OPERATING INSTRUCTIONS
FOR

MODEL 10M

MaCarTa
MAGNETIC CARTRIDGE TAPE
®

8710282

TOM AYE X ASS

Manufactured By

SMC

776 THE DALLAS
SUNNYVALE
735-1406

Sono-Mag Corp.

Bloomington, Illinois U. S. A.

O P E R A T I N G I N S T R U C T I O N S

F O R

MODELS 510/512 & 10A/12A

CARTRIDGE PLAYBACK

* NOTE: Some of the information in Section 3 and Section 4 applies to equipment models other than this equipment. Special features of models 10A/12A are outlined in Section 4.7.

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SECTION 1

EQUIPMENT DESCRIPTION

1.1 GENERAL

NOTE: Carefully unpack and examine equipment for concealed damage when received. Notify the carrier of any damage.

This equipment is designed to playback magnetic cartridge tape in the Fidelipac-type cartridge. It provides standard NAB equalized preamplification for the recorded program and a self-contained cueing system for stopping the tape drive mechanism.

All models covered by this book also contain an Auxiliary or Secondary cue system responding to a signal of 150 Hz on the cue control track of the tape. This signal supplies an "end of message" or similar activation of auxiliary equipment.

Models 510 and 10A are half-track monaural playback units. Models 512 and 12A are stereo quarter-track machines with the NAB three track head configuration being standard.

1.2 SPECIFICATIONS, PLAYBACK

a. Audio output level . . . . . +10 DBM Max.
b. Audio distortion, NAB 0 Level 0.75%
   400 Hz THD
c. Hum and Noise
   Mono - Equal or better than NAB spec. . -48 DB
   2.35 typ.
   Stereo - Equal or better than NAB spec. -44 DB
   2.35 typ.
d. Frequency response
   Meets or exceeds NAB spec. 2.20 typ. . . 50-12KHz, +1-2
   50-15KHz, +1-3
e. Cue control frequency NAB Level, 0.5 DBM . . 1KHz
f. Secondary control frequency . . . . . .150 Hz
   NAB Level, 6.1 DBM
g. Tape speed (Hysteresis sync. motor . . . . 7.5 IPS
   direct drive)
h. Tape drive control . . . . . Linear Solenoid*
i. Power requirements . . . . . 115v. 60 Hz
   Stand-by . . . . 50 watts
   Playing . . . . . 70 watts
j. Panel space (Rack Model -R). . . . . 7" x 19" x 14 3/4"
   (Desk Model -D). . . . . 7" x 14 3/4" x 16"
k. Weight. . . (Rack Model -R). . . . . 38 Lbs.
   (Desk Model -D). . . . . 38 Lbs.

* U.S. Patent #3,113,708

1.3 CONTROLS

POWER SWITCH: Model 510/512 only. This pushbutton is located at the center of panel and it will light red when the machine is ON.

NOTE: On Models 10A and 12A the center pushbutton is a momentary switch to transfer program audio to a "Cue Audio" circuit. A lamp in the switch is turned on each time the machine is "on the air".

START: The right hand button on the panel controls the starting of the tape drive. Machine must be turned on and a cartridge in playing position such that STOP button is lighted.

STOP: This left hand button will disconnect the drive and cause the tape to stop. Lights will transfer back to STOP.

SECTION 2

INSTALLATION AND OPERATION

2.1 CONNECTIONS TO SYSTEM

Rear terminal board TB1 connections include, counting left to right:

#1 - #2	600 ohm audio output Channel A (left)
#3 -	Chassis ground
#4 - #5	600 ohm audio output Channel B (right) Model 512 and 12A
#6 -	Cue audio on Model 10A, #2 common
#7 -	Cue audio on Model 12A, #5 common
#8 -	Remote audio control (with term.#7 on models 510/512)
#9 - #10	Remote stop (normally closed circuit)
#9 - #11	Remote start (normally open circuit)
#12 - #17	Auxiliary tone relay contacts

A jumper is factory installed across #9 and #10, the remote stop circuit, on all models. An additional jumper wire is installed across #7 and #8 on Models 510 and 512 only. This circuit must be closed in order to get audio output.

Auxiliary (secondary) tone control relay circuits are provided at terminals #12 - #17 to control additional equipment on signal from the auxiliary tone.

2.2 CARTRIDGES

Cartridge condition is most important to success of any tape system. When improper reproduction in playback or recording is noted, examine the cartridge.

New cartridges and those suffering rough handling, particularly the large cartridges, should be visually inspected. Turntable release spring, which may be seen through keyhole in bottom of cartridge, must not be jammed under rim of turntable. Inspect tape guide wires and general position of tape in cartridge. Always pre-run new cartridges, those accidentally dropped, and those that have been respliced or adjusted.

In Fig. 12B the correct operating position of cartridge is shown. Pads must hold tape tangent to heads directly over pole piece. If pads are not holding tape tangent to heads at the center of the pole piece, erratic recording, loss of high frequency response and loss of cueing may result.

A cartridge that functions properly should be held aside as a test standard. Do not store cartridges near heat or magnetic fields.

CARTRIDGE BEHAVIOR

NOTE: The following symptoms also may result from other conditions. It is assumed that some but not all cartridges behave as described.

	SYMPTOM	TREATMENT
a.	Tape loops out of cartridge at capstan.	a. Tape is too loose on hub. Find splice and remove 1 to 4 inches of tape. Short length cartridges are much more critical to extra tape in the loop.
b.	Puckering of tape as it passes over guide wire. Wow and flutter on that particular cartridge.	b. Tape is too tight. Pull one or two turns from inner hub and add to tape in main loop.
c.	"Muddy" and/or weak playback for first few seconds of run.	c. Right pressure pad not holding tape up to head.
d.	Cue and auxiliary signal "misses".	d. Pressure pad not holding tape up to cue head.
e.	"Thumping" sound reproduced.	e. Cartridge not properly erased. Cover all parts of cartridge with eraser and separate before turning eraser off.

SECTION 3

MECHANICAL ADJUSTMENTS AND MAINTENANCE

3.1 MECHANICAL ADJUSTMENTS

The majority of mechanical adjustments that may be required will concern themselves with the deck mechanism. Refer to drawing MS507A (MS607A for Carousel) for the following references.

SOLENOID POWER UNIT (refer to 1 drawing MS507A or MS607A) must press pinch roller against capstan with enough pressure to pull tape smoothly. Properly adjusted a new pinch roller (13) will be indented at the capstan about 1/32". A pinch roller that has become glazed hard, or cupped should be replaced by removing the snap ring, nylon spacer and old roller. Wipe the shaft clean and apply a very small drop of oil to the shaft. Install new roller with bronze bearing projecting down toward cross shaft (9). Reinstall nylon washer and snap ring.

Solenoid may be inspected and adjusted internally by removing from the deck after removing screws (8H and 1H). Plunger may be removed from bore by removing rear bumper bracket (3) and unhooking spring (5). Inspect plunger and bore for dirt; wipe clean. Be careful not to bend plunger guide pin. Inspect thrust roller (2) to see that nylon roller is free on its shaft. This assembly must support the plunger so that it will not drag in the bore.

Reassemble solenoid unit and while supporting it in a horizontal position, press plunger quickly to the bottom of the bore and release. There should be no tendency for plunger to stick and it must return to rear bumper. Do not oil plunger. A drop of light oil may be put on guide pin.

Reassemble solenoid on deck and adjust as under Pinch Roller Adjustment.

PINCH ROLLER PRESSURE is adjusted by moving solenoid unit forward to reduce pressure and rearward to increase. To move solenoid, loosen three screws (8H and 1H) and move slightly in indicated direction. Retighten screws and check. If adjustment cannot be obtained, move solenoid all the way forward and then move it back until pinch roller will just touch capstan when plunger (4) is pressed all the way into its bore. Tighten all screws and check pressure. Readjust very slightly if required. Clean capstan and pinch roller as discussed under Head Cleaning.

Driving pressure of the roller can be quickly adjusted at the pressure control screw at the rear of the solenoid tube. Turning this screw one turn counter-clockwise to increase and clockwise to reduce pressure.

Do not use more pressure than required to pull tape at uniform speed. Excessive pressure will overload capstan bearing.

CROSS SHAFT(9) should only be adjusted if replacing parts and if malfunction dictates. End bearing blocks (14) should be adjusted so that end play in the cross shaft is barely perceptible. It must always be free enough for recoil spring (12) to return shaft. A drop of oil on the thrust balls (11) should be applied at 6 month intervals.

3.2 HEAD ADJUSTMENTS

HEAD LOCATION should be checked as follows if adjustments have been disturbed.

a. Loosen head bracket and move to rear.
b. Set guide for cartridge to dimensions shown in Fig. 12.
c. Insert cartridge until it touches capstan at center of cutout in lower shell of cartridge.
d. Pull cartridge back 1/16" and hold.
e. Move head bracket case forward until case touches front edge of cartridge. Pressure pads should appear as in Fig. 12B.
f. If bracket setting is correct, the pressure roller will rise and fall freely through keyhole and when cartridge is running there will be about 1/32" freedom to move and the cartridge right and left as well as in and out. It is important that the cartridge be free and not jammed against the capstan while running.

The head next to the capstan is a dual $\frac{1}{2}$ track and the upper track is the program play track while the lower track is for playback of control signals. This head should be adjusted for height as shown in Fig. 12C.

The left hand head on Record Center Models is for recording program on the upper track and it should be adjusted as in Fig. 12C.

3.3 HEAD ALIGNMENT

If head height above deck (track location)has not been changed, proceed as follows to adjust azimuth.

1. Loosen the socket-head set screw one turn. This screw is located just to rear of the head.
2. Using alignment tape, turn azimuth screw at right end of head holder for peak output of 10 KHZ tape signal.
3. Carefully tighten set screw while observing output.

If head track height has been disturbed, the two slotted sleeve nuts at the left of each head are tightened to lower the head. The rear sleeve nut will tilt the head face upward when tightened and the front sleeve nut will tilt the head downward. Use these sleeve nuts and the azimuth screw to make the head position as shown in Fig. 12C.

To replace heads, loosen clamp screw, and carefully remove socket from head (pull straight back). Install new head and socket with notch up. The face of the head should project 9/32" beyond the base of the HB4 head holder assembly.

On Stereo Models, the 3-track and 4-track (special versions) heads have individual slip-on terminals for connections. These must be installed and removed very carefully to prevent damage. DO NOT SOLDER TO HEAD PINS.

HEAD CLEANING: Cartridge tape is lubricated to a greater extent than reel to reel tape, thus heads and pressure roller will become "dirty" more often. Use a suitable head cleaner, such as MaCarTa Head and Pinch Roller Cleaner. It is necessary to brush the head face with fluid and wipe off while still damp. This also applies to pressure roller and capstan. Do not merely wet the surfaces and allow to dry. Be sure to wipe clean with a soft cloth.

3.4 LUBRICATION

NOTE: For lubrication of exposed bearings use a high grade non-gumming motor oil as Sinclair Rubilene. Motor has sealed ball bearings. Do not oil. The transport deck should be lubricated as described in paragraph 3.1.

On Carousel models, the bronze "oilite" bearings require 1 drop of oil at 6-month intervals. Also lubricate the shift lever slots and the shift rod where it slides into the main drum shaft.

The drum drive motor and the tray shift motor have small holes to oil the rear bearings. DO NOT OVER-OIL.

Carousel trays may be lubricated if required, with a small amount of white Vaseline.

3.5 TRAY INDEX ADJUSTMENT

1. This important adjustment is necessary to insure the cartridge being inserted into the playing transport at the proper relation to the capstan and heads. If the cartridge tray is too high relative to the head support plate, the pinch roller may not be able to enter the hole in the cartridge and drive the tape. If the tray is too low, the cartridge will be forced up at an angle with similar improper results. The correct adjustment is the one that allows each tray to slide smoothly onto the cartridge plate without being spaced above it. See Fig. 4.1; Fig. 4.2; and Fig. 4.4.

2. The index of the signal system with switch SW103 is located immediately at the top rear of the drum.

   Adjustment of the index tripping of SW103 is made by a cam adjusted index block. See Fig. 4.4.

