Crown

MODEL IM-7

OPERATION
AND
SERVICE MANUAL

Model No. SX724 Serial No. V11279

Accessories . . . . . Issued . . . . . .

SERIES

PRO - 700

RECORDER/REPRODUCER

Div. of INTERNATIONAL RADIO & ELECTRONICS CORP. BOX 1000 ELKHART, IN

ONE YEAR WARRANTY

CROWN Warranty Statement:

(a) CROWN warrants to the original using purchaser that all new CROWN equipment shall be free from defects of workmanship and material under normal and proper use and service for a period of one year from date of delivery to original using purchaser.

(b) CROWN guarantees to repair or replace all parts (except meters) thereof showing such defects subject to use of the provision stated herein.

CROWN Warranty Obligation:

(a) Equipment returned within 0-90 days from date equipment delivered to the original using purchaser. All defective parts will be repaired or replaced at no charge for labor or materials.

(b) Equipment returned within 91 - 365 days from date equipment delivered to the original using purchaser, all defective parts will be replaced or repaired at no charge for materials. Labor charge will be equal to actual labor cost incurred in such repair or replacement.

(c) In all cases, the responsibility of CROWN will be limited to making a new or factory reconditioned replacement part available to the dealer through a CROWN Warranty Service Station; it is the responsibility of the dealer to repair or replace defective parts either by his own service personnel or through a CROWN Warranty Service Station.

764CB-1

CROWN Warranty Conditions:

(a) Defective equipment shall be returned, transportation prepaid, to the CROWN dealer from whom the equipment was originally purchased or to a CROWN Warranty Service Station, or to the CROWN factory upon receipt of authorization. Under no circumstances will CROWN accept a returned machine or component without having given written authorization.

(b) Purchaser, for warranty service, must present his CROWN Warranty Service Identification card to a CROWN dealer, CROWN Service Station, or the CROWN factory before parts are repaired or replaced.

(c) Purchaser shall not have used or allowed to have been used in the equipment any part (excluding tubes) not supplied by CROWN through its dealers or Warranty Service Station.

(d) Inspection shall disclose to the satisfaction of the CROWN factory the defects are as above specified and that the equipment has not been altered or repaired by other than the factory accepted procedures, subjected to negligence, misuse or accident, or damaged by excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Normal wear of any parts or material are in no way covered or implied by this Warranty.

(e) Meter defects not reported within ten (10) days from purchase shall be excluded from all provisions of this Warranty.

(f) Replacement parts supplied by this warranty carry only the unexpired portion of the original warranty.

This warranty is effective only when the warranty-registration card is fully and properly filled in and returned to the factory within ten (10) days of delivery of CROWN Equipment.

A factory-validated warranty identification card will then be returned to the purchaser to be used when in-warranty service is necessary. This card must be presented to obtain warranty service.

CROWN reserves the right to modify or change the equipment in whole or in part at any time prior to delivery thereof, in order to include therein electrical or mechanical improvements deemed appropriate by CROWN, but without incurring any liability to modify or change any equipment previously delivered, or to supply new equipment in accordance with any earlier specifications.

INTERNATIONAL
DIVISION OF INTERNATIONAL RADIO AND ELECTRONICS CORP.
1718 WEST MISHAWAKA ROAD JA 3-4919 ELKHART, INDIANA

TABLE OF CONTENTS

(cont.)

LIST OF ILLUSTRATIONS

1.1 GENERAL

The purpose of the transport, or as it is sometimes called, "tape deck," is to mechanically position and move magnetic tape over the heads.

CROWN Pro-700 transports accomplish this with optimum ease and simplicity, and are designed for long trouble-free life. Materials and design are keyed to the highest professional requirements. A high-mass capstan drive system assures rock-steady tape motion. Rugged, oversize reel motors provide tape-handling capabilities seldom found at any price. Tape can be reeled from one end to the other; and it can immediately be brought to a soft and gentle stop. The patented braking system never needs adjusting —there is nothing to adjust, nothing to wear out. There are no brake shoes, or other friction devices—no mechanical linkages or gadgets in the braking system. Braking tension is determined entirely be electrical factors. This same design philosophy has been carried throughout the entire transport; a minimum of moving parts, a maximum of dependability.

The belt-driven capstan is powered by a hysteresis-synchronous drive motor. The capstan rotates constantly so long as power is applied to the drive motor. The drive motor also serves to power the forced-air ventilating system of the machine by drawing cold air in over the drive motor and expelling it out the ends of the enclosed machine.

The two reel motors (torque motors) perform the duties of take-up and pay-off tension, fast forward and rewind, and braking. In the play mode, the take-up tension is controlled by the AC voltage applied to the take-up motor, while pay-off tension is controlled by an AC voltage applied to the pay-off motor. In fast forward or rewind, the pulling motor is powered with a full 117 VAC while the opposite motor has 10 VDC applied for a slight holdback tension.

A large variety of record-reproduce electronics and heads are available. Fig. 1-1 is a typical combination.

FIG. 1 - 1

1.2 SPECIFICATIONS

1.2.1 Performance Specifications

Definition	Three-speed, three-motor professional tape transport
Tape Width	¼ inch, 1.5 and 1.0 Mil (NAB Std.)
Tape Speeds	3-¾, 7-½, 15 ips. Front panel change 3-¾, 7-½. Other speeds available on request
Speed Regulation	±0.2% with ±10% voltage variation from 117 VAC
Wow and Flutter	15 ips - 0.06% (NAB unwtd) 7-½ ips - 0.09% 3-¾ ips - 0.18% These figures are guaranteed maximum values for complete record and reproduce cycle.
Reel Size	10-½ inch NAB maximum, 5 inch EIA minimum.
Start Time	Less than 0.1 seconds. Meets wow specifications within 2 seconds
Fast Forward or Fast Rewind Time	1200 ft. 7 inch reel in 45 seconds 2400 ft. 10-½ inch reel in 58 seconds
Controls	Four push buttons (Rewind, Forward, Stop, Play) control the tape motion. Micro-switch tape sensor halts operation in case of tape breakage or end of tape.
Operating Performance	Completely smooth tape-handling with low tape tensions. Extra heavy duty parts and bearings to give long, trouble free operation. Extremely simple mechanism with only ten moving parts.

1.2.2 Mechanical Specifications

Construction	All exterior aluminum parts are anodized and all steel parts are plated. Precision components, precision craftsmanship, and individual inspection and adjustment ensure the finest quality throughout.
Deck Plate	3/16 inch-thick anodized aluminum.
Assembly	All sub-assemblies completely plug-in. Transport can be disassembled and reassembled in 15 minutes.
Capstan Drive Motor	Hysteresis-synchronous type. Employs ball bearings for long maintenance-free operation. Starting Torque: 16 inch-ounce Running Torque: 13 inch-ounce Running Current: 0.55 amp at 117 VAC
Capstan Shaft	The micro-finished capstan shaft is centerless ground, and is housed in self-aligning olite bearings in a 5-inch cast housing.

