (12) off. End loops on these springs must be fully closed to prevent their becoming disconnected. 3. Bind in turntable centering detent (77).

Section 6
Electronic Assemblies

General

The master electronic assembly consists of a record channel, a reproduce channel, a bias and erase oscillator, and a power supply, mounted on a single chassis. The second electronic assembly is similar to the master, the only difference being that the bias and erase oscillator has been eliminated. The discussions which follow apply to both assemblies, unless otherwise indicated.

Record Channel

The record channel consists of a two-stage microphone preamplifier (V101 and V102A), followed by three stages of amplification (V102B, V103A and V103B). A line input bypasses the microphone preamplifier stages.

When the equipment is shipped from the factory, dummy plug J107P is inserted in receptacle J106S in the microphone preamplifier input circuit, so that the inputs match high impedance microphones. Plug-in transformers, available as accessory equipment, may be plugged into these receptacles and will provide the proper match for low impedance microphones.

The MICROPHONE input J101S and LINE INPUT J102S have separate level controls (R106 and R125 respectively). Both inputs can be used simultaneously, with mixing taking place in the V102B stage. Signals in the record channel are picked off RECORD CALIBRATION potentiometer R114 in the output circuit of this stage, and can be switched to the reproduce amplifier through the MONITOR SELECTOR switch S102, for monitoring.

Record equalization, accomplished in the grid circuit of V103A, is adjusted by trimmer C107, with high frequency preemphasis supplied by a series l-c network in the cathode circuit of V103B. Plate voltage is supplied to the last stage of the record amplifier V103B only when switch S201 on the tape transport is in the REC position. The record amplifier output is mixed with the high frequency bias and then delivered to the record head.

Reproduce Channel

The reproduce channel consists of a two-stage amplifier (V104, V105) and an amplifier-cathode follower output stage

REPRODUCE CHANNEL cont'd.

(V106A and V106B). The signal from the reproduce head appears at connector P101P. Reproduce equalization is provided by C116 and R130. Level is adjusted by potentiometer R137.

The reproduce signal is fed to the output amplifier through the MONITOR SELECTOR switch when it is in its TAPE position. The output amplifier consists of one voltage amplification stage V106A, and a cathode follower output stage V106B, which is transformer-coupled to OUTPUT connector J104S. A v-u meter and load resistor (automatically disconnected when a phone plug is inserted in J104S) shunt the secondary of the output transformer. A phone jack is inserted across the primary of the transformer.

Bias and Erase Oscillator

(Master Assembly Only)

The bias and erase oscillator is an l-c push-pull oscillator operating at approximately 100 kc. The NOISE BALANCE potentiometer R147, common to both grids of the oscillator, is adjusted to eliminate any asymmetry in bias wave form, which would introduce a d-c current in the record head, causing permanent magnetization of the head and a resultant distorted signal. The oscillator, dependent on plate voltage, operates only when switch S201 is in the REC position. Full output of the oscillator is fed to the erase head. The output is also routed to the output circuit of both record amplifiers in both electronic assemblies, where it is adjusted by trimmer capacitors C113, mixed with the signal output, and delivered to both record heads.

Power Supply

The d-c plate supply consists of a full wave rectifier V108, and a capacitor-input l-c filter. A 6.3 volt winding on the power transformer furnishes a-c power to all heaters. HUM BAL potentiometer R150 is adjusted for minimum hum.

Electronic Alignment

Alignment consists in making all necessary adjustments for proper electronic performance. A recorder out of alignment may be characterized by poor frequency response, high noise, low output, high distortion, or a combination of these faults. All Ampex recorders are completely aligned at the factory, and no adjustments should be necessary before placing the equipment in operation.

ELECTRONIC ALIGNMENT cont'd.

Alignment can be accomplished without removing the electronic assemblies from the case. If desired they can be withdrawn by removing the four screws on the front panel. Stand the case in a vertical position and pull the electronic assembly forward. The interconnecting cables between the electronic assemblies and the tape tranport are sufficiently long for access to all adjustments while the units are connected.

Alignment and Test Equipments Requirements

The following equipment is required for proper alignment and testing:

A. Audio Oscillator — Hewlett-Packard Model 200C or equivalent.

B. Vacuum Tube Voltmeter—Hewlett-Packard Model 400C or equivalent.

C. Ampex Alignment Tape — Catalog No. 5563. This tape is recorded at 7½ ips 10 db below normal operating level. The tape contains voice announcements of the following tone sequence: reproduce head alignment tone, reference tone for reproduce level adjustment, and a tone series for reproduce response check.

D. Ampex Head Demagnetizer—Catalog No. 704.

E. High Impedance Headphones.

F. Small Screwdriver.

Head Demagnetization

Demagnetize the record and reproduce heads before aligning the machine. The erase head requires no demagnetization. Magnetized heads will generally produce an increase of 5 to 10 db in noise level, distortion of the recorded signal, and will gradually erase the high frequencies on any tape passed over them.

Demagnetization Procedure

Step 1: Remove both the head cover and the mu metal shield over the head assembly.

Step 2: Place the ON—OFF switch in the OFF position.

Step 3: Cover the tips of the demagnetizer with scotch tape or masking tape. This prevents scratching the heads. Plug the demagnetizer into a source of 117-volt a-c power.

DEMAGNETIZATION PROCEDURE cont'd.

Step 4: The head sequence, from left to right when facing the machine, is erase head, record head, reproduce head. Bring the tips of the demagnetizer into contact with the record head stack. The tips should straddle the gap in the center of the stack. Run the tips slowly up and down the stack several times, and then withdraw the demagnetizer very slowly. Slow withdrawal is required for thorough demagnetization.

Step 5: Repeat step 4 on the reproduce head. It is not necessary to demagnetize the erase head.

Step 6: Replace the head shield, but do not replace the head cover if alignment will follow.

Reproduce Channel Alignment

The following steps constitute the complete alignment of the reproduce channels. *Normal operating level is +4 db (1.23 volts rms).*

A. Reproduce Head Azimuth Adjustment
B. Reproduce Level Setting
C. Reproduce Response Check
D. Reproduce Equalization
E. Hum Balance Adjustment

A. Reproduce Head Azimuth Adjustment

Step 1: Thread the alignment tape on the machine. Terminate the appropriate OUTPUT connector (dependent upon the channel being aligned) with a 600 ohm resistor and connect the vtvm across this load. Plug a set of high impedance head phones into the appropriate phone jack so that voice announcements on the tape can be heard. If not already done, remove the head assembly cover, but not the mu metal shield beneath it. Place the MONITOR SELECTOR switch in TAPE position, and start the tape in motion in the reproduce mode. The head alignment tone will be announced first.

Step 2: Insert a small screwdriver through the access hole nearest the right hand edge of the head shield, and adjust the azimuth screw for maximum output observed on the vtvm. If the head is far out of alignment, several minor peaks occurring on either side of a maximum may be observed; the maximum is

A. REPRODUCE HEAD AZIMUTH ADJUSTMENT cont'd.

clearly 15 to 20 db greater than any of these minor peaks.

Note that the above procedure adjusts the head azimuth for both tracks. Level setting and response check must be repeated for the two reproduce amplifiers, using the controls indicated on the appropriate electronic assembly.

B. Reproduce Level Setting

The next tone on the tape is for reproduce level setting. Adjust the REPRODUCE LEVEL (P.B. LEVEL) potentiometer R137 for a vtvm reading of —6 db (approximately 0.4 volts rms). Maintain this setting for the subsequent response run.

C. Reproduce Response Check

The next series of tones is for the reproduce response check. Observe the response indicated on the vtvm, and check it against specifications. If reproduce response fails to meet specifications, the trouble may be a worn or otherwise faulty reproduce head, a partially erased alignment tape (due to head magnetization), or improper equalization of the reproduce amplifier. Equalization can be checked and adjusted as indicated below.