   To make adjustment:

   a. Remove any cartridges near the 12 o'clock drum area. Note two screws visible near rear edge of trays.

   b. Determine if trays are shifting into play position too high above cartridge deck plate or too low.

   c. Loosen right-hand lock screw 1/4 turn.

   d. If trays are shifting in too high, turn left cam screw clockwise slightly, tighten lock screw, and test tray indexing action.

   e. If trays are too low when shifting into play (hitting edge of cartridge plate), turn cam screw counter-clockwise. Be sure to retighten lock screw.

3. If index condition of trays is satisfactory except for one or two trays it is likely that they have become bent or loose on the drum. If this is true, loosen the tray braces on either side of the questionable tray. If the tray holder is loose on the drum, or has been forced up or down, it will be necessary to remove the screw holding the tray pin (grip the pin with smooth-jaw pliers and loosen the #8 screw). A chemical locking compound (Loctite) is used on these screws and they will require some force to remove. When the tray pin is out, the tray may be pulled out to expose the #8 screws holding the

tray holder. Loosen these screws and move the tray holder in the required direction. The use of a straight edge from the head support plate is recommended. Check at both the inside and outside edges of the holder, bending the holder slightly if necessary to make surfaces coincide. When this situation is realized, carefully tighten all screws and replace tray holder braces so that they just touch but do not exert force on adjacent tray holder. Replace tray and pin.

3.6 TRAY STROKE ADJUSTMENT

NOTE: Improper tray stroke can cause cartridge to stop short of capstan so far that pinch roller cannot press tape against it. The stroke can be too much and the cartridge will be jammed against capstan causing a "squeek" and slow speed. Before attempting the following adjustments, check the distance from the front edge of the tape transport deck to the tray holders as they pass that front edge. The transport must be square to the tray holders and 3/8 inches from them. The amount of stroke is affected by the mechanical adjustments, described below and also the adjustment of limit switches described in Sec. **3.9.**

1. The length of the tray stroke from full "in" position to full "out" position is regulated by shift lever pivot adjustment (see Fig. 4.3). The shoulder screw in the lower end of the shift lever is mounted in a slot in the shift motor plate. If the pivot screw is moved up in the slot, the stroke will be lengthened and conversely.

2. When the cartridges are going too far into the transport (there should be 1/32" between front edge of cartridge and capstan for proper operation) some straining of the shift motor will be observed, and also loosening of pin fork (Fig. 4.1). If the cartridge is not going into the transport far enough, the pressure roller may not be able to come up through the keyhole or may not drive the cartridge properly.

3. NOTE: Before making any adjustment in the shift bar check the clearance of the pin fork (Fig. 4.1), to the shift ring (9/32" maximum). If the shift fork is bent or loose, the cartridge will not be moved far enough into the transport for correct operation.

4. The tray position relative to the capstan and heads should be corrected by moving the shift ring (Fig. 4.1) in or out on the shift rod as required.

The shift ring is clamped to the rod by a socket head cap screw located in the side of the aluminum block at the center. Loosen this screw and move the ring in or out as required. Be certain to keep bar in its same horizontal position. Twisting the bar back and forth slightly will aid in moving it on the shift rod. Reclamp screw securely.

3.7 TRANSFER SWITCH ADJUSTMENT

NOTE: It is necessary to remove electronic chassis to adjust position of SW103 transfer switch.

1. The transfer switch (SW103) is tripped each time the drum turns one notch and stops the drum drive while at the same time transferring power to the shift motor to bring the next tray into play position by the action of the electronic transfer circuit.

2. Transfer switch (SW103) must be adjusted so that it is tripped by the index bar when that member is pressed back by the action of the notches in the drum.

3. Since the drum cannot be turned by hand because of the brake action of motor M3, it is necessary to release this motor by pulling downward on right hand end of the pivoted motor bracket thus compressing the cone spring. See Fig. 4.2.

4. With the drum motor disengaged as described in 3, the drum may be turned in its normal forward direction only (clockwise when viewed from the front.) DO NOT ATTEMPT TO TURN BACKWARD. Observe the action of SW103. This switch should be tripped positively when the follower is being pushed back by the drum notches. SW103 must be released each time the follower drops into an index notch. Check the complete rotation of the drum. Make any correction needed.

3.8 DRUM DRIVE MOTOR

1. The gear reduction motor M3 has a rubber-tire drive wheel on its shaft which is pulled into contact with the inside rim of the drum by a cone shaped pressure spring (See Fig. 4.2). Power is fed to this assembly through relay CR4 each time the tray reaches its retracted position. When the transfer switch SW103 is tripped after each notch, power is removed from M3 and transferred to the tray shift motor M2 to insert the next tray.

2. Clean the inside rim of the drum with alcohol as well as the drive tires. Adjust the pressure spring tension to give positive drive but do not overload. Keep screws and connections tight.

3. If necessary to remove drum drive motor assembly, remove electronic chassis to reach 5/16 inch bolts inside channel frame holding the assembly.

3.9 SHIFT MOTOR LIMIT SWITCHES

1. The two limit switches, SW104 and SW105, (See Fig. 4.3) for the tray shift motor crank arm serve to turn this motor off at the ends of its travel. SW105 will stop the motor if a cartridge is in a tray and the by-pass switch SW102 is activated by the cartridge.

2. The two limit switches are mounted in a manner that permits them to be pivoted toward or away from the crank arm which activates them. When the crank arm is at right angles with the shift lever at the two extremes of the stroke, the corresponding limit switch should be adjusted to "snap". Do not move switch closer to crank than required to trip or over-travel as the crank may damage the switch. The shift motor may be turned by hand by pressing the magnetic brake shoe tight against the motor laminations while rotating the nylon cog-wheel in clockwise direction only.

3.10 CARTRIDGE SWITCH ADJUSTMENT

The cartridge sense switch SW102 (See Fig. 4.2) is correctly adjusted when it is tripped by the cartridge when the cartridge is moving in and is about 1/8 inch from its final "in" position at the head holder. Note that this switch does not stop the travel of the cartridge. That travel is stopped by SW105 limit switch. When cartridge is in place and running, a slight movement of the lever arm of SW102 should be felt. Do not adjust SW102 so that its lever "bottoms" when cartridge is in playing position.

3.11 TRANSPORT ADJUSTMENTS - CAROUSEL

Transport adjustments and attention will generally concern themselves with head cleaning, alignment, pressure roller cleaning and adjustment. Refer to Fig. 12 and Fig. 4.6.

Heads and pressure roller should be cleaned frequently enough to insure consistent operation. Use clean cloth to wipe parts dry and do not allow head cleaner to merely dry without wiping accumulation away. Use MaCarTa Head Cleaner Kit.

Removing Transport: Transport is held in place with two 1/4-20 machine bolts into lower edge of main bearing block and by two 10-32 screws through left end of channel beam. Remove cables and screws to allow deck to be lifted out. When replacing, be certain to reinstall so that position of capstan relative to cartridges is the same. Deck has adjustment right to left as well as in and out to permit correct operation of cartridges.

Solenoid Power Unit: (Refer to 1 on Fig. 4.6) must press pinch roller against capstan with enough pressure to pull tape smoothly. Properly adjusted, a new pinch roller (13) will be indented at the capstan about 1/32 inch. A pinch roller that has become glazed hard, or cupped should be replaced by removing the snap ring, nylon spacer and old roller. Wipe the shaft clean and apply a very small drop of oil to the shaft. Install new roller with bronze bearing projecting down toward cross shaft (9). Reinstall nylon washer and snap ring.

Solenoid may be inspected and adjusted internally by removing from the deck after removing screws (8H and 1H). Plunger may be removed from bore by removing rear bumper bracket (3) and unhooking spring (5). Inspect plunger and bore for dirt; wipe clean. Be careful not to bend plunger guide pin. Inspect thrust roller (2) to see that nylon roller is free on its shaft. This assembly must support the plunger so that it will not drag in the bore. Reassemble solenoid unit and while supporting it in a horizontal position, press plunger quickly to the bottom of the bore and release. There should be no tendancy for plunger to stick and must return to rear bumper. Do not oil plunger. A drop of light oil may be put on guide pin. Reassemble on deck and adjust as under Pinch Roller Pressure.

Pinch Roller Pressure: is adjusted by moving solenoid unit forward to reduce pressure and rearward to increase. To move solenoid, loosen three screws (8H and 1H) and move slightly in indicated direction. Retighten screws and check. If adjustment cannot be obtained, move solenoid all the way forward and then move it back until pinch roller will just touch capstan when plunger (4) is pressed all the way into its bore. Tighten all screws and check pressure. Readjust very slightly if required. Clean capstan and pinch roller as discussed under Head Cleaning.

SECTION 4

ELECTRICAL ADJUSTMENTS AND MAINTENANCE

4.1 GENERAL

The semiconductors and parts incorporated in this device are selected to provide long and trouble free operation. It will be noted that most semiconductors are solidly soldered into the circuit cards while others have been provided with plug-in sockets. The latter devices are considered to be the most likely to cause difficulty because of their relatively larger currents or complexity in the applied circuits.

Because of the necessity to identify large numbers of parts on the printed circuit cards, each of the cards will contain part numbers which are the same. It is recommended that you familiarize yourself with the function of each circuit card. Refer to the part number by the card series on the parts list.

A number of special precautions should be observed in the course of trouble shooting and repair of solid state circuits. Probably most important of these is the necessity to use extreme care not to introduce a short circuit in the handling of probes and connections to the circuits. Many transistors and diodes will short instantly when excess currents are caused to flow in their circuits. Other damage can be caused by excessive soldering temperatures and physical strain on the solid state devices. Please observe good practice in the course of your tests and repair.

4.2 RELAY ACTION

Relay CR1 is the cue-controlled power relay. This relay is energized when the Start button is pressed. (Cartridge in machine). It remains energized until the cue signal is received at which time it drops out and stops tape drive. This relay controls the Stop and Start signal lights and it also disconnects the audio output from the preamplifier when tape is not running.

Relay CR2 is activated only by the Auxiliary Tone or "end of message" signal. Its action is momentary for the duration of the signal from the tape. Poles are wired to TB1 for external control of other machines.

In Recorder models, CR3 is the "Set" record relay used to power record circuits in that model.

In Carousel models, the action of relays CR3 and CR4 is covered in Sec. 4.6 under Carousel Mechanical Control.

4.3 COMPATIBILITY

The Model 590/ 90A and 592/92A Recorders will meet the requirements of the NAB cartridge tape recording and reproducing standards. Compatibility with older models not designed to meet these requirements is limited. Usage should be carefully explored, preferably with assistance of the factory engineering services department.

4.4 ELECTRICAL ADJUSTMENTS - PLAYBACK

OUTPUT LEVEL: Output level is controlled by Gain controls R101 and R102.

EMPHASIS CONTROL: (Located on Program Amplifier Card series P1) is used to vary the response of the preamp above 1 KHz. It is factory adjusted for standard NAB response. To readjust to this standard, connect the playback head in series with signal generator connected to input. Turn generator to 8 KHz and with same generator output, preamp output should be -18 DBM when 400 Hz output = 0 DBM.

Since heads have different characteristics, it is necessary to adjust emphasis control to give uniform flat response from a frequency standard tape. Do not adjust emphasis without aligning heads first.

CUE GAIN CONTROL R103 may be turned clockwise for greater sensitivity to the cue pulses. Its setting is not critical and is operated at full ON for all NAB level tapes.

AUXILIARY TONE GAIN R104 may be turned full ON for all NAB level tapes.

4.5 ELECTRICAL ADJUSTMENTS - RECORD MODELS

NOTE: An extender circuit board holder, EX-1, is available to facilitate the following adjustments.

The following adjustments are made at the factory and will require little attention unless circuit cards are replaced or require maintenance.

BIAS TUNING: Transformer T1 on the bias card, series BG-1, should be adjusted for maximum output as measured by the panel VU meter, switched to "Bias". NOTE: Bias voltage is present only when in Record Set Mode and after Start button is pressed.

BIAS TRAPS: Two tunable traps, L2 on the Record Amplifier card series RA-2 and L1 on the Record Control Card series RC-1 are used. It will be necessary to use a card extension to provide access to these adjustments. Proceed as follows:

L2 on Record Amplifier Card - RA-1/RA-2

1. Connect a Hi-Z VTVM or Scope to either end of C11 (adjacent to the trap) and chassis ground.
2. Install a cartridge, set Record and start the recording process.
3. Tune the trap for minimum voltage. (Use an insulated tool.)