Flywheel Assembly	Weight 4 lbs. The flywheel is nickel-plated steel, with one thousandth of an inch maximum eccentricity.
Reel Motors	Torque motors with self-aligning oilite bearings, 1250 RPM, 0.6 amp at 117 VAC.
Drive Belt	Ground-neoprene drive belt over flywheel and three-step drive pulley (or speed reducers.)
Braking System	Electro-dynamic brakes which never grab, or need adjusting, ensure optimum smoothness in bringing the tape to a gentle stop. A positive-temperature-coefficient resistance is used to provide the braking differential.
Cooling System	Ducted forced-air flows in over the drive motor and is forced out the sides of the machine.
Head Assembly	Erase, record, and reproduce heads are independently tripod-mounted. Azimuth and tracking are independently adjustable and are factory aligned.
Tape Guides	Chrome-plated hardened steel.
Pressure–Roller Solenoid	Actuates pressure roller and tape lifter in Play mode.
Pressure Roller	Neoprene with oilite bearings.
Tape Lifters	Glass-rod lifters lift tape into heads in the Play mode; release and thereby remove tape from heads during Fast Forward, Fast Rewind, and Stop modes.
Tape Reel Holders	Screw-on, positive locking.
Head Covers	Clip on for ease in cleaning of magnetic heads.
Overall Dimensions (no reels)	10-½ in. H x 19 in. W x 9 in. maximum overall depth.

1.2 3 General

Power Requirements	117 VAC, 60 Hz
Power Consumption	105W min. (standby) 155W (play - large reel) 130W (play - small reel) 155W (fast winding)
Remote Control	External momentary (optional) capable of Play and Stop functions.

1.3 TAPE TRANSPORT

The tape transport (see Fig. 1-2) handles ¼-inch magnetic tape on reels ranging from 5 in. to 10-½ in. diameter.

Three speeds are standard, 3-¾, 7-½, and 1 7/8 or 15 ips. Special speeds are available on request. Machines with SX electronics are only two speed.

Tape motion is controlled by the four pushbuttons on the lower right-hand area of the panel. Power and reel size are controlled by the slide switches on the lower left hand area of the panel. The speed shift is located directly above the head assembly.

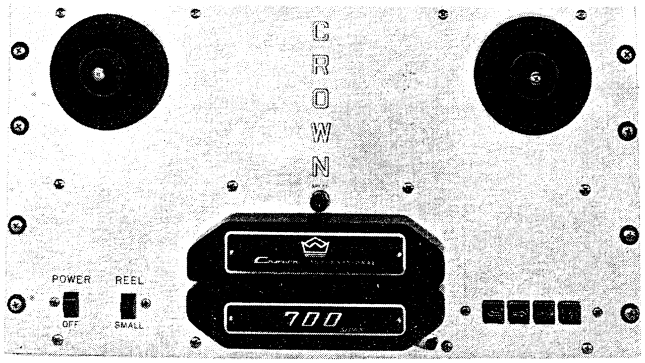


FIG. 1 - 2

1.4 ELECTRONIC ASSEMBLY

A typical record-reproduce electronics is shown in Fig. 1-3. A typical reproduce electronics is shown in Fig. 1-4. A number of other electronics are available; and for more specific information refer to Section 7. Electronics assemblies should usually be mounted directly beneath the transport to keep head leads to a minimum of length.

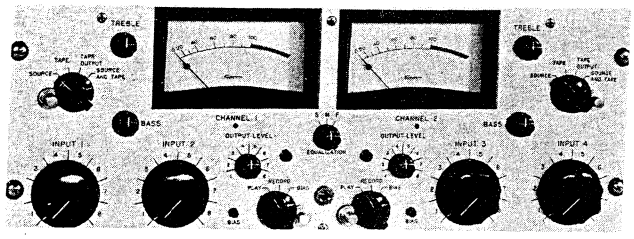


FIG. 1 - 3

FIG. 1 - 4

1.5 HEAD ASSEMBLIES

The head assembly allows for a maximum of three stacks of heads (See Fig. 1-5). In a typical record-reproduce unit, the heads from left to right would be Erase, Record, and Playback. For a minimum of wow and flutter, the reproduce head is placed as close to the capstan as possible; therefore, in a multi-headed reproduce assembly, the head nearest the capstan is the preferred head. Depending on requirements, a large variety of head arrangements are available.

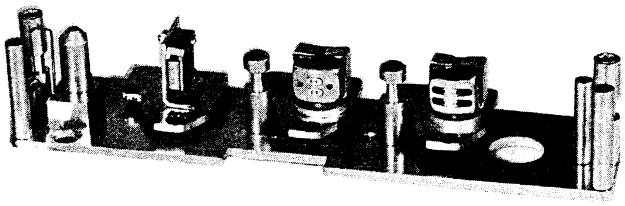


FIG. 1 - 5
4-TRACK STEREO HEAD ASSY.

1.6 ACCESSORY EQUIPMENT

1.6.1 Track Sync

The Track Sync attachment allows the record head to be used for reproduce—for precise recording and editing applications. It may be installed with a CX or CI electronics.

FIG. 1 - 6
TRAC-SYNC ACCESSORY

1.6.5 220 Volt Adapter

Line-voltage conversion from 200 V, 200 V, or 240 VAC down to the 117 VAC required by the PRO-700 is the function of a special 220 Volt Adapter. Mounted above the transport, and adding 1¾ in, in height, the adapter is rated at 285 VA—thus a D-40 or DC 300 amplifier should be separately wired for direct 200, 220 or 240 VAC operation. Color-coded jumper-plugs enable quick-selection of desired input-voltage.

2.1 AFTER UNPACKING

Please inspect the unit for any damage incurred in transit. Since the unit was carefully inspected and tested, it left the factory unmarred. If damage is found, notify the transportation company at once. Only the consignee may institute a claim with the carrier for shipping damage; however, CROWN will cooperate fully in such an event. All packing material must be saved as evidence of damage for carrier's inspection.

1. Wrap Machine in Polethylene Package.

*2. Pack Machine in Carton as Shown, Being Sure Machine is Upside Down.**

Even if the unit arrived in perfect condition, as most do, the packing should be saved. It will prove valuable in preventing damage should transport be necessary. Fig. 2-1a shows a preferred form of packing of a typical uncased machine. The machine should never be shipped rigidly mounted to the shipping container, as this provides no shock absorption. Fig. 2-1b applies to a cased unit.

In shipping, the machine should always be top side down, as this places the heavy motors at the bottom of the pack. Also, the machine should be totally sealed inside the carton by a plastic bag. This protects the machine from moisture and sulfur contaminants in the cardboard packing. (Sulfur corrodes electrical contacts).