Repeat B and C for the reproduce amplifier in the other electronic assembly, then remove the standard tape.

D. Reproduce Equalization

Reproduce equalization (P.B. EQUAL) is a bench procedure. The required test setup and the reproduce amplifier response curve are given in Fig. 6-1. Set the oscillator at 500 cps, and adjust its output for a vtvm reading of —6 db (approximately 0.4 volts rms) to establish a reference. Increase the oscillator frequency to 8000 cps and adjust the reproduce equalizer R130 to set reproduce response on the curve at that point. Sweep the oscillator through the specified frequency range. Response should follow the curve within $\pm\frac{1}{2}$ db. Be sure that the oscillator output remains constant over the range.

Equalization procedures are similar for all machines. The only difference in the procedures is in the audio oscillator settings for $3\frac{3}{4}$ ips operation. For $3\frac{3}{4}$ ips reproduce equalization, (P.B. EQUAL) connect a test set-up as shown in Fig. 6-1. Set the oscillator at 250 cycles, and adjust its output for a vtvm reading of —6 db (0.4 volts rms). Increase the oscillator

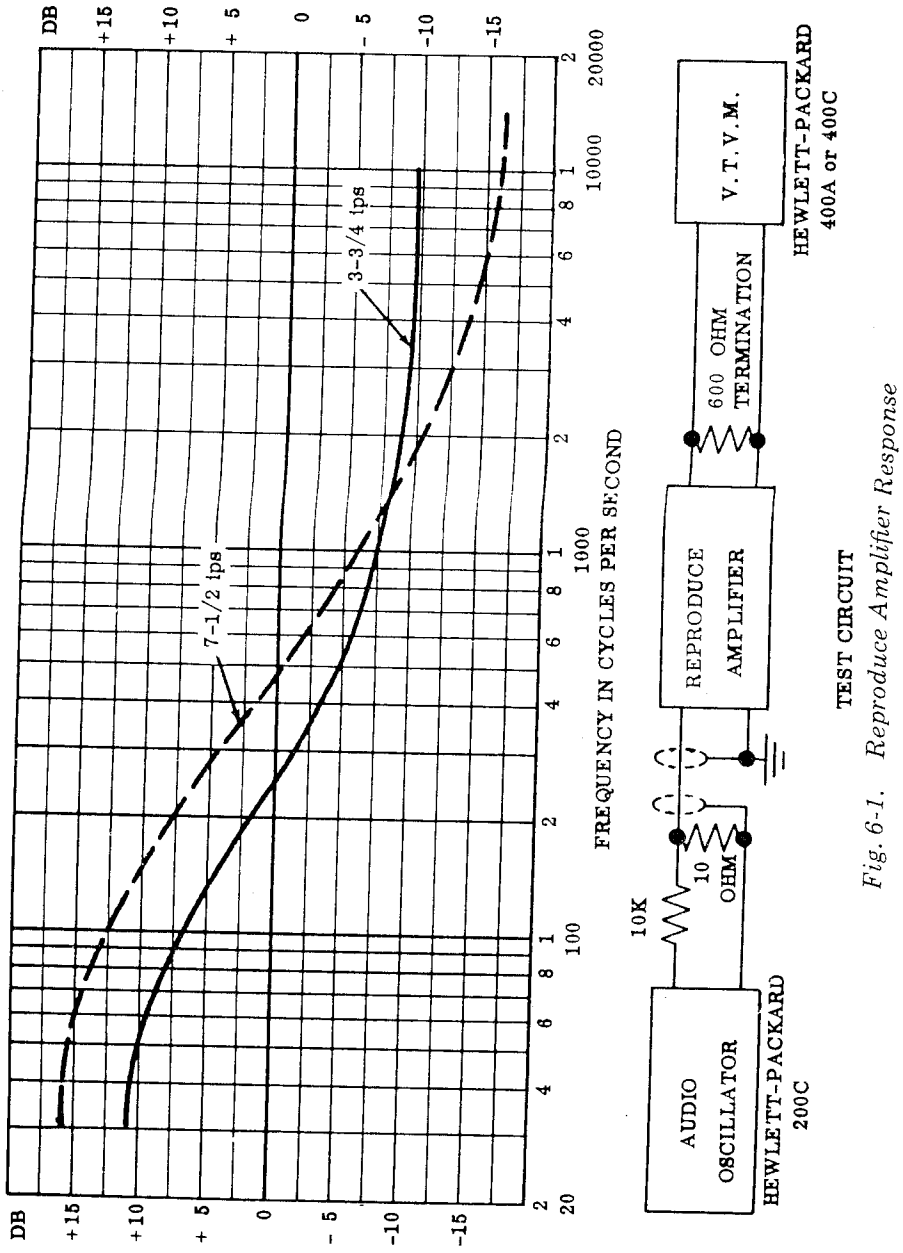


Fig. 6-1. Reproduce Amplifier Response

REPRODUCE EQUALIZATION cont'd.

frequency to 4000 cycles and adjust the resistance R130 (P.B. EQUAL) to set reproduce response on curve at that point. Response should follow the curve within ±½ db.

E. Hum Balance Alignment

After completing steps A through D adjust the hum balance (HUM BAL) potentiometer R150 for minimum hum as seen on a vtvm connected across the OUTPUT with the MONITOR SELECTOR in TAPE position.

Record Channel Alignment

The steps in record channel alignment are as follows:

A. Bias Adjustment
B. Record Level Meter Calibration
C. Record Head Azimuth Adjustment
D. Record Equalization & Response Adjustment
E. Noise Balance Adjustment

With the exception of the record head azimuth adjustment, all steps must be repeated for the two record amplifiers, using the indicated controls on the appropriate electronic assembly.

A. Bias Adjustment

Step 1: Thread a tape on the machine. Terminate the OUTPUT in 600 ohms and connect a vtvm across this load. Connect an audio oscillator set to 500 cps to the LINE INPUT connector and start the tape in motion in the record mode.

Step 2: Place the MONITOR SELECTOR in TAPE position and adjust the LINE REC LEVEL control for a normal operating level vtvm reading of +4 db (1.23 volts rms).

Step 3: Adjust the BIAS trimmer to peak this output. Make this adjustment carefuly because bias will affect the high frequency response, distortion, and noise.

3¾ ips — For bias adjustment, use the same procedure as for 7½ ips with the audio oscillator set at 250 cycles.

B. Record Level Meter Calibration

After peaking the bias as described in Step 3 above, and with the MONITOR SELECTOR still in TAPE position, readjust the LINE REC LEVEL control to bring the vtvm reading back to normal operating level. Switch the MONITOR

B. RECORD LEVEL METER CALIBRATION cont'd.

SELECTOR to INPUT position and adjust the REC. CAL potentiometer R114 until normal operating level is read on the vtvm. The v-u meter is now calibrated, and should read zero v-u $\pm \frac{1}{2}$ db with the MONITOR SELECTOR switch placed in either the INPUT or TAPE position.

C. Record Head Azimuth Adjustment

Step 1: Thread a tape on the machine. Terminate the master OUTPUT in 600 ohms and connect a vtvm across this load. Connect an audio oscillator set at 250 cps to the LINE INPUT. Place the MONITOR SELECTOR switch in its TAPE position. Start the tape in motion in the record mode, and adjust the LINE REC LEVEL control for a vtvm reading of —16 db (0.123 volt rms).

NOTE

With the REC LEVEL controls at minimum, the bias pickup as measured on the vtvm should be —26 db (.04 volt rms). If difficulty is experienced because of bias, connect a wave trap in parallel with the 600 ohm terminating resistance. This trap can be a series l-c circuit resonant at approximately 100 kc.