L1 on Record Control Card - RC-1

1. Temporarily connect a jumper between pin #10 and pin #3 of the Record Control Card.
2. Connect a Hi-Z VTVM or Scope to the end of the trap that joins to R6. Connect the other lead to chassis ground.
3. Install a cartridge, set Record and start the recording process.
4. Tune the trap for minimum voltage.
5. Remove jumper and VTVM.

BIAS VOLTAGE: Record head bias is adjusted by C102 on Card BG-1. Turn screw clockwise to increase bias. To adjust bias, record 1000 Hz at -4VU and while monitoring output of the recording using the panel VU meter. Adjust C10 for peak amplitude. Record on a new cartridge with the tape you normally use. Switch the panel meter to "Bias" position and note reading to refer to later.

STEREO MODELS: The bias tuning and bias traps for Models 592/92A are adjusted as described above. Since there are two record cards, each L2 is adjusted separately. Bias voltage for the record heads is adjusted by C10 for Channel A (left) and by C11 for Channel B. Repeat the instructions given above under BIAS VOLTAGE. All other adjustments are duplicates of monaural instructions.

RECORD COMPENSATION: Control R18, located on the Record Amplifier Card is to vary the recording at frequencies above 10K Hz.

To adjust:

1. First, playback amplifiers must be adjusted with the standard frequency tape. See 3.3.
2. While recording 10 KHz, azimuth record head for peak output of playback.
3. Make a frequency-run recording at -15VU and hold constant output from generator. Use good tape and a good cartridge.
4. Adjust R18 until frequency run recording is +2DB or better from 50 Hz to 12 KHz.

METER CALIBRATION:

1. Turn playback Gain control R101 to half gain or less.
2. Using your preferred tape, record 400 Hz from generator with 1/4% or less distortion. With Record Gain control at maximum, increase input to Model 590 until distortion at output terminals #1 and #2 is 3% THD. Note input level in DBM and maintain.
3. Reduce output with level control by 8 DB.
4. With panel VU meter switched to "Record", adjust Meter Cal. (R21) until meter indicates 0 VU.

TONE GENERATOR LEVELS: The strength of the primary or STOP cue and the Auxiliary tone signals are adjusted by R11 on each of the cards. The proper setting is established by playing the tones through the program pre-amplifier. Adjust this pre-amplifier to read exactly 0 DBM from the NAB 400 cycle reference level tape, or produce a 400 cycle tape @ 0 level after performing the steps under "Meter Calibration" above.

CUE TONE LEVEL ADJUST: (R11 on Cue Generator Card)

1. Temporarily connect the cue received head to the program input jack. (Amplifier Gain established as above.)
2. Temporarily connect a jumper from pin #3 to pin #1 of the card holder.
3. Install a cartridge, set and start the record process.
4. With an insulated tool, adjust R11 to produce an output of +0.4 DB on the output meter.
5. Disconnect jumpers.

AUXILIARY TONE LEVEL ADJUST: (R11 on Tone Generator Card)

1. Temporarily connect the cue receive head to the program input jack. (Amplifier Gain established as above.)
2. Temporarily connect a jumper from the anode of Diode D3 to pin #1 on the card.
3. Install a cartridge, set and start the record process.
4. With and insulated tool, adjust R11 to produce an output of +6.1 DB on the output meter.
5. Disconnect jumpers.

4.6 DESCRIPTION OF CIRCUITS

Program Pre-Amplifier Series P-1 This 4 stage silicon amplifier card provides the necessary Gain and Frequency compensation to elevate the output of the tape head to operating levels. Transistors Q1 and Q2 are connected in a compound DC coupled circuit with both DC and AC feedback to satisfy the requirements of high input impedance and good stability. The output of Q2 looks into the program Gain Control as a load. Transistors Q3 and Q4 are both AC and DC degenerated to prevent their input impedances from seriously reflecting upon the preceeding stage, and to add a measure of temperature stability. Both Q3 and Q4 afford moderately large current gains with Q4 biased at approximately 150 milliwatts DC, making it capable of several milliwatts of AC output at low distortion. Q4 is DC isolated from the output transformer to improve the range of un-distorted frequencies.

Cue and Auxiliary Tone Amplifiers Series CA-1 This 5 transistor circuit card provides amplification and operation of the Cue and Auxiliary tone switching signals. Transistor Q1 operates as a common pre-amplifier for both tones. Its partially AC degenerated emitter improves the input impedance to approximately 15K ohms, suitable for the high impedance type heads. The output of Q1 feeds two tone separating circuits and the two Gain Controls for each sensing circuit. Q2 and Q3 provide the additional amplification for the 1KHz cue tone. Relatively small emitter bypass capacitors C7 and C10 and collector bypass capacitors C8 and C11 tune these stages to a 1 KHz passband, rejecting both high and low frequencies on either skirt.

Q4 and Q5 provide the additional amplification for the 150 Hz auxiliary tone. The selected value of emitter bypass capacitors C14 and C17 and collector bypass capacitors C15 and C18 tune these stages to 150 Hz, rejecting the higher frequencies and reducing considerably the frequencies below 120 Hz.

The outputs of Q3 and Q5 are connected externally to their individual circuits on the switching card.

Cue and Auxiliary Tone Switching Card Series CS-1 The heart of the cue and auxiliary tone sensing system lies within this circuit card.

Best described as a combination of logic and DC gating, this circuit provides, in addition to the DC amplification to drive the relays, a complex sytem of DC feedback, timing and delaying to insure that the individual circuits operate only at the desired time in the operating sequence.

Consider that the normally open START pushbutton is connected from the collector of Q9 to chassis ground. Also consider that the normally closed STOP pushbutton is connected from the emitter of Q1 to chassis ground.

Transistor Q2 is a bi-stable device with its anode connected to +18 volts DC. A negative DC voltage applied at the gate (of Q2 with respect to the anode) causes this transistor to turn "on". A positive DC voltage at this same point causes this transistor to turn "off".

Depressing the START pushbutton (or a contact closure at the external start terminals) feeds a negative pulse to the gate of Q2 and turns it "on". The load circuit of Q2 (R2 and R1) form a voltage divider to chassis ground and provide forward drive current to Q1 which saturates and turns on cue relay Cr1, which is connected to the collector. The secondary load circuit of Q1 consisting of R11 and R12 form a voltage divider to +24 DC to the unijunction timer circuit of Q8, its load switch device Q7 and the auxiliary tone switching transistors Q6 and Q10. Transistors Q8 starts its timing period (normally about 2 seconds), during the timing period, +24 DC is present at the anode of Q7 and as a driving voltage for R19 and the transistor Q9 which is configured as a 2 input "OR" unit. Transistor Q9, conducts for the timing period and maintains a blocked "on" signal for Q2. Since Q7 also forms a series switching element in the auxiliary tone relay CR2 and its switching series transitor Q6, the auxiliary tone circuit is inoperative for the timing period.

At the end of the timing period transistor Q8 provides an output pulse, firing Q7 into conductivity, removing the blocked "on" signal for Q2 and forming a completed load circuit for the auxiliary tone relay. Transistor Q7 and Diode D2 now form a low impedance current path shunting the supply voltage from Q8 which immediately resets.

Transistor Q10 operates as an AC rectifier for the incoming auxiliary tone signals, and provides a DC output across R22 and R14. Resistor R21 and capacitor C4 provide a rectifier load and a slight delaying element for the collector of Q10. This prevents transistor Q6 from switching during brief transient signals that may appear in the system.

Transistor Q4 operates as an AC rectifier for the incoming cue signals, and provides a DC output across R8, R7, and R6. C2 acts as a rectifier load and delaying element for the collector of Q4. Transistor Q3 has its emitter connected to +24 volts DC and the collector connected through Zener Diode D1 and a current limiting resistor R5 to the gate of Q2. This provides a difference in voltage of +6 volts at the gate of Q2 when transistor Q3 conducts.

The combination of the delay of capacitor C2 and the avalanche point of Diode D1 creates a delayed operation of the cue circuit which is approximately twice as long as that experienced by the auxiliary tone.

During the switching time of the auxiliary tone signal and transistor Q6, a DC voltage is returned through resistor R25 to the base of Q9 driving it to the "on" stage and blocking Q2 "on" for the same period. Because of the inherent difference in the delay time of the two systems, the auxiliary tone is prevented from stopping the cue system.

Power Supply Series PS-1 This circuit board contains the components which provide the operating DC supply voltages for the various circuits. Diodes D1 and D2 are connected in a full wave center tapped configuration and provide an output of +25 VDC to the input filter capacitor C1. Transistor Q1 is connected as a series regulator and capacity multiplier. Output at its emitter is approximately +24 VDC. Ripple has been reduced to approximately 5 millivolts. Zener Diode D3 and the filter capacitor C3 provide a decoupled output, referenced at 6 volts lower than the output of Q1 or approximately +18 VDC. This voltage is used as a bridging voltage for the cue switching system. Resistor R4 and capacitor C4 provide an additional decoupled stage to feed the program pre-amplifier(s) at approximately +20 VDC.

Carousel Mechanical Control Card Series MC-1 This card contains two seperate circuits for the purpose of controlling the position and attitude of the Carousel mechanism. The delayed 1 shot circuit Q1 and Q2 creates an operating signal for relay CR3 consistent with the end of the playing period, to eject the tray. Silicon controlled rectifier Q11 and its associated circuit transfers the AC power from shift to rotate consistent with the position of the mechanism.

a. Delaying 1 shot circuit - Resistor R1 couples the collector voltage of transistor Q1 (in the cue switching circuit) to the base of Q2. When the cue relay is pulled in, this voltage is near "0". When the cue relay drops out this voltage rises to +24 volts.

The combination of resistor R1 and capacitor C1 provides for a delay of approximately 1 second before transistor Q2 switches. The increasing voltage across R3 causes a current flow through R4 and C2 driving transistor Q1 into conduction and pulling in relay CR3. After approximately 2 seconds capacitor C2 charges to supply value, current ceases to flow, transistor Q1 reverts to cut-off and relay CR3 drops out. The contacts of CR3 momentarily bridge the AC power across the cartridge tray switch and cause the tray to move out.

b. Shift-Rotate control circuit - (Refer to simplified shift/rotate control circuit.)

This circuit's function is to translate the information received from the various position sensing micro-switches into decision and cause the relay CR4 to either call for drum rotation or shift. It is cross interlocked in several ways to provide a maximum amount of safety from simultaneous operation of both the motors, which could jam the mechanism. Its operation is as follows:

Q11 is connected in such a manner that even though the index switch is resting closed when power is applied, no gate signal is present because of the predominant value of C12. This causes the SCR to remain in the "off" state. When the drum moves, the "index switch" transfers and discharges C11 and charges C12 to supply voltage. When the drum reaches index position, the "index switch" reverts. This causes an "on" signal of short duration at the gate and Q11 fires pulling in CR4. CR4 transfers AC power from the Rotate Motor to the Shift Motor and the tray moves in.

When the tray is shifted fully in, the "in limit" switch is opened, removing anode power and Q11 is turned off. If a cartridge is not in place, the "cartridge switch" and the "out limit switch" form a completed circuit causing the tray to eject and search for one that is in place. When a cartridge is in place, the tray stops "in" and awaits play.

The cartridge may be ejected by depressing the "tray" pushbutton or by the 1 shot relay activation at the end of normal play.

When the cartridge is ejected, the "out limit" switch will transfer power through its normally open contact and the contact of CR4 to the rotate motor which will now rotate to the next index position.

If the "manual" pushbutton is in the MANUAL position the next tray will wait and must be manually inserted by depressing the "tray" pushbutton.

If either the "rotate" pushbutton or the Random Selector contact (if used) is open, the SCR anode power is removed and the drum continues to rotate until the next index position following closure of these circuits.