3. Pack Cased Machine Upside Down as Shown:

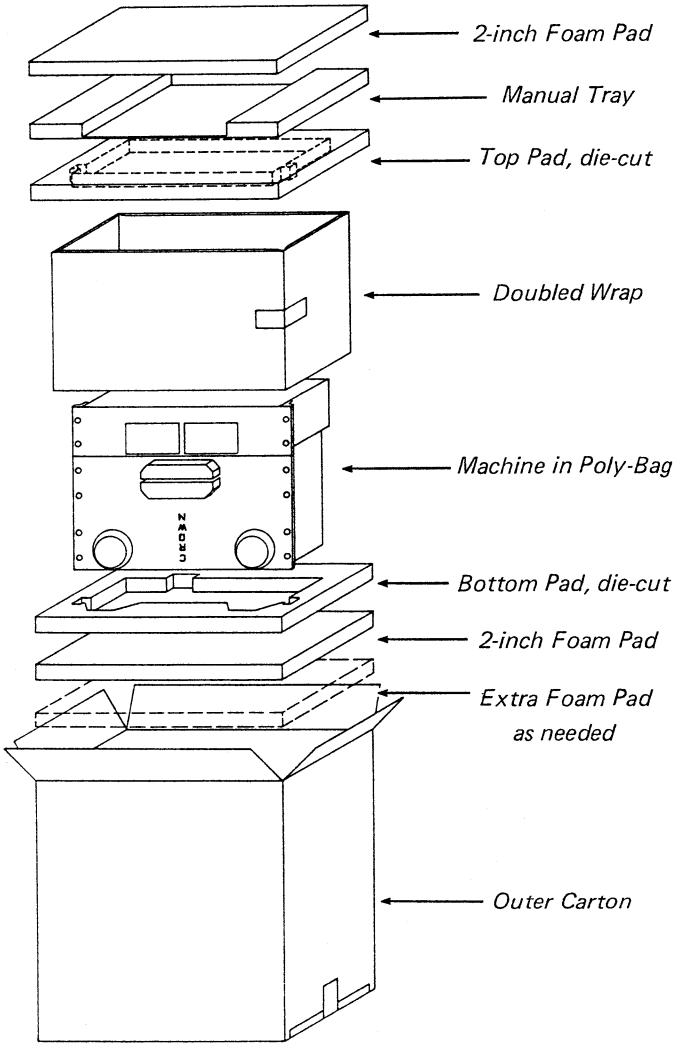


FIG. 2 - 1a

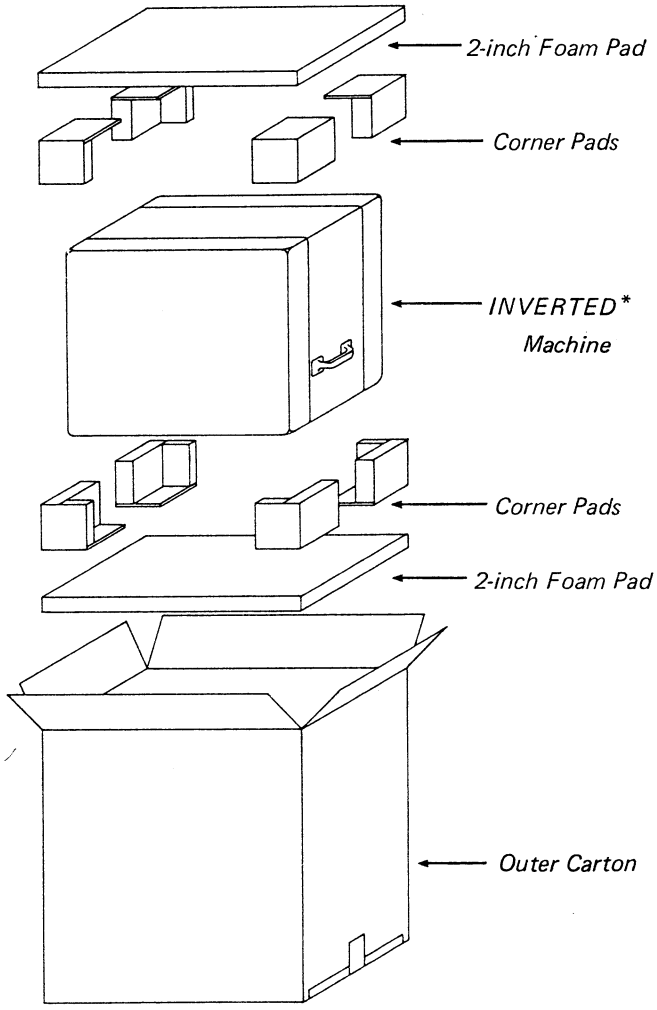


FIG. 2 - 1b

TYPICAL SHIPPING PACK

2.2 MOUNTING and ENVIRONMENT

The recorder should *not* be mounted in an area where: the tape would be exposed to high temperatures, high magnetic fields would be encountered, proper ventilation is not allowed, or high vibration would be encountered while playing. The machine is sufficiently shielded to operate in areas where a reasonable amount of RF is present, such as a radio station.

When the machine is ordered with the portable case, all assemblies are mounted in place at the factory.

The transport and electronics are designed to be mounted in standard 19 in. racks, with the transport situated directly above the electronics for the shortest head leads.

Provisions should be made for obtaining a source of clean cool air for the air inlet at the drive motor. The air outlets at the ends of the machine must not be blocked.

Care must be taken, on units with more than one set of electronics, to insure that electronics and head leads are not permuted upon mounting. To assign a head to an electronics other than the one it was equalized with may result in an equalization error.

Note: The Transport and Electronics must be electrically connected together (grounded). This connection is usually provided by the ¾ x ¾ angles, or by mounting in a metal rack-cabinet. In custom installations on non-metallic panels, a separate ground wire must be provided between the sections.

Fig. 2-2 and 2-3 show the clearances to be observed when mounting the machine.