Step 2: Increase the oscillator setting to 10,000 cycles. Insert a small screwdriver through the access hole nearest the center of the head shield and adjust the record head azimuth screw for maximum output. Be sure to select the correct peak as described under Reproduce Head Azimuth Adjustment step 2. (REC. EQUAL).
Note that this aligns the record head azimuth for both tracks.

D. Record Equalization (Alternate Procedure)

Step 1: Record equalization can be accomplished without disconnecting the electronic assembly from the tape transport. The reproduce channel must be properly aligned and the record head in good condition. Thread a tape on the machine.

Step 2: Terminate the OUTPUT in 600 ohms and connect the vtvm across this load.

D. RECORD EQUALIZATION (ALTERNATE PROCEDURE) cont'd.

Step 3: Set an audio oscillator to 250 cycles and connect it to the LINE INPUT connector.

Step 4: Place the MONITOR SELECTOR switch in TAPE position, and start the machine in the record mode.

Step 5: Adjust the LINE REC LEVEL control for a vtvm reading of —16 db (0.123 volt rms.)

Step 6: Increase the oscillator setting to 8000 cps and adjust the REC. EQUAL capacitor C107 for a vtvm reading of —16 db (0.123 volt rms). Frequency response can now be checked by sweeping the oscillator through the range given in the specifications.

(Preferred Procedure)

The bench procedure for record equalization given below is independent of the reproduce amplifier and is therefore preferred to the alternate procedure outlined above. The record response curve and test setup are shown in Fig. 6-2.

Step 1: Disconnect the electronic assembly from the tape transport.

Step 2: Disconnect the a-c power plug.

Step 3: Connect a 1000-ohm resistor between pins 1 and 2 of Jones Plug P102S (P102P on the slave assembly) and connect a vtvm across this load.

Step 4: Strap pins 5 and 6 of this plug together.

Step 5: Remove the bias and erase oscillator tube V102.

Step 6: Reconnect the a-c power and place the ON-OFF switch in the ON position.

Step 7: Connect an audio oscillator to the LINE INPUT connector J102S, set it to 250 cps and adjust the LINE REC LEVEL control for a vtvm reading of —6 db (.4 volts rms).

Step 8: Increase the oscillator setting to 8000 cps and adjust the REC. EQUAL capacitor C107 to set the response on curve at this point.

Step 9: Now sweep the oscillator slowly through the specified frequency range and check that the response follows the curve throughout. The oscillator output *must remain constant over the range.*
$3\frac{3}{4}$ ips — For REC. EQUAL use the procedure outlined for record equalization at $7\frac{1}{2}$ ips with the REC. EQUAL capacitor C107 adjustment made with the audio oscillator set at 4000 cycles.

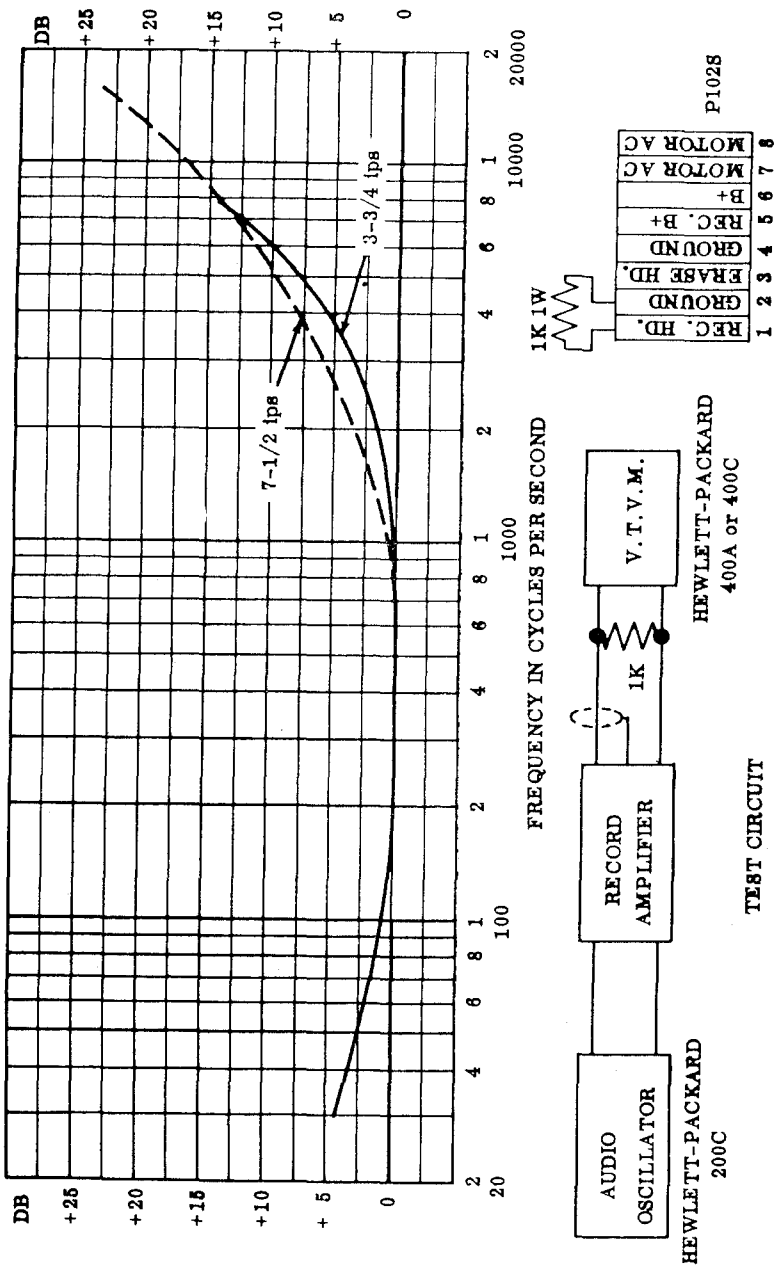


Fig. 6-2. Record Amplifier Response

E. Noise Balance Adjustment

Step 1: Thread a tape on the machine.

Step 2: Connect a 0.1 mfd capacitor and a sensitive vtvm across the OUTPUT connector for the master assembly.

Step 3: Plug a set of head phones into the PHONES jack.

Step 4: Disconnect all inputs.

Step 5: Turn the LINE REC LEVEL and MIC REC LEVEL controls to zero.

Step 6: Start the tape in motion in the record mode.

Step 7: Adjust the noise balance (NOISE BAL.) potentiometer R147 for a minimum reading on the vtvm or a minimum popping noise in the headphones.

Repeat A, B, and D for the second electronic assembly.

Section 7 Parts List

The following parts list provides all information necessary for ordering replacement parts. Always use Ampex Catalog numbers when ordering parts. To expedite processing, always include the following information in placing parts orders:

A. Model Number
B. Serial Number
C. Ampex Catalog Number of Part
D. Part Description

EXAMPLE:

Spring, Clutch "U". No. 6246, for Model 601-2. Serial No. 6D0042.