Power Supply Card PS-2: Record Models This circuit board contains the components which provide the operating DC supply voltage for the various circuits. Diodes D1 and D2 are connected in a full wave center tapped configuration and provide an output of +25 VDC to the input filter capacitor C1. Transistor Q1 is connected as a series regulator and capacity multiplier. Output at its emitter is approximately +24 VDC. Ripple has been reduced to approximately 5 millivolts. Zener Diode D4 and the filter capacitor C3 provide a de-coupled output referenced at 6 volts lower than the output of Q1 or approximately +18 VDC. This voltage is used as a bridging voltage for the cue switching system. Resistor R2 and capacitor C4 provide an additional de-coupled stage to feed the program pre-amplifier(s) at approximately +20 VDC. Diode D3, resistor R3 and capacitor C5 are components used to produce the -6 DC supply required for the gate circuits in the cue and auxiliary tone recorders.

Recording Control Card Series RC-1 This card contains four separate circuits that perform functions in the recording process. They operate as follows:

(a) Transistor Q1 and its associated circuit operates as a mixing emitter follower to couple the tone bursts from the two tone generators to the tone recording head. Coil L1 and capacitor C6 form a resonant bias trap to prevent the 80 KHz bias from distorting the audio. A third mixing point is provided for recording additional tones on the cue track.

(b) Transistor Q2 and its associated circuit operates as a bias gate for the tone track. Resistor R9 is connected to the -6 volt DC bus and drives Q2 into saturation. Positive voltages fed to R8 allows Q2 to be driven to cut-off during the tone bursts, applying the necessary bias to record these tones.

(c) Transistor Q4 operates as a series DC gate for the bias generator. It is driven by the one-shot multivibrator of the auxiliary tone record card, and applies DC to the bias generator. This allows the auxiliary tone to be applied during editing of a recorded cartridge or at a different time.

(d) Transistor Q3 and its associated circuit is connected in the series control circuit of the set record relay. Each time that the cue relay is released, a short pulse is coupled through C7 and R14 driving Q3 to cut-off and releasing coil power from the record set relay.

Cue and Auxiliary Tone Generator Card Series TG-1 Two tone generator cards of this series are used in most recording models. They differ only in the value of certain parts which allow for the change in frequencies at which they operate. In each case, the functions are the same.

Transistors Q1 and Q2 operate as a Wein bridge oscillator tuned to either 150 Hz or 1KHz determined by design components. Operating DC voltage to these stages are de-coupled and regulated at +12 volts by Zener Diode D1, capacitor C8 and resistor R15. Transistors Q4 and Q5 are configured as a one-shot multivibrator timed to operate at 0.5 seconds (normally). The output of Q4 is connected externally through Diode D2 to operate the tone record bias gate (part of card RC-1) and internally to the base of Q3.

Transistor Q3 is biased through R13 to the -6 volt DC bus and is normally in saturation. C6 provides DC isolation from the gain adj. control and an effective AC short circuit for the tone audio. Each time that the one-shot multivibrator operates, Q3 is driven from saturation to cut-off and a timed tone burst is generated.

Recording Amplifier Card Series RA-2 This 4-stage circuit provides the amplification and frequency characteristics required to drive the program recording head and the recording VU meter. The RA-2 circuit replaces and is interchangeable with the earlier model RA-1.

Q1 and Q2 are direct coupled degenerated amplifiers with approximately flat frequency response. Q3 is the VU meter drive amplifier and R21 is the calibration control.

Q4 is a frequency shaped amplifier with adjustable boost of the 12 KHz to 20 KHz gain. Compensator control R18 varies the amount of gain of Q4 at upper audio frequencies to provide the greater head currents needed for overall flat response.

L2 and C13 form an adjustable resonant trap tuned to the bias frequency, approximately 80 KC. This trap is tuned for minimum bias voltage as measured on the C11 side of L2 to ground.

Refer to page 4 - 4 for details of meter calibration and compensation adjustments.

80 KHz Bias Generator Card Series BG-1 This card produces the 80 KHz bias voltages for the recording process.

Transistor Q1 operates in a split phase Hartley configuration operating at the fundamental frequency. Transistors Q2 and Q3 are operating as a class B push-pull amplifier.

Transformer T2 and capacitor C9 tune the output for maximum efficiency. Resistor R9 and capacitor C10 provide the divided adjustable bias for the record head. On stereo models, capacitor C11 and resistor R11 perform a similar function for the added right channel. Resistor R1 and capacitor C1 provide a delaying action upon application and release of the operating voltage to prevent sudden application of bias to the head, and preventing the resultant "pop".

A lower voltage tap on the secondary of transformer T2 provides bias to the gating system for the tone record head.

4.7 SPECIAL CIRCUITS

Models 10A/12A playbacks and model 20A/22A Carousels have the following circuit differences:

A. The time delay circuit in the CS-1 circuit board is extended to give 4 to 6 seconds delay. This is done by changing resistor R17 from 100K to approximately 270K.
B. An additional Raysistor is used to control signal output from transistor Q1 in cue amplifier circuit, CA-1. This controlled signal is connected to the ACC output jack. This signal path may be used to take information encoded on the cue track of the tape.
C. In the above models the signal control Raysistor is turned on by a "held Start".

Models 90/92A have the signal read-out features of the playback models listed above except that the signal output is on rear socket SO5, pin #3.

Further circuits connected through socket SO5 provide for remote controlling of cue track bias to permit the recording of external information on the cue track.

A signal from the cue tone generator is also provided to activate an external encoding process.

Refer to Addenda page 2-2A for the Model 90/92A.

4.8 SYMPTOM TABLE - PLAYBACK

The following list of troubles and their possible causes are provided to assist in the isolation of the difficulty and to direct attention to the circuits involved. They do not definitely rule out all other possibilites.

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
Blows fuses as soon as turned on	Power Supply PS-	Shorted Diode D1 - D2	Use ohmmeter
		Shorted Capacitor C1	Use ohmmeter
	General chassis area, or circuit card, or transport	Shorted part	Remove P.S. card, start ohmmeter test from Pin #3. Remove other cards, one at a time, and see if short clears.
Circuits all dead	Power Supply PS-	Open transistor Q1--open in transformer	Test for input volt, at C1; test transistor. Measure volt, from power transformer
No audio output	Chassis	Open Raysistor	Temporarily bridge element with jumper
	Program Card Series P-1	Defective Q1 through Q4, or assoc. circuit component.	Use headphones w/.01 capacitor--test each stage
Will not start	Chassis or Pushbuttons	Open STOP circuit--Defective START pushbutton	Use ohmmeter--check for continuity.
	Card CS-1	Bad transistor Q1, Q2, Q3, or Q4	Substitute or test--measure voltages
	Card CA-1	Feeding Hum or DC to CS-1	Temporarily remove CA-1. Test for circuit function
Will not receive either tone	Card CS-1	Defective Q7 or Q8	Measure voltage at anode. See if Q7 fires
	Card CA-1	Defective Q1 or assoc. circuit.	Substitute Q1--measure volt.

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
Will not stop except when STOP pushbutton is held	Card CS-1	Shorted Q1 or Q2 Shorted Q9	Measure voltages Substitute transistors
Will not stop on cue	Card CS-1	Defective Q2, Q3, or D1	Substitute or test
	Card CA-1	No signal amplification	Test Q2, Q3
Will not receive Aux. tone signal	Card CA-1	No signal amplification	Test Q4, Q5
	Card CS-1	Defective Q6 or Q10	Substitute or test
Aux. tone relay CR2 stays pulled in	Card CS-1	Shorted Q6 or Q10	Substitue or test
	Card PS-1	Excess 120 Hz Hum--Q1 shorted	Measure ripple at Pin #3 of card--5 to 10 millivolts is normal determined by amount of supply load
Starts for no apparent reason	Card CS-1	Sensitive Q2	Replace
	External	Excessive transient Entering on REMOTE START	Use shielding to reduce transient or bypass input
	Internal	Defective suppressor capacitor	Test all capacitors in open chassis area

4.9 SYMPTOM TABLE - CAROUSEL

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
Starts for no apparent reason	Card CS-1	Sensitive Q2	Replace
	External	Excessive transient Entering on REMOTE START	Use shielding to reduce transient or bypass input
	Internal	Defective suppressor capacitor	Test all capacitors in open chassis area
Drum rotates constantly	Card MC-1	No DC power	Measure at Pin #1
		Defective SCR, Q11	Substitute or test
		Defective C11, or C12	Test with ohmmeter
	Chassis	Shorted .5 capacitor PL3-3 to PL3-9	Test with ohmmeter
	Main frame	Defective "index" switch	Test for action w/ ohmmeter
		Open ROTATE pushbutton	Test for action w/ ohmmeter
		Open "in Limit" switch	Test for action w/ ohmmeter
		Open Random accesscircuit	Close Pin #11 to #8 on SO4
Shifts constantly, does not rotate	Card MC-1	Q11 defective (shorted)	Substitute or test
		Shorted capacitor C11	Test w/ohmmeter
	Chassis	CR4 contacts stuck	Replace relay
		Shorted .5 capacitor PL3-4 to PL3-9	Test w/ohmmeter

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
Will not stop tray at IN position	Card MC-1	Q1 shorted causing relay CR3 to hold in	Remove CR3 or open "MANUAL" push-button--Test for function
	Main frame	Defective "in limit" switch	Test for action w/ ohmmeter
		"Cartridge switch" not tripped properly by cartridge	Test for action--See that cartridges are tight in trays
		"Out limit" switch not operating by shift crank	Test for action--adjust or replace as necessary

4.10 SYMPTOM TABLE - RECORD

In the course of tests to determine source of difficulty in the recording processes, use the panel VU meters and their switching feature to determine if bias voltages are present and that the program audio is present at least through the first stages of the recording amplifiers. It will be assumed that this knowledge is a factor in the following chart.

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
No bias	Card BG-1	No DC voltage	Use voltmeter
		Defective transistor Q1, Q2, Q3	Test or replace. Measure DC volt. per chart
		Shorted C9	Measure - replace
Audio not recorded-- No meter reading	Card RA-2	No DC volt.	Use voltmeter-- Check Relay CR3 contacts
		Defective Q1 or Q2	Test--Measure volt.
	Chassis	Open input transformer or assoc. circuit	Use ohmmeter--Test for continuity of parts
Audio not recorded-- Meter reads O.K.	Card RA-2	Defective Q4	Test--Measure volt.
	External	Open Record Head or cable	Test continuity-- Listen for audio w/headphones
Records-- Poor high frequency response	External	Head azimuth wrong	Refer to Adjustments Section
	Card RA-2	Open C10 or C15 Open L1	Test--replace if necessary
	Card BG-1	Bias too high	Re-adjust bias
Neither tone will record	Card RC-1	Q2 shorted-- no bias to head	Test--replace--Use VTVM on Record Head, See if 10V. RMS bursts of bias appear when Aux. pushbutton is depressed

TROUBLE	AREA OF DIFFICULTY	POSSIBLE CAUSE	TEST RECOMMENDED
Neither tone will record	Card BG-1	Tap on T2 open	Test w/ohmmeter
	Card RC-1	Q1 or assoc. circuit	Measure volt.--Listen w/headphones or amplifier
Tone won't record--(can refer to either tone)	Card TG-1 (Either)	Defective Q4 or Q5	Connect jumper from emitter to collector of Q4--See if tone records continuously Test volt.
		Q3 shorted	Test--Open C6 and see if osc. is running by connecting phones to top of gain control
		Osc. not running--Defective Q1, Q2 or assoc. circuit	Measure voltages--Test and replace if necessary
	External	Relay or P.B. not closing	Use ohmmeter
Aux. tone doesn't record when in play mode	Card RC-1	Open transistor Q4	Test and replace
Tone records constantly	Card TG-1	Shorted Q4	Test--Measure volt.
	Card PS-2	No -DC system	Test Diode D3
Set relay CR3 won't stay in	Card RC-1	Transistor Q3 open	Test--Replace
	Relay CR3	Contact Pin 6 and 10	Clean or replace
Record won't cancel at cue	Card RC-1	Transistor Q3 shorted--Defective C7	Test and replace
	Relay CR1	Contact Pins 4 and 12	Clean or replace

4.11 VOLTAGE TABLE

The following is a tabulation of voltages measured at the leads of transistors. These voltages are measured with a 20,000 ohm per volt (or better) meter and unless otherwise indicated are steady state values. (With respect to chassis.)