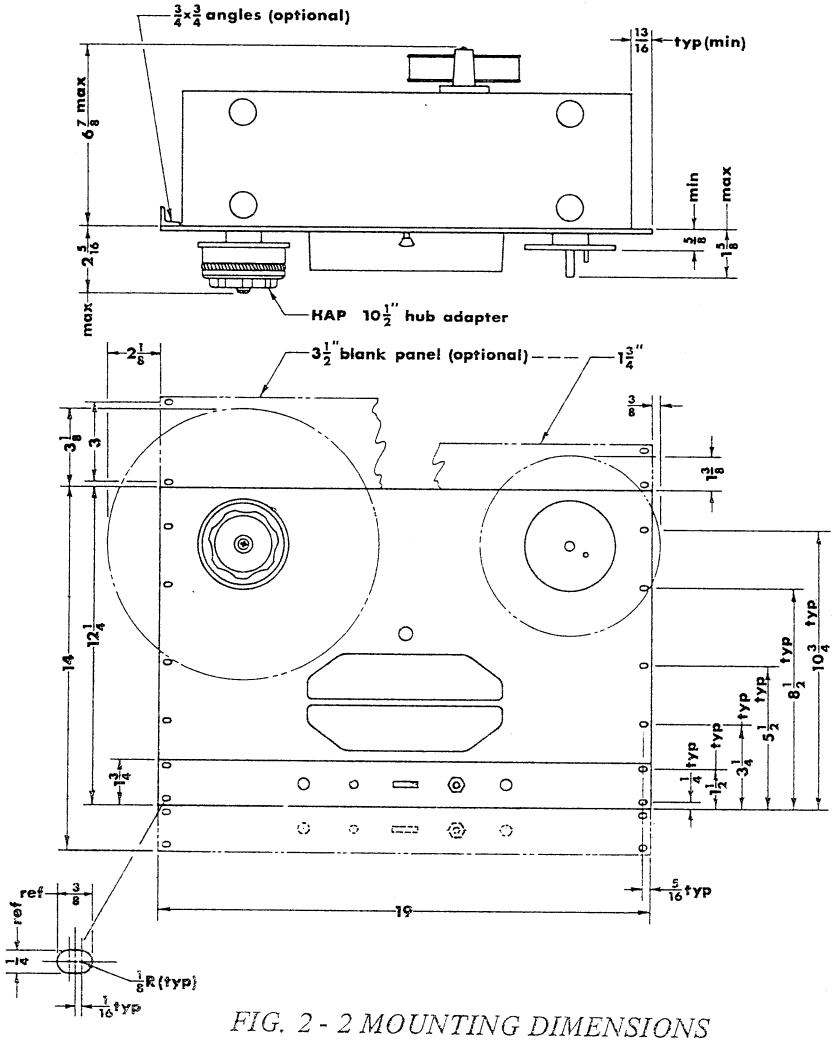


FIG. 2 - 2 MOUNTING DIMENSIONS (REPRODUCERS)

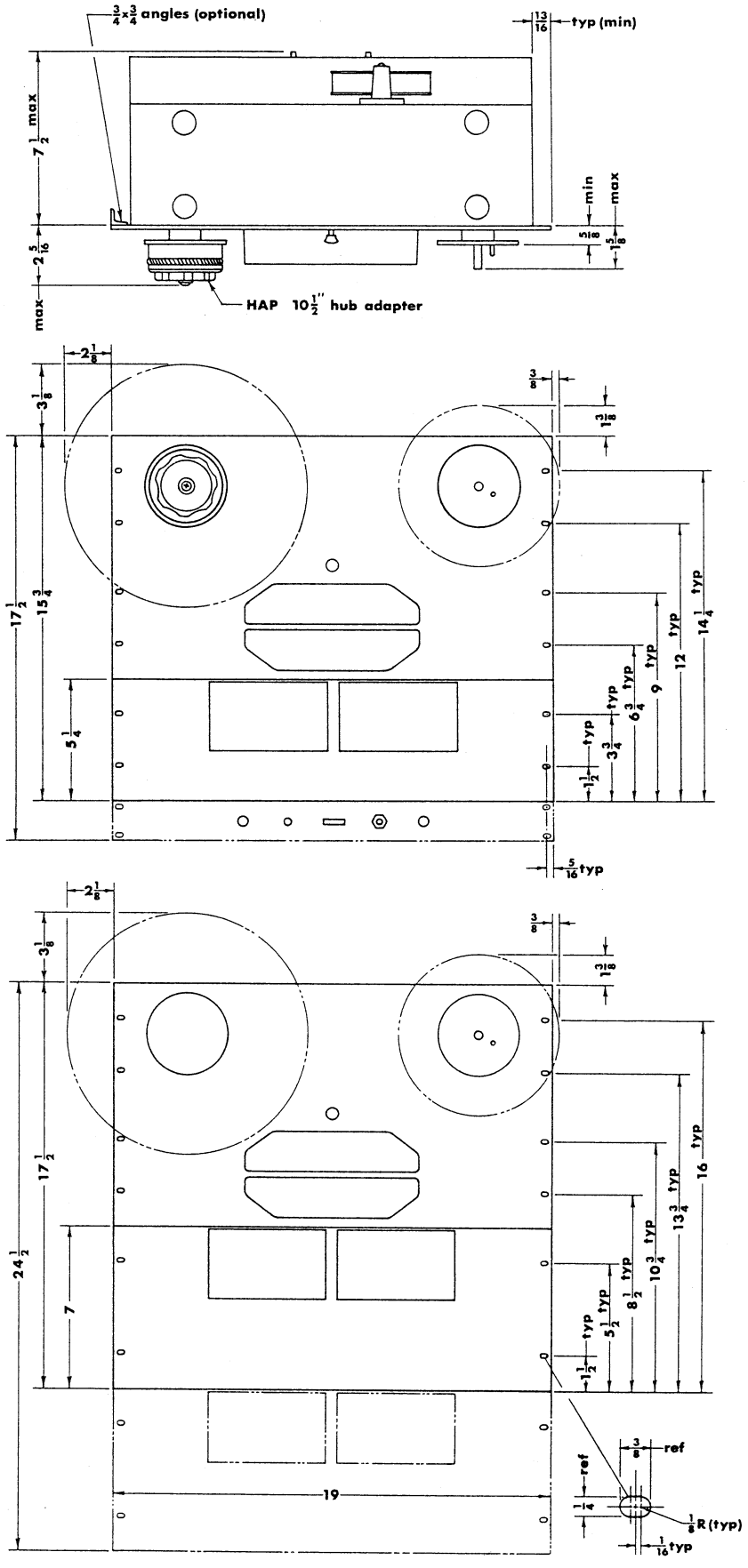


FIG. 2 - 3 MOUNTING DIMENSIONS (RECORDERS)

2.3 ASSEMBLY INTERCONNECTIONS

The basic assembly interconnections or cabling between transport and electronics is composed of one power cable to each electronics and head leads, one for each record channel and one for each reproduce channel. Power cables must join to the power output jack on the rear of the transport (Figs. 2-1, 2-5, 2-6, or 2-7). Each head lead is tagged with its respective channel number which must go to the electronics associated with that channel. In units with more than one set of electronics, care must be used not to interchange them or serious equalization errors may appear. Four-channel recorders will have a special cable passing between electronics to interconnect the bias oscillator and bias amplifier. On the rear chassis is an unfused auxilliary AC outlet which is switched by the transport power switch. For more specific information refer to Section 7.2.