TAPE TRANSPORT

Reference Symbol	Description	Ampex Catalog Number
	Tape Guide Assembly	
83	Bar, Tape Guide	6201
85	Cap, Tape Guide	6202-1
84	Ball Bearing	421-029
	Machine Screw, Phillips Hd., 6-32 x 3/4	471-607 *
	Shim Washer, .149 ID x 5/16 OD x .025 thk, brass	501-062
	Shim Washer, .149 ID x 5/16 OD x .031 thk, brass	501-072 *
78	Turntable	6205
	Machine Screw, Flat Head, 4-40 x 1/4	471-614 *
79	Capstan Idler Wheel Assembly, with Oilite bearing	6211-1
80	Cap, Capstan Idler	6203
	Cambric Washer, .24 ID x 7/16 OD x .010 thk	9482-1 *
	Hairpin Retainer for 1/4" shaft	431-006 *
75	Link, Turntable Pivot	6221
	Cotter Pin, 1/16 x 1/2"	401-005 *
	Clevis Pin, 1/8 x 11/32"	400-004 *
	Sub-Plate Assembly	6227-3
10	Spring, Rewind Idler	6136 *
11	Spring, Release Lever	6215 *
1	Sub-Plate Casting	6275
13	Slide Lever, Brake Actuator	6277
14	Release Lever, Play Mode Brake	6278
2	Brake Shock Relief Assembly	6279-1

* Included in Kit #7802

Reference Symbol	Description	Ampex Catalog Number
	Rewind Idler Assembly	6284-1
7	Idler Wheel with Oilite bearing	6285
8	Guide Assembly	6288-1
	Cambric Washer, .24 ID x 7/16 OD x .010 thk	9482-1 *
	Hairpin Retainer for 1/4" shaft	431-006 *
12	Actuator Spring, 11/64 dia x 1" long	9368-1 *
	Spring, Clevis Pin, 3/8 x 13/16	6314 *
9	Switch Deck Assembly	30077-1
	Lamicoid Washer, Side Lever, 1/8 ID x 5/8 OD x 1/32 thk	6318 *
	Lockwasher, #4 Int. tooth	502-024
	Screw, #4-40 x 1/2"	471-560
	Nut, #4-40 Hex	492-008
	Cotter Pin, 1/16" x 1/2" long	401-005 *
	Clevis Pin, 1/8 x 15-32" long	400-007 *
	Clevis Pin, 1/8 x 21/32" long	400-010
	Clevis Pin, 1/8 x 25/32" long	400-016 *
	Plain Washer, #10	501-011 *
	Hairpin Retainer for 3/16" shaft	431-002 *
	Resistor, 100 ohms, 1/2 watt	041-038
	Tie point 3 lug	180-035
	Washer, fibre	503-019
	Screw, #4-40 x 5/8 lug	471-653
	Switch Guard, side	9727
	Capstan Idler Arm Assembly	6235-1
53	Anchor	6224
51	Arm Sub-Assembly	6236
52	Roller	6237
54	Spring, 21/64 x 1-27/64" long	6910 *
	Clevis Pin, 1/8 x 15/32" long	400-007
	Motor Assembly	
	Felt Washer, 15/64 ID x 3/4 OD x 1/16" thk	6219 *
63	Motor	6239-1
62	Mounting Plate	6240
61	Pulley, 60 cps, 7-1/2 ips	6241-0
	50 cps, 7-1/2 ips	6241-1
	60 cps, 3-3/4 ips	6241-2
	50 cps, 3-3/4 ips	6241-3
	Screw, 8-32 x 3/8" long	471-567 *
	Sem Fastener, 8-32 x 3/8" long	475-039 *
	Soldering Lug	172-001 *
65	Thrust Disc, Nylon, .312 dia x 1/16" thk	6934 *
68	Drive Belt, Nylon, 60 cps, 7-1/2 ips	2871-3
	50 cps, 7-1/2 ips	2871-6
	60 cps, 3-3/4 ips	2871-7
	50 cps, 3-3/4 ips	2871-14

* Included in Kit #7802

Reference Symbol	Description	Ampex Catalog Number
66	Spring, Motor Thrust, 5/16 x 1-7/8" long	7531 *
71	Plunger, Motor Thrust	7532
	Spacer, Motor Mounting, 1/4 OD x .531 long	7582 *
	Rubber Shockmount	7922-1
60	Ball, 1/4" dia.	420-006 *
	Motor Mount Washer, C. R. S. 13/64 ID x 5/8 OD	2431 *
	Motor Mount Screw, Binder Hd., 10-24 x 7/8" long	471-573 *
	Socket Hd. Set Screw, 8-32 x 1/8 long, cup point	477-115
	Takeup Arm Assembly	6242-1
20	Spring, Conical, 1" dia. x 31/32" long	6137 *
26	Pivot Spring, 17/32 x 13/16" long	6218 *
	Thrust Washer, .015 spring steel, 1/4 ID x 3/8 OD	6223-1 *
24	Pivot Arm	6243
29	Hub, with Shaft	6244
17	Spring, Clutch "U"	6246
19	Clutch, Play Takeup	6247
18	Disc Assembly, with small felt	6248-1
15	Disc Assembly, with large felt	6248-2
16	Clutch Assembly, fast forward, with Oilite bearing	6251
28	Link, Turntable Control	6253
27	Washer, Spring Retaining, Cup	6254
23	Collar, Drum	6293
25	Brake Assembly, Holdback	
	Use Replacement Holdback Brake Assembly Kit (Each kit contains two Brake Assemblies)	7974-1
	Lamicoid Washer, 1/4 ID x 1/32" thk	186-1 *
21	Oilite Bearing	422-004
22	Ball Bearing	421-019
	Cotter pin, 1/16" x 1/2" long	401-005 *
	#4 Lockwasher, int. teeth	502-024 *
	Binding Hd. Machine Screw, 4-40 x 5/16" long	471-634 *
	Hex Nut, 4-40	492-008 *
	Socket Hd. Set Screw, 6-32 x 1/8" long	477-114 *
	Spring, Turntable Height 11/32" x 9/32" long	6217 *
	Rewind Arm Assembly	6255-1
	Thrust Washer, .015 spring steel, 1/4 ID x 3/8 OD	6223-1 *
36	Pivot Arm	6243
38	Hub, with shaft	6244
32	Spring, Clutch "U"	6246

* Included in Kit #7802

Reference Symbol	Description	Ampex Catalog Number
30	Disc Assembly, with large felt	6248-2
31	Clutch Assembly, rewind, with Oilite bearing	6251
35	Collar, "Drum"	6293
33	Collar, Spacer	6316
37	Holdback Brake Assembly	
	Use Replacement Holdback Brake Assembly Kit	7974-1
	(Each kit contains two #6320-1 Brake Assemblies)	
	Lamicoid Washer, 1/4 ID x 1/32" thk	186-1
34	Ball Bearing	421-019
	#4 Lockwasher, Int. teeth	502-024 *
	Binder Hd. Machine Screw, 4-40 x 5/16" long	471-634 *
	Hex Nut, 4-40	492-008 *
	Socket Hd. Set Screw, 6-32 x 1/8" long	477-114 *
	Socket Hd. Set Screw, 8-32 x 3/16" long	477-040 *
64	Turntable Height Spring, 11/32 x 9/32" long	6217
	Play Control Arm Assembly	6256-1
45	Actuator, Play	6257
46	Switch Mechanism	6261
47	Roll Pin, 3/32 x 5/8" long	406-002
	Rewind/Fast Forward Control Assembly	6259-1
48	Actuator, Rewind/Fast Forward	6258
49	Switch Mechanism	6261
50	Roll Pin, 3/32 x 5/8" long	406-002
	Ball, 5/16" dia.	420-004
55/58	Belt Tensioning Idler Arm Assembly	6263-1
59	Spring, 11/64 dia. x 15/16" long	6216 *
	Play Takeup Arm Assembly	6267-1
41	Spring	6138
40	Pulley Assembly, with Oilite bearing	6268
39	Arm Assembly	6270
	Cambric Washer, .24 ID x 7/16 OD x .010 thk	9482 *
	Lamicoid Washer, 1/4 ID x 1/32" thk	186-1 *
	Hairpin Retainer for 1/4" shaft	431-006 *
69	Takeup Belt, Rubber "O" Ring	432-010
	Top Plate Assembly	6439-1
	Leaf Spring	6234
	Sem Screw	475-031
	Neon Bulb	060-013
	Brass Grommet	261-006
	Tape Guide Post	7456
	Top Plate Casting, with grill & Oilite bearing	9065-1