CARD SERIES PS-1

	Collector		Emitter		Base	
Transistor	DC V.	AC Ripple	DC V.	AC Ripple	DC V.	AC Ripple
Q1	+27	0.1 RMS	+25	.005 v. RMS	+26	.006 v. RMS

CARD SERIES P-1

Transistor	Coll.	Emitter	Base
Q1	+4.0	+0.02	+0.3
Q2	+6.4	+3.8	+4.0
Q3	+4.2	+0.3	+0.85
Q4	+9.2	+1.2	+1.55

CARD SERIES CA-1

Transistor	Coll.	Emitter	Base
Q1	+9.4	+5.4	+5.5
Q2	+12.0	+0.5	+1.0
Q3	+8.0	+1.0	+1.5
Q4	+15.0	+0.9	+1.4
Q5	+8.3	+1.0	+1.5

CARD SERIES CS-1

Transistor	Collector		Emitter		Base	
	Normal	Switched	Normal	Switched	Normal	Switched
Q1	+24	+0.2	0	0	0	+0.7
Q3	+18	+24	+24	+24	+24	+23.5
Q4	+24	+6	0	0	0	0
Q5	0	+24	+24	+24	+24	+23.5
Q6	+0.7	+24	+24	+24	+24	+23.5
Q9	+18	0(1)	0	0	0	+0.6(2)
Q10	0(3)	0	0	0	0	0

CARD SERIES CS-1

	Cathode		Anode		Gate	
Device	Stop	Run	Stop	Run	Stop	Run
Q2	0	+18	+18	+18	+18	+17.5
Q7	0	0	0	+0.7(4)	0	+0.2

	Base 2		Base 1		Emitter	
Device	Stop	Run	Stop	Run	Stop	Run
Q8	0	+0.7(4)	0	+0.2	0	+1.0

NOTES: (1) Rises to +18 volts after timing period
(2) Falls to 0 volts after timing period
(3) Rises to +24 immediately after start
(4) Rises to +18 volts immediately after start--Falls to this value after timing

CIRCUIT BOARD SERIES MC-1 - CAROUSEL

	Collector		Emitter		Base	
Transistor	Stop	Run	Stop	Run	Stop	Run
Q1	0(1)	0	+24	+24	+24	+24
Q2	0	+24	0	0	+0.7	0

Measure the following in the "MANUAL" switch position

	Cathode		Anode		Gate	
Device	Cart. in	Out @ Index	Cart. in	Out	Cart. in	Out
Q11	0	+0.7(2)	0	0	0	(3)

NOTES:

(1) Rises to +24 volts for approximately 2 seconds following each cue.
(2) Rises to +24 while tray is moving out and until drum reaches index.
(3) Voltage at this element is a very short pulse and can be seen best only with an oscilloscope.

CARD SERIES PS-2

Transistor	Collector		Emitter		Base	
Q1	DC V.	AC Ripple*	DC V.	AC Ripple*	DC V.	AC Ripple*
Playing	27.3	.300	26.0	.003	26.7	.0016
Recording	26.8	.480	24.8	.005	25.5	.003
Stand-by	28	.120	27.0	.0016	27.7	.001

* Measured w/respect to filter capac-lead.

CARD SERIES BG-1

Transistor	Coll.	Emitter	Base
Q1	19	3.6	3.6
Q2	19	3.6	-1.0
Q3	19	2.8	-0.6

CARD SERIES RA-2

Transistor	Coll.	Emitter	Base
Q1	+3.5	0.75	1.25
Q2	14.0	3.0	3.5
Q3	10.0	0.9	1.5
Q4	18.5	1.5	2.0

(Either) CARD SERIES TG-1

Transistor	Coll.	Emitter	Base
Q1	8.7	0.5	1.0
Q2	8.7	0.5	1.0
Q3	0	0	-0.6
Q4	(a)-0.25	25	25
Q5	(b)25	0	(c)0

(Either) CARD SERIES RC-1

Transistor	Coll.	Emitter	Base
Q1	24	21	21.6
Q2	0	0	-0.15
Q3	25	25	24
Q4	25	25	25

NOTE:

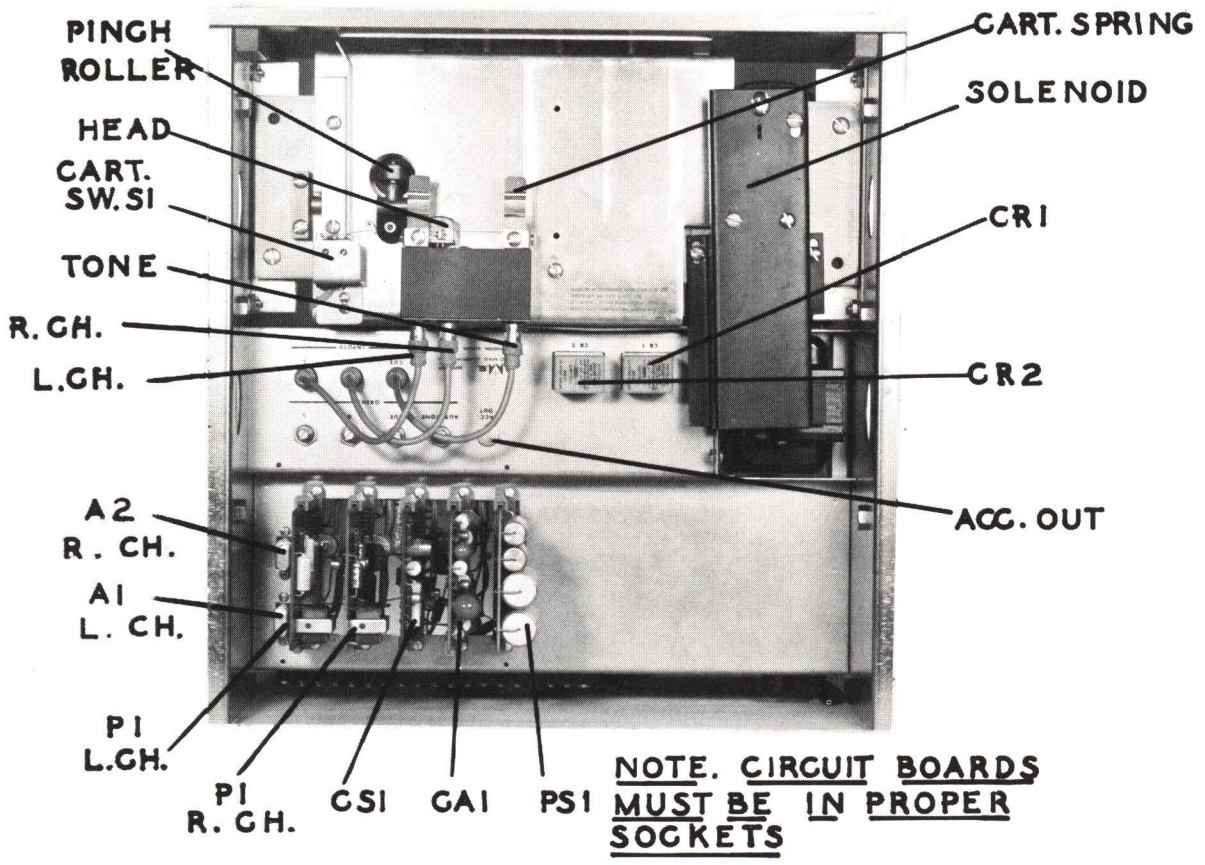
(a) To +24 when Aux Button Pressed

(b) Drops to "0" Aux Button Pressed

(c) Pulses to 0.2v on Aux.

Voltages measured on these cards with machine in the recording mode.