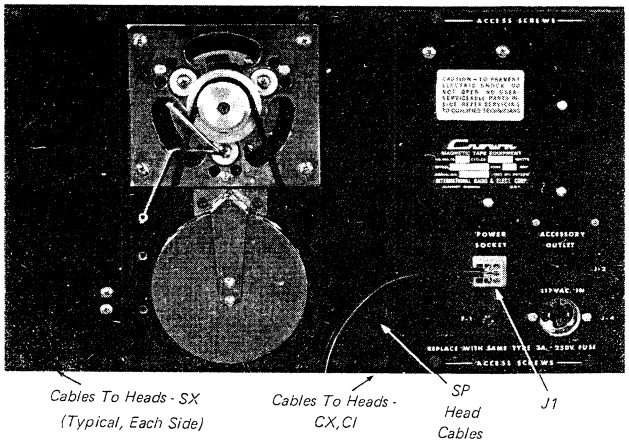


FIG. 2 - 4 'PRO-700' TRANSPORT

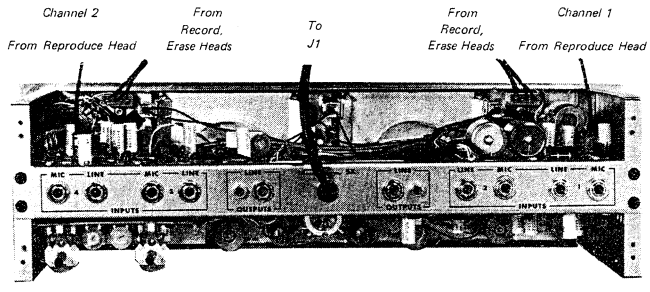


FIG. 2 - 5 'SX' STEREO CHASSIS

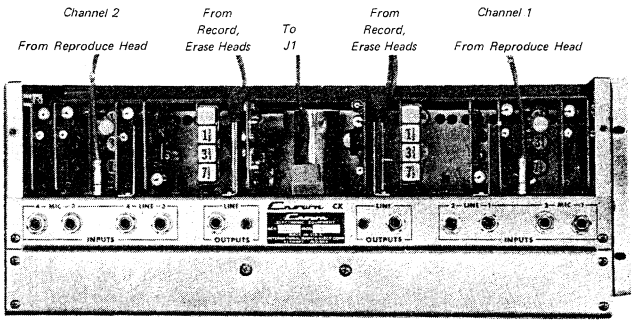


FIG. 2 - 6 'CX' STEREO CHASSIS

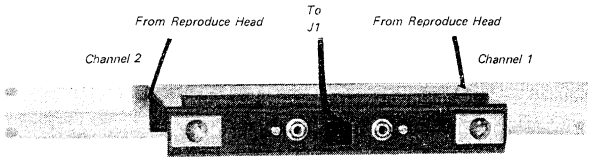


FIG. 2 - 7 'SP' REPRODUCE CHASSIS

2.4 CONNECTING SIGNAL LINES

All inputs and outputs use ¼ in. phone plugs. Machines with Lo-Z input hardware and balanced outputs also have XL connectors (female inputs and male outputs). Some electronics also have a pin-jack line output.

Where XL connectors are used, pins 2 and 3 are the signal leads and pin 1 is ground.

Front-panel monitor or earphone jacks on all stereo electronics, except the CI series, are stereo ¼ in. phone jacks.

For more specific information on the electrical specifications on inputs and outputs refer to the Electronics' section.

2.5 CONNECTING POWER

The AC power cord, which is provided, plugs into the male chassis-mount receptacle on the back of the machine (See Fig. 2-4). The power cord should be dressed away from all signal leads.

3.1 OPERATING CONTROLS AND INDICATORS (See Fig. 3-1 and 3-2)

Power	Controls power to the transport and to the record, reproduce electronics .
Reel	The REEL switch sets the motor torques for the proper tape tensions depending on the size reels used. A 10-½ inch diameter reel is considered large and 7-½ inch and 5 inch reels, small. Set the reel size switch accordingly. Both reels (take-up and pay-off) must be the same size. *Do not intermix reel sizes.*
Speed	The Speed Shift is used to shift the capstan drive belt between two steps on the drive motor pulley and thereby change the play speed. The speed shift should be used only when the drive motor is in operation. A snap-type action should be used, by quickly pushing or pulling the speed shift all the way. On a typical machine, which speed-shifts between 3-¾ and 7-½ ips, the drive motor must be shut off and the belt manually placed on the 15 ips (largest) step. The speed shift should be left in the 7-½ ips position. If special speed reducers are employed, they are also manually shifted (See Fig. 3-4).
Cue (option)	The CUE lever provides a method for precisely locating a specific sound on the tape when moving the tape slowly over the heads (pull knob down to engage). At all other times, this knob should be off (up).
Micro-switch Tape Sensor	An automatic tape sensor (automatic stop) is provided in the form of a microswitch. This sensor returns the deck only from Play mode to Stop mode with tape runout or breakage.
⇦ Rewind Button	Places tape in rapid motion in rewind mode from take-up to pay-off reel.
⇨ Fast Forward Button	Places tape in rapid motion in Fast Forward mode from pay-off to take-up reel.
STOP Pushbutton	Stops tape motion from any mode.
PLAY Pushbutton	Places tape in forward motion at pre-selected speed for recording and/or reproducing.