* Included in Kit #7802

Reference Symbol	Description	Ampex Catalog Number
C203	Motor Capacitor, Electrolytic, 2.5 mfd, 220 V	035-121
	Kep Nut, 8-32	496-001 *
	Capacitor Mounting Screw, Binder Hd., 8/32 x 5/8"	471-569 *
	Tube Socket, Contact, min.	173-020
	Spring, Jones Plug Retainer	16340-1
	Head Cable Harness Assembly	30076-1
	Plug, 8 contact, male	147-006
	Plug, 8 contact, female	146-003
R202	Resistor, 20 K ohm	043-080
	Solder Lug	172-003
	Adapter	30075-1
42	Capstan Assembly, with flywheel, shaft & ball	9353-1
81	Dust Seal, felt, 15/64 ID x 3/4 OD x 1/16" thk	6219 *
43	Felt Washer, 13/16 ID x 1-1/8 OD x 3/32" thk	6262 *
82	Capstan Dust Shield	6273
65	Thrust Disc, Nylon, .312 dia. x 1/16" thk	6934 *
	Cambric Washer, .24 ID x 7/16 OD x .010 thk	9482-1*
70	Special Set Screw, Capstan Thrust, 3/8-27 x 1-1/8"	477-120 *
	Hex Jam Nut, 3/8-27	492-042 *
90	Head Assembly	30071-1-R
86	Cover, Head Assembly	6207-1
91	Tape Guide, Head	6208-1
	Shield, Head Assembly	6213
	Phillips Oval Hd. Machine Screw, 4-40 x 1-3/4"	471-611 *
	Sem Fastener, 6-32 x 1/4", int. teeth	475-014 *
	Sem Fastener, 4-40 x 1/4", int. teeth	475-006 *
	Cork Washer, 1/8 ID x 21/32 OD x 3/32" thk	6283 *
88	Reel Hold Down Knob	6319
76	Spring Detent, Turntable Centering	6911 *
77/89	Steel Ball, 5/16" dia.	420-004 *
	Leaf Spring, Rewind Control	17512
	Power Cable	084-002
	Bar Knob, with set screw	230-007
	Lamicoid Washer, 5/16 ID x 1/32 thk	186-0 *
	Lamicoid Washer, 1/4 ID x 1/32 thk	186-1 *
	Lamicoid Washer, 5/16 ID x 1/64 thk	186-3 *
	Lamicoid Washer, 1/4 ID x 1/16 thk	186-4 *
R204	Resistor, Composition, 100 ohm, 1/2 watt	041-038
R205	Resistor, Wirewound, 20 K, 10 watt	043-080
C204, C205	Capacitor, Ceramic Disc, .01 ufd, 500 vdcw	030-002
J203S	Connector, Chassis, 8 contact, female	147-006

* Included in Kit #7802

Reference Symbol	Description	Ampex Catalog Number
	PORTABLE CASE ASSEMBLY, Saddle Tan	7511-2
	Rubber Shockmount Nut, Top Plate	6937-1
	Plastic Foot 3/8 in. long	7666B
	5/8 in. long	250-005
	Mounting Hardware for Plastic Foot:	
	6-32 Kep Nut	496-002
	6-32 x 1/2 Binding Head Machine Screw	471-496
	6-32 x 5/8 Binding Head Machine Screw	471-497
	6-32 x 3/4 Binding Head Machine Screw	471-498
	6-32 x 7/8 Binding Head Machine Screw	471-499
	No. 6 Plain Steel Washer	501-009
	Hinge Leaf, no pin	092-004
	Hinge Leaf, with fixed pin	092-006
	Latch, Fastener	311-017
	Catch, Fastener	311-018
	No. 8 Oval Phillips Sheet Metal Screw, type Z	476-025
	8-32 x 1/2 Oval Phillips Machine Screw	471-608
	Tinnerman Nut, Electronics	497-011
	Handle	089-004
	Handle-mounting, Cap, brass	162-014
	ELECTRONICS ASSEMBLIES	
C101	CAPACITOR, electrolytic: 3x40 uf, 252; Mallory WP 520	031-084
C102	CAPACITOR, tubular: .1 ufd 400 v; C-D No. ST4P1	035-069
C103	CAPACITOR, electrolytic: 4x10 ufd 450v; Mallory FP-434	031-077
C104	CAPACITOR: .047 ufd 400 v; C-D ST4S47	035-057
C105, C111, C121	CAPACITOR, tubular: .0047 ufd 400 v ±5%; C-D ST4D47	035-026
C106	CAPACITOR, tubular: .1 ufd 400v; C-D ST4P1	035-069
C107, C113	CAPACITOR, trimmer: 100 uuf; El Menco 302 type 30	038-002
C108	CAPACITOR: .1 ufd 200v ±5%; C-D ST2P1	035-065
C110, C122	CAPACITOR, ceramic disc: .01 ufd; Centralab DD103	030-002
C112	CAPACITOR, tubular: .5 ufd 400v; Sangamo 300 405	035-110
C114	CAPACITOR, electrolytic: 3x20 ufd 450v; Mallory 376.5	031-080
C115	CAPACITOR, electrolytic: 1000 ufd 6v; Sprague TVA-1104	031-038
C116	CAPACITOR, paper: .039 ufd 400v 5%	035-050

Reference Symbol	Description	Ampex Catalog Number
C118	CAPACITOR, paper: .022 ufd 400v; C-D ST4S22	035-047
C123, C128	CAPACITOR, electrolytic: 4 ufd 150 v	031-020
C124, C127**	CAPACITOR, mica: .001 ufd 500v ±5%; Sangamo KR-1210	034-068
C125**, C126**	CAPACITOR, mica: 350 uuf 500v ±5%; Sangamo KR	034-054
F101	FUSE: 2 ampere 250v	070-016
	FUSE HOLDER, with Hardware	085-003
J101S	CONNECTOR: microphone input, 3 contact shielded; Cannon XL-3-13N	146-022
J102S	JACK: Miniature phone, 2-conductor: Switchcraft 41	148-020
J103S	JACK: phone; Switchcraft 11	148-015
J104S	JACK: output phone; 3 conductor	148-024
J105P**	CONNECTOR, miniature: power 2 contact; GE2711	147-020
J107P	PLUG, octal: dummy plug assembly	17420-1
	CONNECTOR, tape transport connector: Jones S-308-cct	144-007
	CONNECTOR: reproduce head cable; Jones P-302-cct-L	145-023
L101	CHOKE, r-f: 20 mhy; Miller 691	051-018
L102	CHOKE, 5.5 hy: Merit C-2975	541-028
M101	V-U Meter	6351-1
	METER, glass	098-002
	RETAINING RING: self-locking	430-039
R101	RESISTOR, composition: 2.2 megohm 1/2 watt	041-086
R102, R122, R139	RESISTOR, composition: 2,200 ohm 1/2 watt A-B EB-2221	041-052
R103	RESISTOR, carbon film: 82,000 ohm 1/2 watt 350v; Stemag type A-1	042-014
R104, R105, R135	RESISTOR, carbon film: 100,000 ohm 1 watt 500v Stemag type A-2	042-011
R106	POTENTIOMETER, audio taper: 100,000 ohm; A-B JA1041 SD3056	044-015
R107	RESISTOR, carbon film: 47,000 ohm, 1/2 watt 350v Stemag type A-1	042-013
R108, R123, R134	RESISTOR, composition: 22,000 ohm, 1/2 watt; A-B EB-2231	041-064
R109, R110	RESISTOR, composition: 270,000 ohm, 1/2 watt; A-B EB-2741	041-077
R111	RESISTOR, composition: 1,500 ohm 1/2 watt ±5%	041-008
R112, R144	RESISTOR, composition: 47,000 ohm 1/2 watt; A-B EB-4731	041-068