MODELS 510/512 & 10A/12A



NOTE. CIRCUIT BOARDS MUST BE IN PROPER SOCKETS

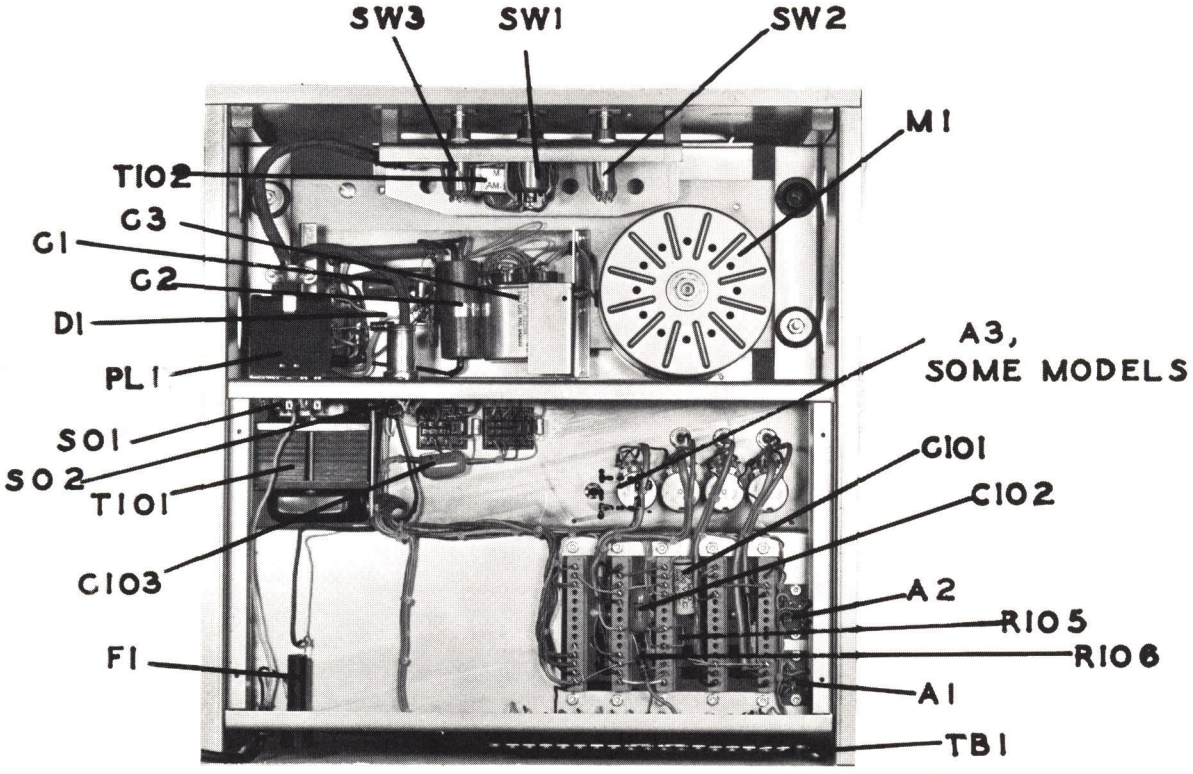
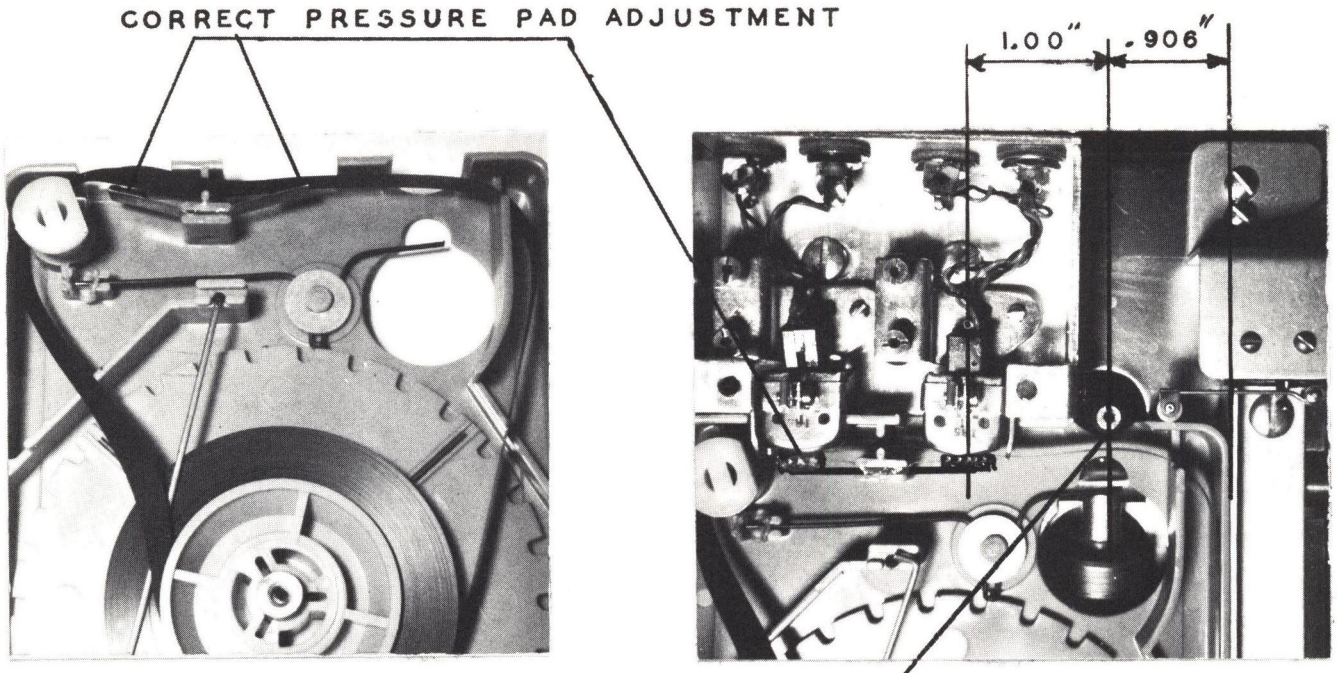
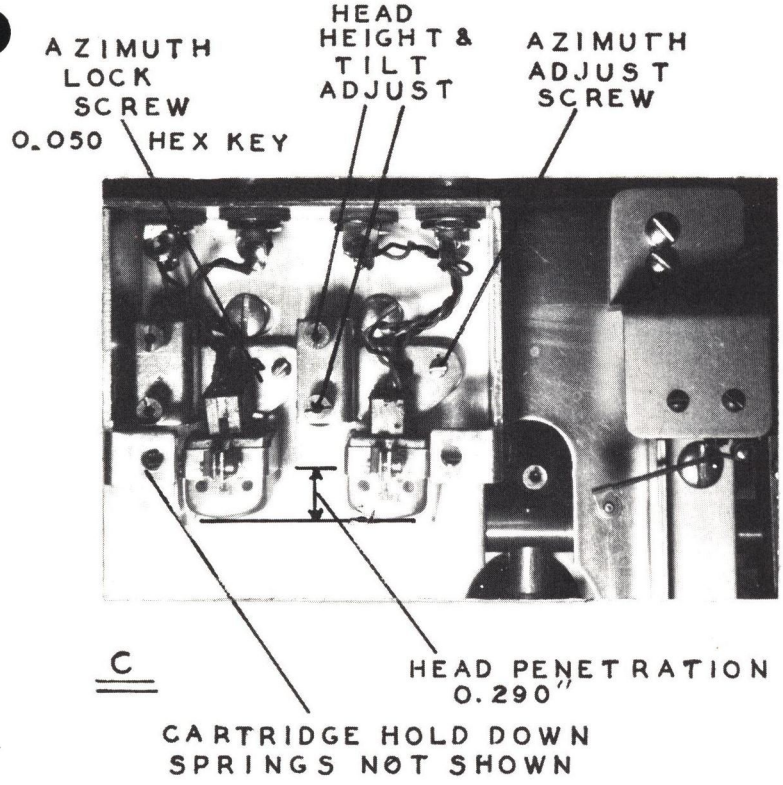
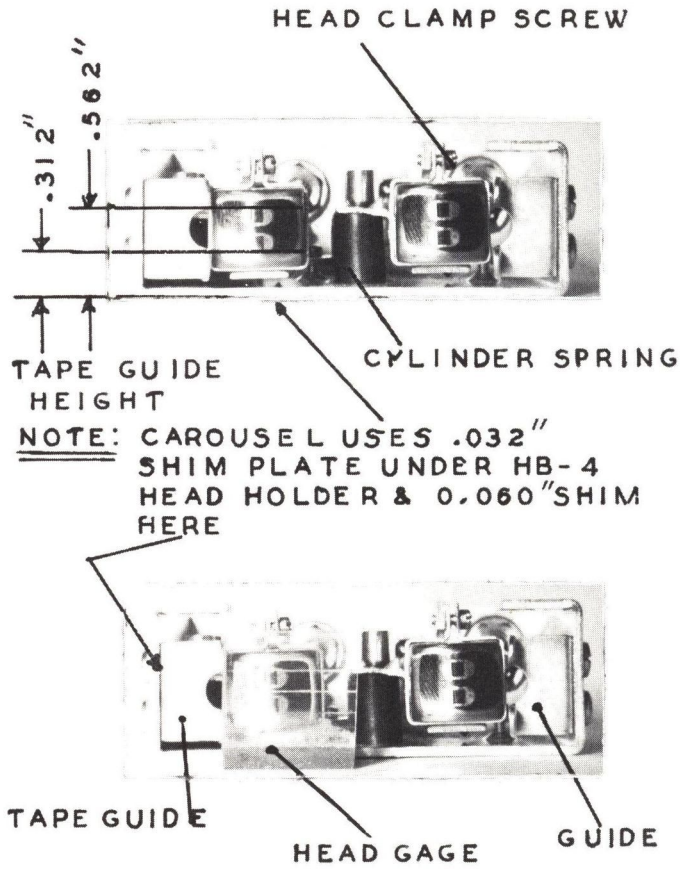


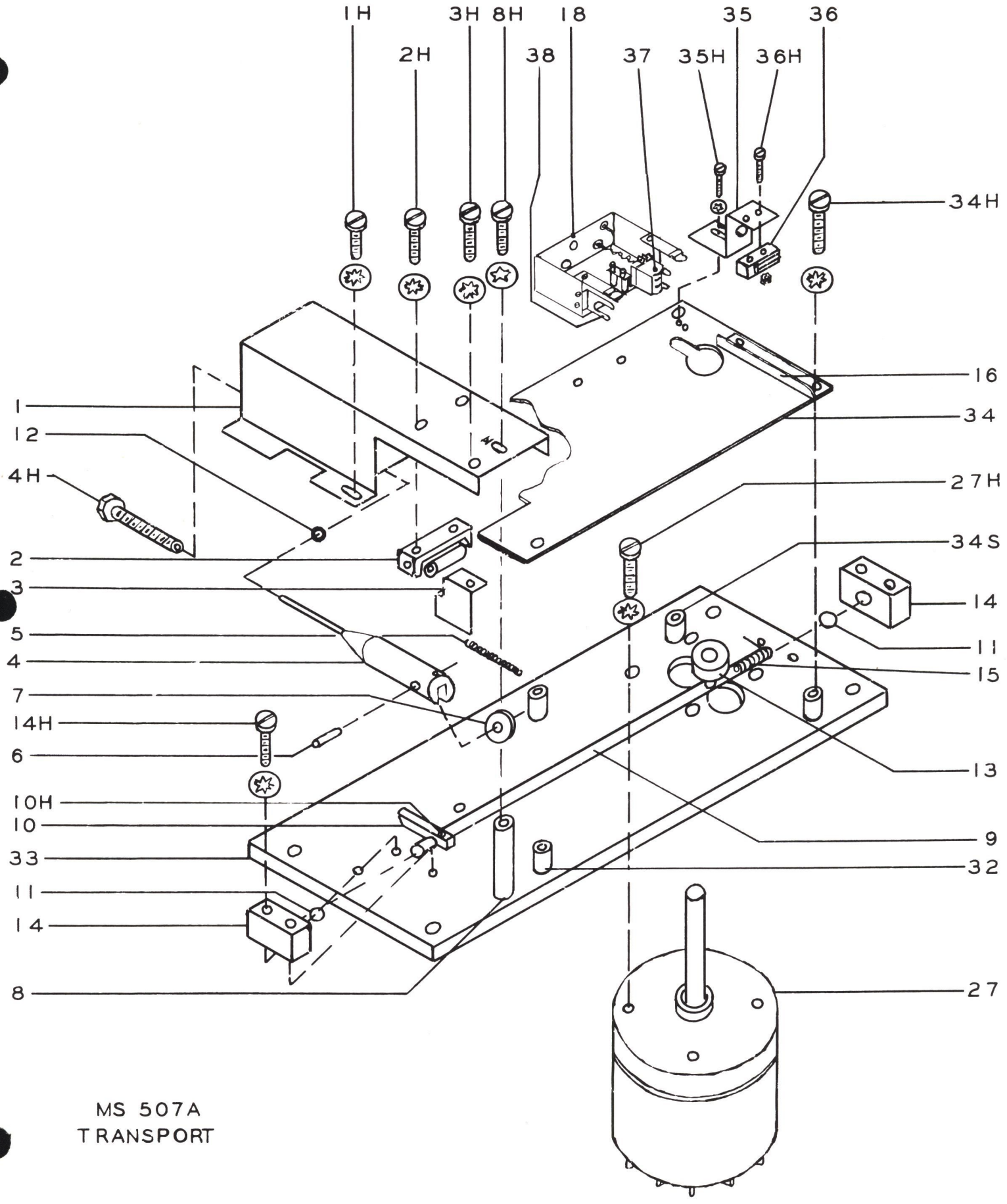
FIG. 12







HB-4 HEAD HOLDER



MS 507A
TRANSPORT

P A R T S L I S T S S E C T I O N

F O R

A L L M O D E L S

Refer to appropriate lists
for parts identification

Specify model and serial number
when ordering parts

SONO-MAG CORPORATION
1011-1019 W. Washington St.
Bloomington, Ill. 61701
Phone 829-7115 Code 309

PARTS LIST

POWER SUPPLY CIRCUIT BOARD

SERIES PS-1

R2--------220 ohms, ½ watt
R4--------220 ohms, ½ watt
(Stereo--150 ohms, 1 watt)

C1, C2--------1100 mf @ 30V. Electrolytic
C3, C4--------250 mf @ 30V. Electrolytic

D1, D2----Diode 1N3253
D3--------Zener Diode, 1N4735A or 1N753

Q1----------Transistor 2N1701

PS-1 Used in all models except: 590/592 and 90A/92A

POWER SUPPLY CIRCUIT BOARD

SERIES PS-2

R1--------220 ohms, ½ watt
R2--------150 ohms, 1 watt
R3--------100 ohms, ½ watt

C1, C2---------1100 mfd @ 30V. Electrolytic
C3, C4, C5-----250 mfd @ 30V. Electrolytic

D1, D2, D3-----1N3253
D4-------------Zener 1N4735

Q1-------------Transistor 2N1701

All Resistors 5% Tol.

PS-2 Used in models 590/592 and 90A/92A

NOTE: Zener Diode 1N4749A (24V) may be used in parallel with C2 on some models of PS-1 - PS-2

SONO-MAG CORP.
Bloomington, Illinois U.S.A.

PARTS LIST

CUE AND AUX. TONE AMPLIFIER CIRCUIT BOARD

SERIES CA-1

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
R1	220K ohms, ½ watt	C1, C4, C9	1 mfd @ 25V.
R2	22K ohms, ½ watt	C2, C14, C17	50 mfd @ 25V.
R3, R6 R19	4700 ohms, ½ watt	C3, C5, C8	
R4	220 ohms, ½ watt	C11, C15	.1 mfd @100V. Mylar
R5	3300 ohms, ½ watt	C6, C12	.33 mfd @100V. Mylar
R7	47K ohms, ½ watt	C7, C10	2 mfd @25V.
R8, R12 R16, R23 R9, R13	1K ohms, ½ watt	C13, C16	8 mfd @ 25V.
R17, R21 R10, R11	100K ohms, ½ watt	C18	.2 mfd @100V. Mylar
R15, R14, R18, R20		C19	4 mfd @ 25V.
R22, R24	10K ohms, ½ watt	Q1 thru Q5	Transistor 2N3242

CUE AND AUX. TONE SWITCHING CIRCUIT BOARD

SERIES CS-1/CS-1A

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
R1, R6, R9		C1	.001 mf @ 100V. Mylar
R12, R14, R23	2200 ohms, ½ watt	C2, C3, C4	8 mf @ 25V. Elect.
R2, R7, R20	4700 ohms, ½ watt	D1	Zener Diode, 1N4730A or 1N748
R3	1K ohms, ½ watt		
R4, R13	1500 ohms, ½ watt	D2	Diode, 1N3253
R5, R21	470 ohms, ½ watt		
R8, R22	10K ohms, ½ watt	Q1	Transistor, 2N3053
R10, R24	3300 ohms, ½ watt	Q2	SCS 3N59/3N81 (CS1A)
R11	15K ohms, ½ watt	Q3, Q5, Q6	Transistor 40319
R16	27 ohms, ½ watt	Q4, Q9, Q10	Transistor 2N3242
*R17, R25	100K ohms, ½ watt	Q7	SCR, C6F
R18	100 ohms, ½ watt	Q8	Transistor 2N2646
R19	47K ohms, ½ watt		
R26	3300 ohms, ½ watt		

All ½ watt Resistors 5% Tol.
CA-1 and CS-1 used in Models: 510/512/590/592/250/252/581/
and Models 10A/12A/90A/92A/20A/22A/382

*R17 will be approximately 300K. on 5 sec. Delay Boards.