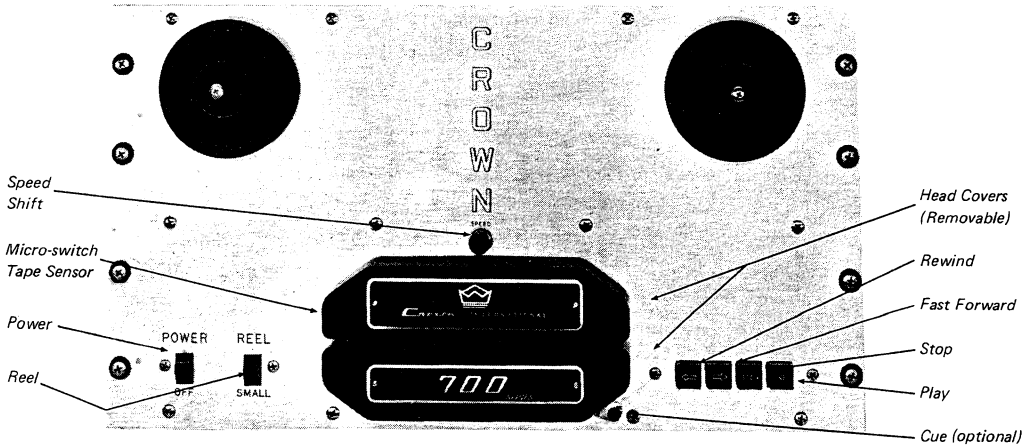


FIG. 3 - 1 PRO-700 TRANSPORT CONTROLS

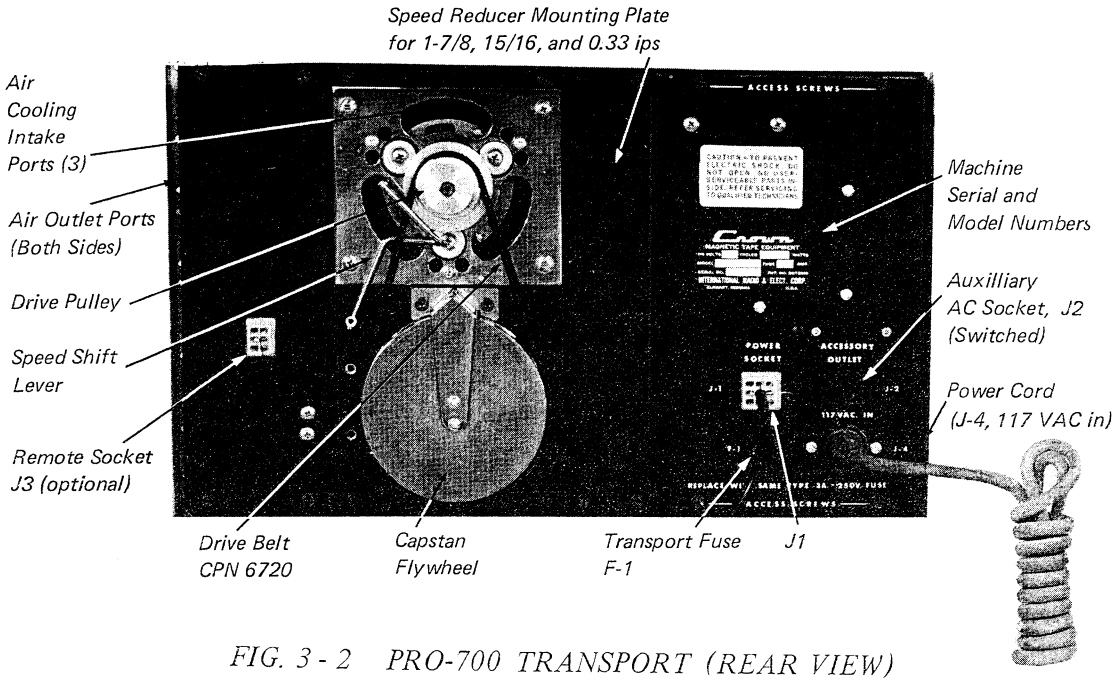


FIG. 3 - 2 PRO-700 TRANSPORT (REAR VIEW)

3.2 THREADING THE TAPE

Mount reels on the hubs. Put the empty reel on the right hub, and the full reel on the left hub. (Use the same size of reels on both). Pull about two feet of tape from the full reel, insert the tape between the two head covers, and wrap the end of the tape around the empty hub two or three times. Be sure the tape is not twisted. The dull (oxide) side of the tape *must* be on *top* as it goes through the slot.

3.3 APPLYING POWER

To apply power to the transport and record-reproduce electronics, switch on the transport POWER switch.

3.4 SELECTING REEL SIZE

If 10-½ inch reels are used, place in the REEL position. For 7 or 5 inch reels, place the switch in the SMALL position. Both reels would be the same diameter.

3.5 SELECTING TAPE SPEED

In order to use the front-panel speed shift, the capstan drive motor must be running. On a standard machine having speeds of 15, 7-½, and 3-¾ ips: for 7-½ ips, quickly pull the speed-shift rod out to its full extension, and release; for 3-¾ ips, quickly push the rod fully inward, and release. For 15 ips: stop the drive motor, move the speed-shift rod to 7-½ position, and manually place the belt on the largest step of the pulley.

Similar operation will be noted when using a machine with 15-7½ front-panel speed shift.

NOTE: On 3-speed machines, the drive belt must be manually shifted to the 3¾ groove (see p. 24, par. 5.8.2).

Special speeds using speed reducers will require manual belt shifts and the use of additional special drive belts (See Fig. 3-3).

3.6 TRANSPORTING TAPE

Once tape is threaded, and the POWER switch turned on, the machine is ready to be given its handling commands. To transport the tape, it is only necessary to push the Play button. For instruction on how to record and reproduce the tape refer to Section 7.3.

3.7 RAPID SERVICE GUIDE

If abnormal operation of the transport is suspected, several double-checks and tests may be performed. A chart (see Fig. 3-4) showing symptom test, reason(s), and cure, is shown below. Reference is also provided to the specific theory and service paragraphs where applicable.