** On Master Electronic Assembly only

Reference Symbol	Description	Ampex Catalog Number
R113, R117, R140	RESISTOR: 100,000 ohm 1/2 watt; A-B EB-1041	041-072
R114, R125, R137	POTENTIOMETER, audio taper: 250,000 ohm; Centralab BA-011-1224	044-042
R115, R131, R138, R141	RESISTOR, composition: 1 megohm 1/2 watt; A-B EB-1051	041-031
R116	RESISTOR, composition: 33,000 ohm 1/2 watt ±5%	041-017
R118	RESISTOR, composition: 560 ohm 1/2 watt; A-B EB-3311	041-045
R119	RESISTOR, composition: 47,000 ohm 2 watt; A-B EB-4731	041-220
R120, R127	RESISTOR, composition: 470,000 ohm 1/2 watt; A-B EB-4741	041-080
R121	RESISTOR, composition: 470 ohm 1/2 watt; A-B EB-4711	041-044
R124	RESISTOR, composition: 10,000 ohm 1 watt; A-B EB-1031	041-158
R128, R132	RESISTOR, composition: 1,800 ohm 1/2 watt	041-051
R129	RESISTOR, carbon film: 220,000 ohm 1 watt 500v; Stemag type A-2	042-012
R130	POTENTIOMETER, audio taper: 10,000 ohm; IRC type Q	044-039
R133	RESISTOR: 15,000 ohm 1/2 watt	041-062
R136	RESISTOR: 330,000 ohm 1/2 watt	041-078
R142	RESISTOR, composition: 820 ohm 1/2 watt; A-B EB-8211	041-047
R143	RESISTOR: 10,000 ohm 2 watt	041-213
R145**, R146**, R148, R149	RESISTOR, composition: 4,700 ohm 1/2 watt; A-B EB-4721	041-056
R147**	POTENTIOMETER, linear taper: 10,000 ohm; IRC type Q	044-050
R150	POTENTIOMETER, linear taper: 100 ohm; Mallory type C-P	044-095
R151	RESISTOR, composition: 560 ohm 1/2 watt 10%	041-045
S101	SWITCH, SPST toggle: 3 amp 250v; C-H 8280 K15	120-028
S102	SWITCH, SPDT, wafer: non-shorting; Oak 59016-23	122-016
T101	TRANSFORMER: power	6298-1
T102**	TRANSFORMER: bias and erase	6352-1
T104	TRANSFORMER: output	17419-1
V101, V105	VACUUM TUBE: 5879	012-028
V102	VACUUM TUBE: 12AY7	012-043
V103, V106, V107**	VACUUM TUBE: 12AU7	012-023

** On Master Electronic Assembly only

Reference Symbol	Description	Ampex Catalog Number
V104	VACUUM TUBE: 6F5	012-042
V108	VACUUM TUBE: 5Y3GT	012-013
	TUBE SHIELD	160-012
	SHIELD, choke	9188-1
	Special Adjusting Screw with Retainer Sleeve	474-010
	Tinnerman Cable Clamp for 6-32 Screw	302-034
	Knob, 1-1/2 in. dia. skirt	230-013
	No. 12 Lockwasher, Internal Teeth	502-059
	3/8 Lockwasher, Internal Teeth	502-077
	3/8 Lockwasher, Internal Teeth, Fine	502-063
	1/2 Lockwasher, Internal Teeth, Fine	502-064
	6-32 x 1 in. Long Bind Head Brass Machine Screw	471-580
	No. 12 Plain Brass Washer	501-036
	Fibre Washer, 3/8 ID x 5/8 OD x 1/32 in. thick	503-006
	Pan Head Sam Fastener, 6-32 x 3/8 in. long	475-016
	"J" type Tinnerman Nut for 6-32 screw	497-002
	Flat latch Type Tinnerman Nut for 6Z screw	497-007
	3-lug Tie Point	180-024
	2-lug Terminal Strip	180-023
	2-lug Terminal Strip, Right Lug Grounded	180-025
	Washer, Condenser insulating	6094
	Bottom Plate, Electronics	6399-1

ACCESSORIES

Head Demagnetizer	704
Amplifier-Speaker Model 620: In portable Samsonite Case, saddle tan	9419-2
601-620 Interconnecting Cable Assembly, 8 ft.	9411-1
601-620 Interconnecting Cable Assembly, 20 ft.	9411-2
Plug-in Low Impedance Microphone Input Transformer	17331-1

Tape Speed Conversion Kits

For field application, includes pulley, belt, standard alignment tape for new speed, and complete installation and alignment instructions for converting from 7-1/2 in/sec. to 3-3/4 or vice versa.

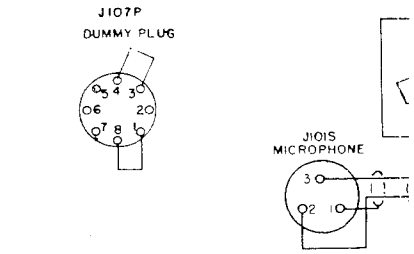
FOR 60 CYCLE MACHINES

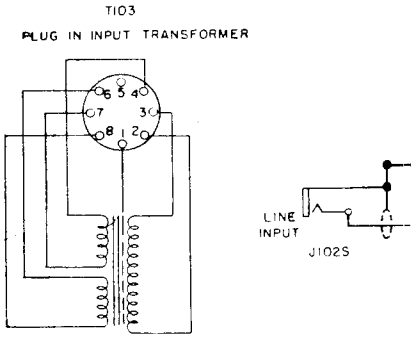
Change from 7-1/2 ips to 3-3/4 ips	7556-0
Change from 3-3/4 ips to 7-1/2 ips	7556-1

FOR 50 CYCLE MACHINES

Change from 7-1/2 ips to 3-3/4 ips	7556-2
Change from 3-3/4 ips to 7-1/2 ips	7556-3

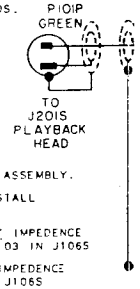
Reference Symbol	Description	Ampex Catalog Number
	Power Frequency Conversion Kits:	
	For converting 7-1/2 ips machine from operation on 60 cps current to operation on 50 cps current	9738
	For converting 7-1/2 ips machine from operation on 50 cps current to operation on 60 cps current	9739
	For converting 3-3/4 ips machine from operation on 60 cps current to operation on 50 cps current	9740
	For converting 3-3/4 ips machine from operation on 50 cps current to operation on 60 cps current	9741
	Each kit contains the appropriate pulley, belt and mounting instructions.	
	Can of Oil, Caloil Turbine #11, 4 oz.	087-005
	Head Cleaner, 4 oz.	087-005
	Alignment Tape, 7-1/2 ips	5563
	Alignment Tape, 3-3/4 ips	6000
	Spare Parts Kit for 7-1/2 ips 60 cps Machines	9742-1
	Contains following parts:	
1	Drive Belt	2871-3
1	Capstan Idler	6211-1
1	Spring	6246
1	Felt Clutch Disc Assy., small	6248-1
1	Felt Clutch Disc, Assy., large	6248-2
1	Rewind Idler	6284-1
2	Reel Hold Down Knob	6319
4	Rubber Shockmount	6937-1
1	Filter Capacitor - 1000 Mfd., 6 Volts	031-038
1	Fuse - 1 amp	070-003
1	Takeup Belt	432-010
1	Potentiometer - 100K	044-015
1	5Y3GT Vacuum Tube	012-013
1	12AU7 Vacuum Tube	012-023
1	5879 Vacuum Tube	012-028
1	6F5 Vacuum Tube	012-042
1	12AY7 Vacuum Tube	012-043
	Spare Parts Kit for 7-1/2 ips 50 cps Machine	9742-2
	Contents same as 9742-1 except for belt	2871-6
	Spare Parts Kit for 3-3/4 ips 60 cps Machine	9742-3
	Contents same as 9742-1 except for belt	2871-7
	Spare Parts Kit for 3-3/4 ips 50 cps Machine	9742-4
	Contents same as 9742-1 except for belt	2871-14
	Minor Hardware Kit Contains 250 small parts normally used in servicing, including all parts marked with single asterisk (*)	7802
	Holdback Brakes Replacement Kit Contains two Holdback Brake Assemblies	7974-1