SONO-MAG CORP.
Bloomington, Illinois U.S.A.

PARTS LIST

PROGRAM PRE-AMPLIFIER CIRCUIT BOARD

SERIES P-1

PART NO.	DESCRIPTION
R1	100K ohms, ½ watt
R2, R10	47K ohms, ½ watt
R3	220 ohms, ½ watt
R4	330 ohms, ½ watt
R5	2200 ohms, ½ watt
R6, R11	4700 ohms, ½ watt
R7	1000 ohms, ½ watt
R8, R9	15K ohms, ½ watt
R12	100 ohms, ½ watt
R13	22K ohms, ½ watt
R14	10K ohms, ½ watt
R15	470 ohms, ½ watt
R16	56 ohms, ½ watt
R17	5K Control

PART NO.	DESCRIPTION
C1	1 mfd @ 25V.
C2, C6	50 mfd @ 25V.
C3	.033 mfd @ 100V. Mylar
C4, C5	8 mfd @ 25V.
C7	
C8	4 mfd @ 25V.
T1	M-763 output transformer
Q1 thru Q4	Transistor 2N3242A

All ½ watt Resistors 5% Tol.

P-1 used in Models: 510/512/590/592/250/252/581

and 10A/12A/90A/92A/20A/22A/382

SONO-MAG CORP.
Bloomington, Illinois U.S.A.

PARTS LIST

RECORDING AMPLIFIER CIRCUIT BOARD

SERIES RA-2

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
R1, R19, R20	1000 ohms	C1, C4, C12	100 mf @ 25V. DC
R2	330K ohms	C2, C5, C9, C11	1 mf @ 25V.
R3	15K ohms		
R4	270K ohms	C3, C13	270 pf
R5, R7, R12, R22	10K ohms	C6	0.0022 mf
		C7	50 mf @ 25V.
R6	4700 ohms	C8	0.33 mf
R8	27K ohms	C10	0.01 mf
R9, R16	22K ohms	C14	8 mf @ 25V.
R10	12K ohms	C15	470 pf
R11	68K ohms	L1	10 MH. Choke
R13	1500 ohms	L2	8-20 MH. #387-20M Trap
R14	220K ohms		
R15	8200 ohms	Q1, Q2, Q3	RCA 2N3242A
R17	2200 ohms	Q4	
R18, R21	10K Control MTC-1		

All Resistors 5% Tol. $\frac{1}{2}$ watt

Used in Models: 590/592; 90A/92A; 90M/92M

NOTE: The RA-2 circuit board is direct replacement for older RA-1 series.

SONO-MAG CORP.
Bloomington, Illinois U.S.A.

PARTS LIST

RECORDER CONTROL CIRCUIT BOARD

SERIES RC-1

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
R1, R2, R3, R5, R8	22K ohms, ½ watt	C1	1 mf @ 25V.
R4	33K ohms, ½ watt	C2	4 mf @ 25V.
R6, R12, R13 R15	1K ohms, ½ watt	C3	8 mf @ 25V.
R7	10K ohms, ½ watt	C4	50 pf, Disc
R9	15K ohms, ½ watt	C5	.01 mf, Mylar
R10, R14	2200 ohms, ½ watt	C6	270 pf, Disc
R11	4700 ohms, ½ watt	C7	100 mf @ 25V.
R16	100 ohms, ½ watt	C8	50 mf @ 25V.
R17	470 ohms, ½ watt		

L1 - Inductor, 8-20 mh, #387-20M

Q1 - Transistor, 2N3242
Q2 - Transistor, 2N1415
Q3 - Transistor, 40319
Q4 - Transistor, 2N3053

Used in Models: 590/592 and 90A/92A

MECHANICAL CONTROL CIRCUIT BOARD
SERIES MC-1

Part Number	Description	Part Number	Description
R1	47K ohm, ½ watt	C1	600 mf @ 6v. Elect.
R2, R5	2200 ohm, ½ watt	C2	50 mf @ 25v. Elect.
R3, R4, R11	10K ohm, ½ watt	C11	1 mf @ 25v. Elect.
R12	1K ohm, ½ watt	C12	8 mf @ 25v. Elect.
		Q1	Transistor 40319
All ½ watt resistors 5% Tol.		Q2	Transistor 2N3053
		Q11	SCR, C6F

MC-1 used in Models: 250/252 and 20A/22A

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PARTS LIST

TONE GENERATOR CIRCUIT BOARD

SERIES TG-1

PART NO.	1 KHz TONE	150 HZ TONE	GENERAL DESCRIPTION
C1, C2	.02 mf	.15 mf	100V. Mylar Capacitor
C3, C5, C6	1 mfd	8 mfd	25V. Electrolytic
C4	.033 mf	.15 mf	100V. Mylar Capacitor
C7	8 mf	8 mf	25V. Electrolytic
C8	50 mf	50 mf	25V. Electrolytic
C9 (Note #1)	15 mf	15 mf	25V. Electrolytic
C10	1 mf	1 mf	25V. Electrolytic
R6	12K	15K	Ohms, ½ Watt Resistor

The following part numbers are common to both tone generator cards:

R1, R2, R5, R7, R9	10K Ohms, ½ watt Resistor
R3, R8, R22	100K Ohms, ½ watt Resistor
R4	1500 Ohms, ½ watt Resistor
R10	1500 Ohms, ½ watt Resistor
R11	10K Ohm Control, MTC-1
R12, R16, R21	2200 Ohms, ½ watt Resistor
R13	15K Ohms, ½ watt Resistor
R14, R17, R18	22K Ohms, ½ watt Resistor
R15	2700 Ohms, ½ watt Resistor
R19, R20	47K Ohms, ½ watt Resistor

D1 - 1N4742A Silicon Zener Diode
D2, D3* - 1N3253 Silicon Diode

Q1, Q2, Q3, Q5 - Transistor 2N3242
Q4 - Transistor 40319

* 150 HZ Only

Note #1: Subject to change to provide desired tone length.

SONO-MAG CORP.
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PARTS LIST

80 KHz BIAS GENERATOR CIRCUIT BOARD

SERIES BG-1

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
R1	56 ohms, ½ watt	C1	250 mf @ 30V. Elect.
R2, R10*, R12*	100K ohms, ½ watt	C2	.0047 mf @100V. Mylar
R3	470 ohms, ½ watt	C3	.0022 mf @100V. Mylar
R4	4700 ohms, ½ watt	C4, C6, C8	.1 mf @100V. Mylar
R5, R8	3300 ohms, ½ watt	C5, C7	470 pf Poly-Film
R6, R7	100 ohms, ½ watt	C9	.039 mf Poly-Film
R9, R11	10K ohms, ½ watt	C10 (Mono)	4-40 pf Trimmer
R10 (Mono)	150K ohms, ½ watt	*C10, C11	16-150 pf Trimmer

* Stereo Models 592/92A only

T1 - Oscillator Coil, M7064
T2 - 80 KHz Output Transformer, M7065 (Mono 590/90A)
T2 - 80 KHz Output Transformer, M7066 (Stereo 592/92A)

Q1, Q2, Q3 - Transistor, 2N3053

Used in Models: 590/592 and 90A/92A

SONO-MAG CORP.
Bloomington, Illinois U.S.A.

PARTS LIST

CHASSIS SECTION - MODELS 510/512/10A/12A

R101 . . . . . 10K ohm control, Audio Taper- "L" Program Gain
R102 . . . . . 10K ohm control, Audio Taper-"R" Program Gain*
R103 . . . . . 10K ohm control, Audio Taper- Cue Gain
R104 . . . . . 10K ohm control, Audio Taper- Aux. Tone Gain
R105 . . . . . 100 ohm, ½ watt
R106 . . . . . 220 ohm, ½ watt (150 - 1 watt Stereo Models)*

C101 . . . . . .47 mf 100v., Mylar
C102 . . . . . .25 mf 100v., Mylar
C103 . . . . . .1 mf 400v., Mylar

A1 - A2* . . . . . Raysistor, CK1123
A3 . . . . . Raysistor, CK1123 (Models 10A/12A)

D101, D102, D103 . . . . . Diode, 1N3253

CR1, CR2, CR3 . . . . . Relay 24 VDC . . . KHP17D11/67R4

SWITCHES

Start - Stop - Set - Aux . . . . . #1018, Bulb #328
Power . . . . . #1160, Bulb #328
Cue Audio (Model 10A). . . . . #1018, Bulb #327
(Model 12A). . . . . #1060, Bulb #327

T101 . . . . Transformer, Power . . . . #M-818
T102 . . . . Transformer, ON Lamp . . . #M-820 (Models 510/512 only)

F1 . . . . . Fuse, 1 amp.

MAGNETIC HEADS
(Specify type when ordering)

All Models . . . Playback . . . Dual ½ track, type PB2H2K-N
All Models . . . Playback . . . 3 track NAB, type PB3Q7K-N

TRANSPORT POWER SUPPLY

R1 . . . . 12 ohm, 2 watt wire
R2 . . . . 200 ohm, 10 watt wire

C1 . . . .1 mf 400v. Mylar
C2 . . . 50-30 mf 150 VDC Electrolytic
C3 . . . (See motor rating)

D1 . . . . Diode, 1N3256

Deck Sw. . . . . Type 11SM1 (Specify if operator is required)

* Models 512/12A

RECORD CENTER PARTS LIST

CHASSIS SECTION

R101 . . . . . 10K ohm control, Audio Taper - "L" Program Gain
R102 . . . . . 10K ohm control, Audio Taper - "R" Program Gain*
R103 . . . . . 10K ohm control, Audio Taper - Cue Gain
R104 . . . . . 10K ohm control, Audio Taper - Aux. Tone Gain
R105 . . . . . 100 r. ½ watt
R106 . . . . . 220 r. ½ watt (150 - 1 watt Stereo Models)*
R107 . . . . . 1K ohm control - Line Gain (Dual on Stereo)*
R108 . . . . . Dual 1K ohm control - Balance (Model 592/92A)

C101 . . . . . .47 mf 100v., Mylar
C102 . . . . . .25 mf 100v., Mylar
C103 . . . . . .1 mf 400v., Mylar

A1 - A2* . . . . Raysistor, CK1123
A3 . . . . . Raysistor, CK1123 (Models 10A/12A/90A/92A)

D101, D102, D103 . . . . . Diode 1N3253

CR1, CR2, CR3 . . . . . Relay, 24 VDC KHP17D11/67R4

SWITCHES

Start - Stop - Set - Aux. . . . . #1018, Bulb #328
Power . . . . . #1160, Bulb #328
Cue Audio (Model 90A) . . . . . #1018, Bulb #327
(Model 92A) . . . . . #1060, Bulb #327
Meter . . . . . 2P - 3 Pos. Rotary #3223J
(Model 590/90A)
4P - 3 Pos. Rotary #3243J
(Model 592/92A)

T101 . . . . . Transformer, Power . . . . M - 818
T102 . . . . . Transformer, ON Lamp . . . M - 820 (Models 590/592 only)

F1 . . . . . Fuse, 1 amp.