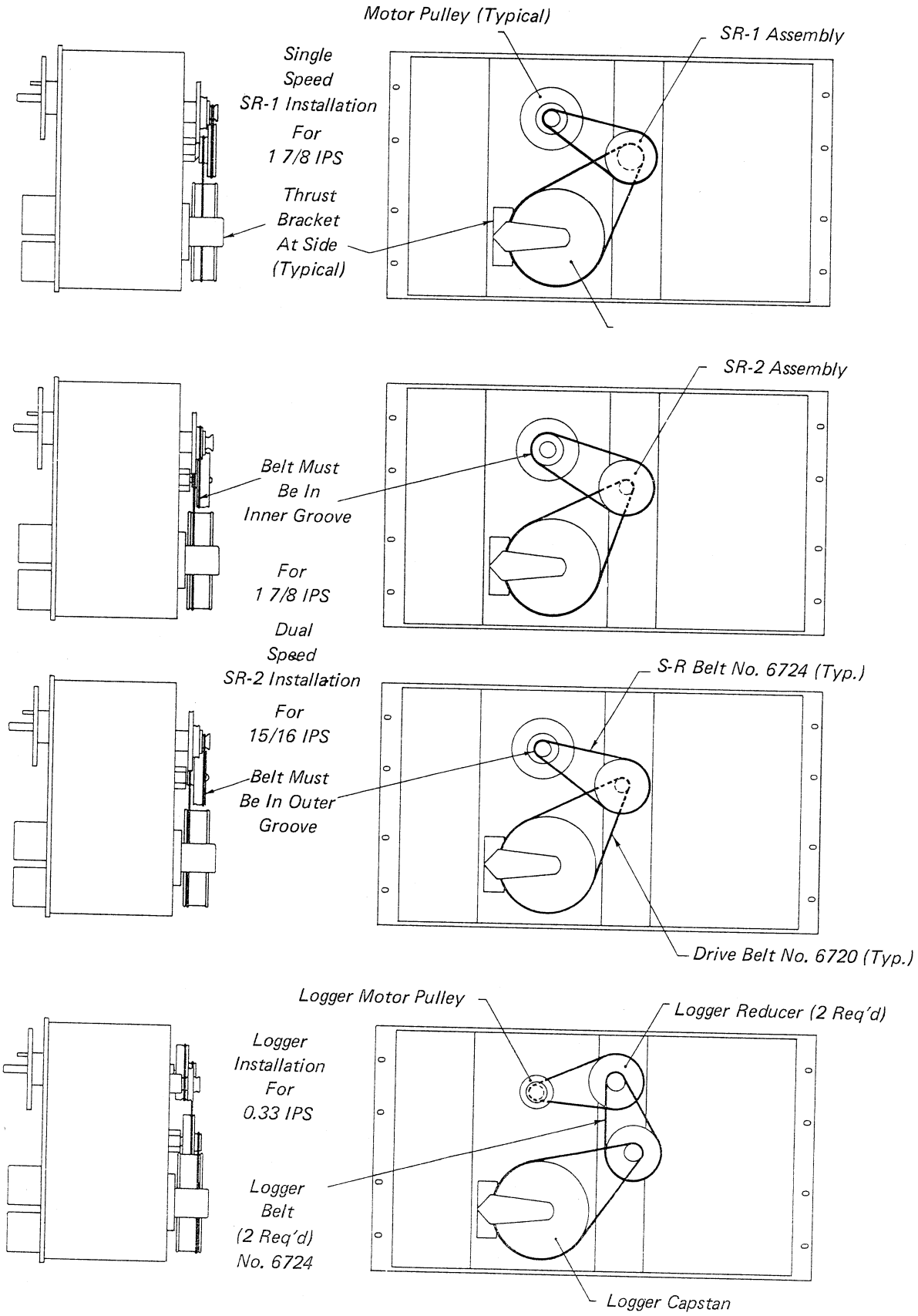


FIG. 3 - 3 SPEED REDUCERS

SYMPTOM	TEST	REASON(S)	CURE	REF.
No power	Meters' lamps should light	Defective power cord, or fuse F1 Power switch OFF Fuse-cap of F1 loose	Replace power cord, or correct fuse Tighten cap till snug	Par. 3.3
Tape tension in PLAY mode excessive or slack (or)	Tape stretches or squeaks in guides, slack loop formed with possible drop-outs	Reel switch in wrong position	Reel switch must be up for 10½ in reels, down for 7 in, 5 in. reels	Par. 3.4
Excessive tape 'bobble' at start of PLAY mode	Loop forms, may pull inside of reel flange	Sticky tape, or heads and guides contaminated	Clean heads, guides; Use good tape	Par. 4.1
Tape playback sounds slow or fast	Reproduction 'tinny' or 'bassy'	Incorrect tape speed, or equalization (see section 7)	Speed shift (or manual shift of belt) required	Par. 3.1, 3.5 or 7
Sluggish tape movement in Fast-wind modes	Listen for loud cue signal Rotate motor shafts with power OFF	Cue lever engaged Reeling motor shaft binding	Release lever Realign motor bearings	Par. 3.1 Par. 4.5
High Wow and/or Flutter	Certain music sounds unsteady, wavers Slow tape start-up in play mode	Sticky or wide tape, or capstan, heads or guides contaminated Low capstan-to-roller pressure Defect in drive system	Use first-quality tape; Clean heads, guides Re-adjust pressure-roller pressure Service drive system	Par. 4.1 Par. 5.4.3 Par. 4.6
Erratic or Sudden Stop from Fast-wind modes to STOP (large 10½ in reels)	High-brakes engaged, tape stretches or slips down inside large reel flange Differential lamps should light at beginning of high-braking mode	Wide or weak flanges of 10½ in. metal reels with 1 mil tape Differential lamp defective	Use true reels, or semi-precision type Use good-grade 1 mil or thicker tape Replace lamp I1 or I2 Crown part No. 2611 (No. 304)	Par. 5.7.3

FIG. 3 - 4 RAPID SERVICE GUIDE

4.1 CLEANING

In Fig. 4-1 are shown the parts which need periodic cleaning for optimum performance and life of the machine. Metalic tools should not be used on the heads or guides when cleaning as serious damage could result. Use CROWN Head Cleaner (CROWN HC) or isopropyl alcohol. Some solvents are also solvents for plastics used in potting the head, the pressure roller, and other plastic parts of the machine. Care should always be used to keep the solvent confined to the objects being cleaned and out of all lubricated moving parts where it would destroy the lubricant.

Different types of tape will cause different amounts of oxide and dirt to accumulate on the heads at different rates. Check the heads often. When a build-up is noticed, they should be carefully and thoroughly cleaned. A match or wooden toothpick may be used to loosen the dirt if necessary. Low or distorted record and reproduce level or incomplete erasures are also evidences of dirty heads. Clean heads are less likely to show signs of uneven or rapid wear.

Tape guides, lifters, and pressure brushes are additional parts which come in contact with the tape. Like the heads, they should be kept clean and free of oxide particles and build-up. Brush out any large particles and use a solvent to remove any remaining build-up. Do not allow oxide particles to fill up space between vertical fibers in the brushes.

Occasional cleaning of the pressure roller is advisable, especially if large amounts of oxide build-up or any sign of oil appears on the surface of the pressure roller. It is also good practice to clean the capstan as removal of oxide particles and other foreign matter will aid in keeping wow and flutter to a minimum. Excess oil from the capstan bearing may at times appear on the capstan shaft itself. This is especially true in hot environments or after oiling. Make sure that any oil is carefully removed.

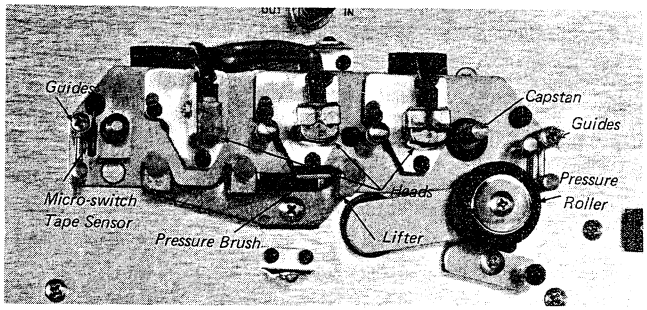


FIG. 4 - 1 TAPE PATH (HEADS, GUIDES, ETC.)

4.2 DEMAGNETIZATION

The heads and guides of the transport should be demagnetized at any time there is a suspicion that the heads may have become magnetized, or when there is any evidence of magnetization. Magnetization will cause an increase in the tape noise level, degrade a recorded tape, and cause even-order harmonic distortion when recording a tape.

In any case, it is a good practice to demagnetize the head assembly on a regular basis. Perhaps every 300 to 500 hours of normal use would justify average needs. This is accomplished by removing the head cover, and bringing a bulk eraser or head demagnetizer into close proximity with the heads. The eraser or demagnetizer should be turned on and off at a distance of at least three feet, and should be moved slowly while near the heads.

Sometimes the capstan shaft, capstan tip, or the capstan flywheel will become magnetized. This will induce a sinusoidal low frequency (subaudio) noise into the playback head. If the shaft is to be demagnetized, the flywheel and shaft must be removed from the back of the machine for the operation.

4.3 HEADS

Wear must be expected in the heads, due to the abrasive nature of the tape. However, some tape is much more abrasive than other tapes. It is best and actually cheaper in the long run to use a good grade of tape on your recorder. Be careful of dirt and foreign particles in the tape deck.