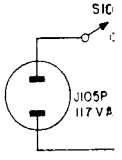


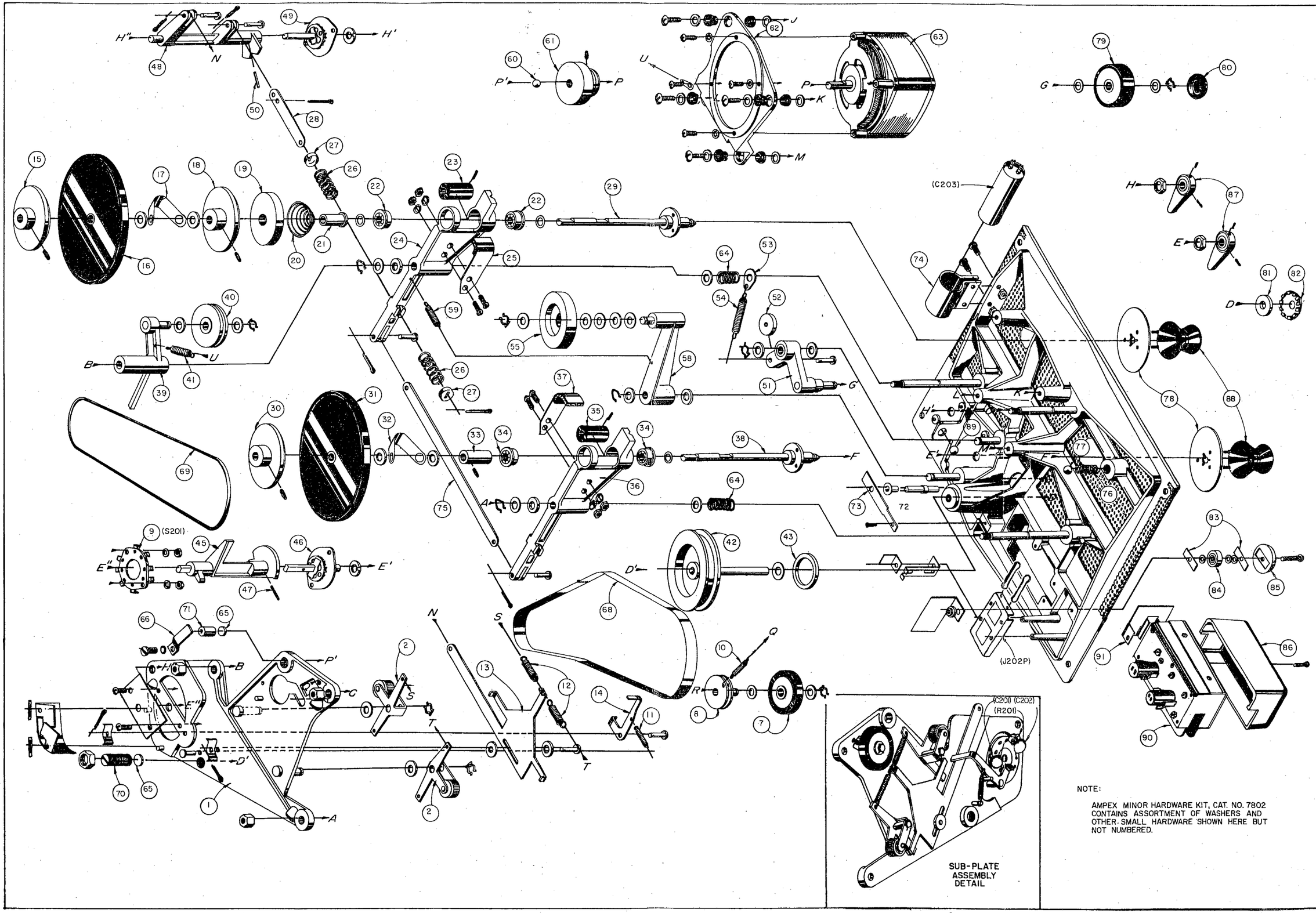


NOTES:

1. ALL CAPACITORS IN MICROFARADS, 400 VOLTS UNLESS OTHERWISE NOTED.
2. ALL RESISTORS IN OHMS, ±10% 1/2 WATT UNLESS OTHERWISE NOTED.
3. DC VOLTAGES MEASURED WITH 20,000 Ω/V METER WITH RESPECT TO CHASSIS.
4. NEUTRAL 1, PLAY 2, RECORD 3.
5. SEE D-17416 FOR ELECTRONICS ASSEMBLY.
6. FOR HIGH IMPEDENCE INPUT INSTALL DUMMY PLUG J107P.
7. FOR 150 OHM TO 250 OHM INPUT IMPEDENCE INSTALL INPUT TRANSFORMER T103 IN J106S.
8. FOR 30 OHM TO 50 OHM INPUT IMPEDENCE INSTALL TRANSFORMER T103 IN J106S AND REMOVE JUMPER FROM 6 TO 7 AND CONNECT 4 TO 6 AND 7 TO 8 ON J106S.







SUB-PLATE ASSEMBLY DETAIL

NOTE:

AMPEX MINOR HARDWARE KIT, CAT. NO. 7802 CONTAINS ASSORTMENT OF WASHERS AND OTHER SMALL HARDWARE SHOWN HERE BUT NOT NUMBERED.

J107P
DUMMY PLUG

T103
PLUG IN INPUT TRANSFORMER

NOTES:

1. ALL CAPACITORS IN MICROFARADS, 460 VOLTS UNLESS OTHERWISE NOTED.
2. ALL RESISTORS IN OHMS, ±10% 1/2 WATT UNLESS OTHERWISE NOTED.
3. DC VOLTAGES MEASURED WITH 20,000 Ω/V METER WITH RESPECT TO CHASSIS.
4. NEUTRAL 1, PLAY 2, RECORD 3.
5. SEE D-17416 FOR ELECTRONICS ASSEMBLY.
6. FOR HIGH IMPEDENCE INPUT INSTALL DUMMY PLUG J107P
7. FOR 150 OHM TO 250 OHM INPUT IMPEDENCE INSTALL INPUT TRANSFORMER T103 IN J106S
8. FOR 30 OHM TO 50 OHM INPUT IMPEDENCE INSTALL TRANSFORMER T103 IN J106S AND REMOVE JUMPER FROM 6 TO 7 AND CONNECT 4 TO 6 AND 7 TO 8 ON J106S.