* Models 592/92A

CHASSIS SECTION

CONTINUED

MAGNETIC HEADS
(Specify type when ordering)

Models 590/90A . . .	Recording . . .	Dual $\frac{1}{2}$ track, type PB2H4R-N
All Models	Playback . . .	Dual $\frac{1}{2}$ track, type PB2H2K-N
Models 592/92A . . .	Recording . . .	3 track NAB, type PB3Q4R-N
All Models	Playback . . .	3 track NAB, type PB3Q7K-N

TRANSPORT POWER SUPPLY

R1 . . . 12 ohm, 2 watt wire
R2 . . . 200 ohm, 10 watt wire

C1 . . . .1 mf 400v. Mylar
C2 . . . 50-30 mf. 150 VDC Electrolytic
C3 . . . (See motor rating)

D1 . . . . . Diode, 1N3256

Deck Sw . . . . . Type 11SM1 (Specify if operator is required)

CAROUSEL PARTS LIST

Models 250/252 & 20A/22A
Chassis parts (See separate circuit board parts list)

Resistors

R1 . . . 220 (mono)
150 (stereo)
R2 . . . 100 ohms ½w.
R3 . . . 12 ohms 2w.
R4 . . . 200 ohms 10w.

Pots.

Prog. Gain . . . 10K
Cue Gain 10K
Aux. Gain. . . . 10K

Capacitors

C1 . . . . 0.1 mf. 400v
C2 . . . . 0.47 mf.
C3 . . . . 0.5 mf. 400v
C4 . . . . 0.5 mf. 400v
C5 . . . . 0.25 mf.
C105 . . . 50/30 mf. 150v
C134 . . . See motor rating

Relays

CR1, CR2, CR3, CR4 . . . 24v. DC KHP17D11

Diodes

D4, D5, D6, D7 . . . 1N3253
D8 (20A/22A only). . 1N3253
D9 . . . . . 1N3256

Photo-resistors

A1 - A2 . . . . CK1123
A3 . . . . CK1123 used in Models 20A/22A

Switches

PB101 . . .	Stop	#1018	#327
PB102 . . .	Start.	#1018	#327
PB103 . . .	Tray	#1060	
PB104 . . .	Rotate	#1060	
PB105 . . .	Auto-Manual.	#1160	#327
PB106 . . .	Power.	#1160	#328 *
	Cue-Audio (Model 20A). . . .	#1018	#327
	(Model 22A). . . .	#1060	#327
SW102 . . .	Cartridge.	#DT2RV22A7	
SW103 . . .	Index.	#BA2RV22T	
SW104 . . .	"Out" Limit.	#BA2RV22T	
SW105 . . .	"In" Limit	#BA2RV22T	

Signal Lamp

* Use #327 Lamp on Models with -RSC Chip Control

Fuses

F1 . . . ½ A. Slo Blo
F2 . . . 2A

Magnetic Heads
(Specify type used)

Dual ½ Track PB2H2K-N
3 Track. PB3Q7K-N

Power Transformer

T1 . . . . . M818

CAROUSEL MECHANISM PARTS

REFERENCE NO.	PART NAME	PART NUMBER
	Shift lever	MS2405A
	Crank	MS2405B
	Drum Pressure spring	MS2416B
	Drum drive tires (3 rqd.)	Q29
	Cartridge tray and holder assembly	MS2413-14
	Tray holder brace	MS2414B
	Shift rod	MS2403C
	Shift ring	MS2408AB

RANDOM SELECTOR

MODEL RS10

SW107	24 Pos. Selector Sw	2E00A24-1X46K
SW601	Random/Sequence Sw	AH&H 20994BF
SW602	Cartridge Selector	2E00A24-1
SW603	Next to run selector	Cent. 1001
PB601	Start pushbutton	AH&H 3392R
PB602	Reject pushbutton	AH&H 3392
CR601	Drum Control Relay	KRP14A24VAC
CR602	Switcher Relay	KHP17D-24VDC
CR603	Start Relay	KHP17D-24VDC
C107		0.1 mf
C108		0.1 mf
C601		250 mf/50v
C602		500 mf/50v
R601		10 ohm 1W
R602		10 ohm 1W

SELECTOR POWER SUPPLY

MODEL RSP

T1	Power Transformer	P6428/M817
SW1	Power Switch	AH&H 20994E W
R1		2.5 ohm 2W
SD1-4		1N3253
C1	1000 mf/25v	TVL1230
F1		1A.
S1	Lamp	#1819
01, 02, 03	Power Sockets	S318AB

PARTS LIST

MACARTA TRANSPORT
DECK MODEL - MS507A

REFERENCE NO. DRAWING MS507A	PART NAME	PART NO.
- 1	Solenoid Assembly	MS100-11
- 2	Thrust Roller Assembly	MS100-5
- 3	Plunger Bumper Assembly	MS100-6
- 4	Plunger Assembly	MS100-3
- 5	Plunger Spring	MS100-7B
- 8	Solenoid Spacer	MS100-12B
- 9	Cross Shaft Assembly	MS100-2A
-11	Cross Shaft Ball 2 rqd. 5/16"D.	
-15	Cross Shaft Spring	MS100-7A
-13	Pinch Roller	MS100-13A
-14	End Bearing, Cross Shaft (2 rqd.)	MS100-7C
-16	Cartridge Guide	MS507-34C
-18	Head Bracket Assembly (Spec. Type)	MS100-22
-19	Head Bracket Cover (Spec. Type)	MS100-22A
-27	Motor - Direct Drive Hysterisis (115 V - 60 ips)	40H-25 *
-33	Deck Plate	MS507A
-34	Cartridge Plate	MS507A-34
-34S	Plate Spacers $\frac{1}{2}$"D. x 9/16"H. (4 rqd.)	MS507A-34S
-36	Cartridge Lever Switch	11SM1-JS246
-37	Playback Head	Specify
-38	Tape Guide	Specify

* 3-3/4 - 7-1/2 IPS Motor, C = 2.5 mf

also 40H-55, C = 1.5 mf
40H-45, C = 1.5 mf

PARTS LIST

CAROUSEL TRANSPORT
DECK MODEL MS607A - Fig. 4.6

REFERENCE NO. MS607A - Fig. 4.6	PART NAME	PART NUMBER
-1	Solenoid Assembly	MS100-11
-2	Thrust roller assembly	MS100-5
-3	Plunger bumper assembly	MS100-6
-3H	Hdw. 8-32 x $\frac{1}{4}$" MS	
-4	Plunger assembly	MS100-3
-5	Plunger spring	MS100-7B
-8	Solenoid spacer	MS100-12B
-9	Cross shaft assy.	MS100-2A
-11	Cross shaft ball 2 rqd. 5/16" D.	
-15	Cross shaft spring	MS100-7A
-13	Pinch roller	MS100-13A
-14	End bearing, cross shaft 2 rqd.	MS100-7C
-18	Head bracket assy.	HB41B
-19	Head bracket cover	
-27	Motor--Direct drive Hyst. (115V - 60 cps) Specify.	40H-55 . . . 1.5 mf 40H-45 . . . 1.5 mf 40H-25 . . . 2.5 mf
-33	Deck plate	MS607A-33
-34	Cartridge plate	MS607A-34
-34S	Plate spacers 9/16" H 3 rqd. 2 counter sink	MS607A-34S
-35	Deck support	MS607A-35A
-35H	Hdw. 10-32 x 3/8" 2 rqd	
-36	Cartridge lever switch	DT2RV22A7
-37	Playback Head	Specify type
-38	Head Bracket Spacer	

CAROUSEL MECHANISM PARTS

(Refer to Fig. 4.1, 4.2, 4.3, 4.4)

M2	Tray Shift Motor	M509
M3	Drum Drive Motor	M508
	Index Bar	MS2463
	Index Block	SMC2464A
	Nylon index stylii	SMC2465
	Index spring--flat	MS2416
	Hinge block	MS2465
	Switch bracket	MS2455A
	Nylon guide	MS2455B
	Pin Fork	MS2408D

510/512
10A/12A

DOTTED LINES ARE WIRED TO "R" CHANNEL ON MODELS 512 AND 12A. OTHER CONNECTIONS ARE COMPARABLE TO THE "L" CHANNEL SHOWN.

IGM MODEL 12A
THIS WIRE CONNECTS TO TB-1, TERM. #7. RESISTOR R106 IS JOINED ON TERM. #8. NO AUDIO CONTROL POSSIBLE.

PROGRAM PRE-AMPLIFIER SERIES P1

C1 - 1MF
C2 - 50MF
C3 - .033
C4 - 8MF
C5 - 8MF
C6 - 50MF
C7 8MF
C8 - 4MF
R1 100K
R2 47K
R3 270
R4 330
R5 2200
R6 4700
R7 1K
R8 15K
R9 15K
R10 47K
R11 4700
R12 100
R13 22K
R14 10K
R15 470
R16 56
R17 - 5K
Q1 Q2 Q3 Q4
M-763
R101 10K PROGRAM GAIN
PROG. INPUT HEAD
CUE INPUT HEAD

CUE & AUX. TONE AMPLIFIER CARD
SERIES CA-1

C1 - 1MF
C2 - 50MF
C3 - .1
C4 1MF
C5 - .1
C6 - .33
C8 .1
C9 1MF
C10 - 2MF
C11 .1
C12 - .33
C13 - 8MF
C14 - 50MF
C15 .2
C16 - 8MF
C17 - 50MF
C18 .2
C19 - 4MF
C20 - 50MF
R1 220K
R2 22K
R3 4700
R4 220
R5 3300
R6 4700
R7 - 47K
R8 1K
R9 100K
R10 - 10K
R11 10K
R12 1K
R13 47K
R14 - 10K
R15 4700
R16 1K
R17 100K
R18 10K
R19 4700
R20 - 10K
R21 47K
R22 4700
R23 1K
R24 - 10K
Q1 Q2 Q3 Q4 Q5
R103 10K CUE GAIN
R104 10K AUX. TONE GAIN
-- CUE SECTION --
-- AUX. TONE SECTION --

CUE & AUX. TONE SWITCHING CARD
SERIES CS-1A

† R17 = 330K MOD. 10A/12A
C1 .001
C2 8MF
C3 8MF
C4 - 8MF
C101 - .47
C102 - .25
R1 1000
R2 2200
R3 - 1K
R4 - 1500
R5 470
R6 2200
R7 4700
R8 10K
R9 2200
R10 2200
R11 15K
R12 2200
R13 1500
R14 2200
R16 33
R17 100K
R18 100
R19 - 47K
R20 - 4700
R21 470
R22 10K
R23 - 2200
R24 - 3300
R25 - 100K
R26 - 3300
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10
D1 IN4730 3.9V
D2 IN3253
R105 100
IGM ONLY

POWER SUPPLY CARD
SERIES PS-1

SW1 POWER
1A. F1
117 V. 60 HZ
T101 M-818/A
D1 IN3253
D2 - IN3253
C1 - 1100MF - 30V
C2 - 1100MF - 30V.
R2 220
Q1
24V. IN4749A
D3 IN4735 6.3V
C3 250MF - 30V
C4 250MF 30V.
R4 - 220 (150 - 1W, STEREO)
+24
+18
T101 M-820
SW1 POWER
ON
SO-2

CUE AUDIO
IGM MODELS ONLY
A1 A2
R106 - 220 (150 - 1W, STEREO)
6.3V READY
RUN
START
STOP
SW2
SW3
GND.
C103 - .1
D101 IN3253
D102 IN3253
CR 1 CUE RELAY
CR 2 AUX. TONE RELAY

1 -- 600 OHM OUTPUT "L" CHANNEL
2 --
3 -- GND.
4 -- 600 OHM OUTPUT "R" CHANNEL
5 --
6 -- CUE AUDIO "L" (IGM)
7 -- EXTERNAL "R" AUDIO CONTROL
8 --
9 -- COM.
10 -- N.C. STOP
11 -- NO. START
12 -- N.C.
13 -- C.
14 -- N.O.
15 -- N.C.
16 -- C.
17 -- N.O.
-- AUX. TONE RX. --

TRANSPORT ASSEMBLY
PL 2
DECK GND.
S1 DECK SW.
D1 IN3256
R1 12-2W
R2 200-10W
C1 .1
C2 30-50 @ 150 V.
C3 - 2.5MF
R=HI
Y=LO
WH
OR
P
G
BL
BLK
MOTOR
SOL.

Ma Car Ta MODEL 510 and 512 PLAYBACK
IGM MODEL 10A and 12A

NONE
WEM
DRAWN BY MOS
5 JAN 70
SONO-MAG CORPORATION
BLOOMINGTON, ILLINOIS
ORG. 4-66
REV. 1-70
DRAWING NUMBER 510