J106S
J101S MICROPHONE
V101 5879
+195V
R104 100K 1W
R105 100K 1W
C102 .1
R106 100K MIC REG. LEVEL
R101 2.2M
V102A 1/2 12AY7
R107 47K
22K R108
C104 .047
R109 270K
R110 270K
V102B 1/2 12AY7
R112 47K
C106 .1
R113 100K
R114 250K REC CAL.
R115 1M
REC. EQUAL
C107 100μμfd
V103A 1/2 12AU7
R119 47K 2W
C110 .01 500V
R115 33K 5%
C108 .1 5% 200V
R117 100K
R120 470K
V103B 1/2 12AU7
R123 22K 2W
C112 .5
BIAS ADJ
C113 100μμfd
R121 470
L101 20mhy
R122 2.2K
C111 .0047 5%
R102 2.2K
C101A 40 25V
R103 82K
C103A 10 450V
LINE REC LEVEL
R125 250K
R111 1.5K 5%
C105 .0047 5%
R118 560
C101B 40 25V
C103B 10 450V
LINE INPUT
J102S

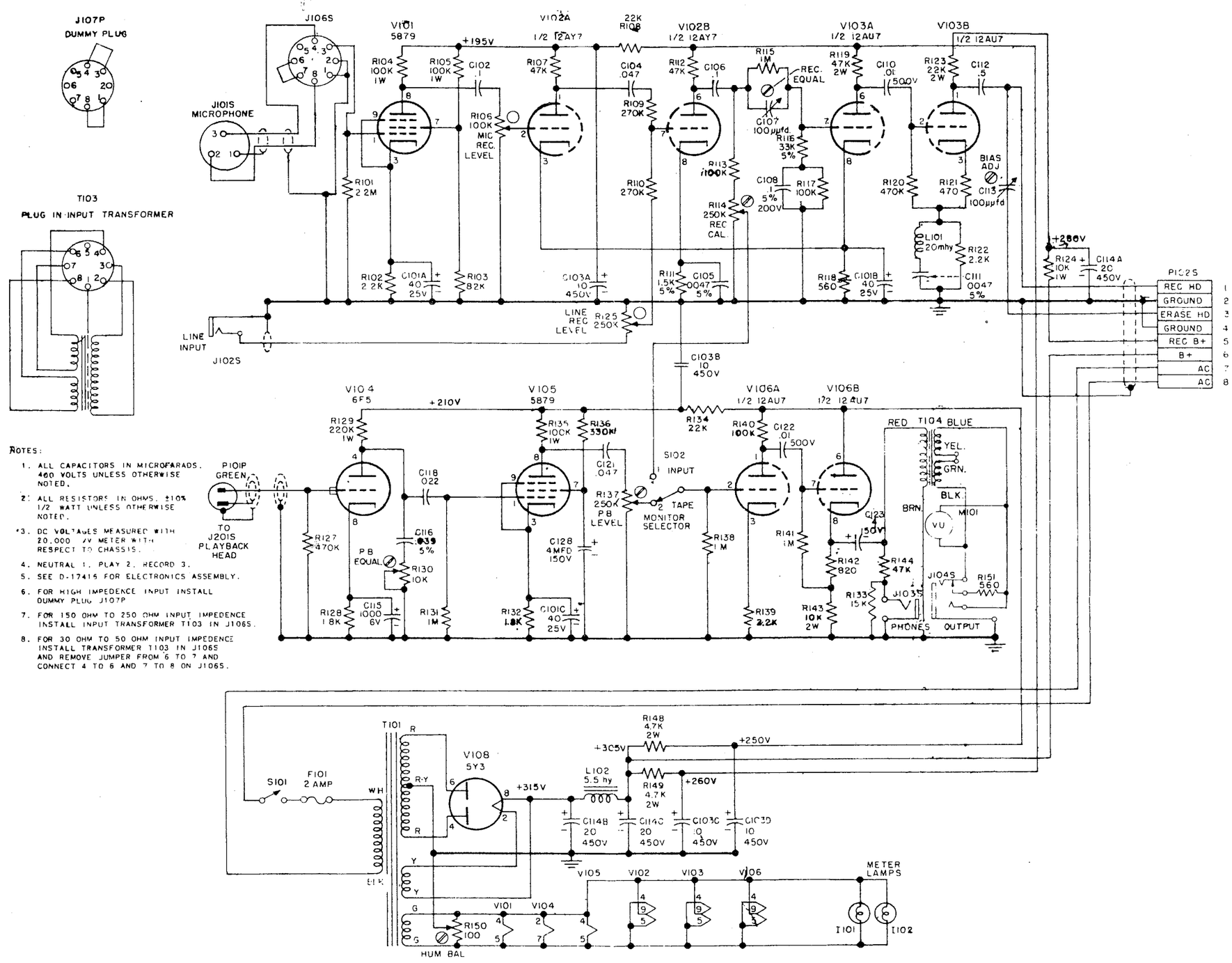
TAPE TRAVEL
RECORD HEAD
PLAYBACK HEAD
ERASE HEAD
CH 1
CH 2
ORANGE
BLACK
RED
BLACK
C202 .01 500V
R202 20K 10W
C201 .01 500V
J201S GREEN
J204S YEL.
R201 100
S201 (NOTE 4)
R203 470K
120
MOTOR
B201
C203 2.5 220VAC

+280V
R124 10K 1W
C114A 20 450V
P102S
J202P
REC HD 1
GROUND 2
ERASE HD 3
GROUND 4
REC B+ 5
B+ 6
MOTOR AC 7
MOTOR AC 8
J203S
TO P102P ON SLAVE 2 D-30074
R204 100
C205 .01 500V
R205 20K 10W

V104 6F5
+210V
V105 5879
R129 220K 1W
R135 100K 1W
R136 330K
C121 .047
V106A 1/2 12AU7
R134 22K
R140 100K
C122 .01 500V
V106B 1/2 12AU7
RED T104 BLUE
YEL.
GRN.
BLK.
BRN.
M101
VU
P101P GREEN
TO J201S PLAYBACK HEAD
C118 .022
R127 470K
C116 .039 5%
PB EQUAL
R130 10K
C115 1000 6V
R128 1.8K
R131 1M
C101C 40 25V
R132 1.8K
C128 4MFD 150V
S102
1 INPUT
2 TAPE MONITOR SELECTOR
R137 250K P.B. LEVEL
R138 1M
C123 50V
R141 1M
R142 820
R144 47K
R133 15K
J103S
J104S
R151 560
R139 2.2K
R143 10K 2W
PHONES
OUTPUT

T102
BL
R
C124 001 5% 500V
C125 350 uufd V
C126 350 uufd 5% 500V
C127 001 5% 500 V
V107A 1/2 12AU7
V107B 1/2 12AU7
R145 4.7K
R146 4.7K
R147 10K
NOISE BAL.

T101
S101
F101 2 AMP
WH
BK.
R
R-Y
Y
G
J105P 117 V.A.C.
V108 5Y3
+315V
R148 4.7K 2W
+305V
+250V
L102 5.5 hy
R149 4.7K 2W
+260V
C114B 20 450V
C114C 20 450V
C103C 10 450V
C103D 10 450V
V105 V102 V103 V106 V107
METER LAMPS
V101 V104
R150 100
HUM BAL
I101
I102



NOTES:

1. ALL CAPACITORS IN MICROFARADS. 400 VOLTS UNLESS OTHERWISE NOTED.
2. ALL RESISTORS IN OHMS, ±10% 1/2 WATT UNLESS OTHERWISE NOTED.
3. DC VOLTAGES MEASURED WITH 20,000 Ω/V METER WITH RESPECT TO CHASSIS.
4. NEUTRAL 1. PLAY 2. RECORD 3.
5. SEE D-17415 FOR ELECTRONICS ASSEMBLY.
6. FOR HIGH IMPEDENCE INPUT INSTALL DUMMY PLUG J107P.
7. FOR 150 OHM TO 250 OHM INPUT IMPEDENCE INSTALL INPUT TRANSFORMER T103 IN J106S.
8. FOR 30 OHM TO 50 OHM INPUT IMPEDENCE INSTALL TRANSFORMER T103 IN J106S AND REMOVE JUMPER FROM 6 TO 7 AND CONNECT 4 TO 6 AND 7 TO 8 ON J106S.

Fig. 6-4. Schematic Diagram—Slave Electronic Assembly