Always use regular splicing tape for splicing. *Never* use household cellophane tape or any other kind of tape not designed specifically for tape splicing. It will gum up the heads and pressure brushes.

The life expectancy of the heads is 4,000 hours or more. The real and only true test of how much is too much wear is the manner in which it affects the performance of the machine.

Further information on the heads and their alignment is given in Section 5.1.

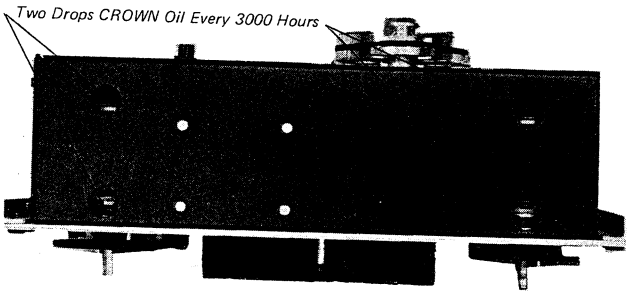
4.4 LUBRICATION

Most moving parts in the mechanism are operating in lubricated oilite bearings (see Fig. 4-2). Therefore, very little oil is required. The reel motors and pressure roller bearings should be oiled after 1,000 hours of operation or one year, whichever comes first. The drive shaft housing should be oiled after 3,000 hours of operation. CROWN lubricant (CROWN CO) is recommended.

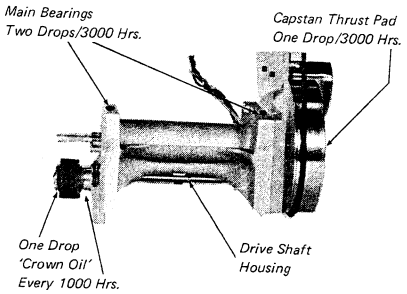
If any excess oil seeps to the outer edges of the moving parts, causing slippage in the drive mechanism, clean off all parts thus affected. See Section 4.1 on cleaning.

Do not over-oil! Two drops of oil on each bearing is usually sufficient. Too much oil on capstan bearing or pressure-roller bearings could cause the oil to go to parts that contact the tape and cause serious trouble.

Caution – "U" Series only



TOP VIEW



RIGHT-SIDE VIEW

FIG. 4 - 2 LUBRICATION DIAGRAMS

4.5 REEL MOTORS

When reel motors are new and bearings are tight, it is possible that bearings might stick occasionally. If this happens, it indicates that a bearing is slightly cocked. This may happen during shipment or rough handling. The motor shaft should be tapped lightly in all four directions and at both ends of the motor where possible. This will usually align the bearings. Do not dis-assemble the motor unless absolutely necessary. It may be very difficult to restore it to the original alignment.

4.6 WOW and FLUTTER

There are many factors which may contribute to wow and flutter. Items listed should serve as a guide and may also suggest further checks to make:

1. Dirty capstan
2. Dirty or rough capstan-shaft bearings
3. Shaft too loose in bearings
4. Excessive tape wrap on heads
5. Bad test tape
6. Dirt on test tape
7. Improper pressure-roller pressure
8. Bad pressure roller
9. Pressure roller binding on side
10. Pressure roller with dry or dirty bearings
11. Reel flanges wobbly causing tape to touch reel
12. Flange adjustment causing tape to drag on one side of guide
13. Head-cover guides cramping tape
14. Oily Tape, capstan, or pressure roller
15. Bent capstan tip
16. Irregular belts
17. Mis-aligned motor
18. Oily belt

NOTES ON "PERMALUBE"

In early 1969 CROWN introduced permanent lubrication in some or all bearings described above. All machines thus equipped were assigned a "V" prefix in serial no. e.g. V9965.

DO NOT USE ANY OIL on any reel motor bearings of "V" series machines. Additionally, some early "V" series units incorporated Permalube capstan bearings and/or pressure-roller bearings. A yellow label on the pressure bar identifies these bearings.

IMPORTANT !

IMPORTANT !

DO NOT USE OIL or any other lubrication for the life of this machine!

You, as a CROWN owner, are the first to enjoy a Sapce-Age breakthrough in maintenance-free operation -- CROWN Permanent Lubrication (PL-10).

As a result, the Serial Number of this machine begins with prefix "K" or "V" -- indicating CROWN PL-10 has been incorporated into some bearings.

PL-10 is not affected by extremes in temperature, humidity, and operating hours of equipment. Extensive testing has proved that PL-10 is non-oxidizing, non-jelling, and will not provide seizing of a shaft in a properly-impregnated bearing.

NOTE: In Par. 4.4 (of Section 4 MAINTENANCE), these instructions apply only to the PRESSURE ROLLER and CAPSTAN bearings; which should be oiled very sparingly. NEVER oil the REEL MOTORS!

All other operating instructions are identical to "J" or "U" series. The Parts List and Schematics in Section 6 are identical to "J" or "U" series, with the exception of new part numbers as noted on following page.

8NC29

5.1 HEAD ALIGNMENT

Before you begin, all tools which are likely to come in contact with the head assembly should be demagnetized to avoid magnetizing the head assembly. Do not attempt to service the heads unless you have a professional alignment tape, necessary tools, and experience to do so.

5.1.1 Reproduce Head Azimuth

Make sure the Record switch is in the Play position; then thread an alignment tape. Standard alignment tapes provide tones for azimuth alignment, reference level, and frequency response. With the azimuth section playing, adjust the output control until clear indication is seen on the meter. For slight adjustments, turn the azimuth screw slightly to the right and left and leave it at the point where the highest level is indicated on the meter. The two other screws have to do with tipping the head; and, by very careful adjustment, fluctuations of playback level may be reduced (see fig. 4-1).

5.1.2 Record Head Azimuth

After the reproduce head has been aligned, the record head may be aligned in the following manner:

1. Remove the alignment tape, and thread a tape that can be used for recording.
2. Plug an audio oscillator into the high level input and record a 10KHz note on the tape. Record at a level of -10 VU at 7-½ ips.
3. With the Meter switch in "B" or "Tape" position, adjust the record head in the same manner as the play head, using the designated screws.

Adjustments made to the record head must be made slowly, since there is a time delay between recording and playback.

5.1.3 Tracking

The 'tracking' of the tape is very important to obtain consistently good results, especially when using multi-track recorders, such as two-track and four-track stereo. 'Tracking' refers to the tape moving across the heads exactly where it should. (See Fig. 5-1)

Notes:

(1) All views are toward head-faces, with panel at bottom of each configuration.
(2) Tape Travel is from left to right.
(3) Standard tape width is 0.246 ±.002 inches.
(4) RECORDED-TRACK data per NAB STANDARD, ¼-inch Magnetic tape equipment (reel-to-reel), April 1965.

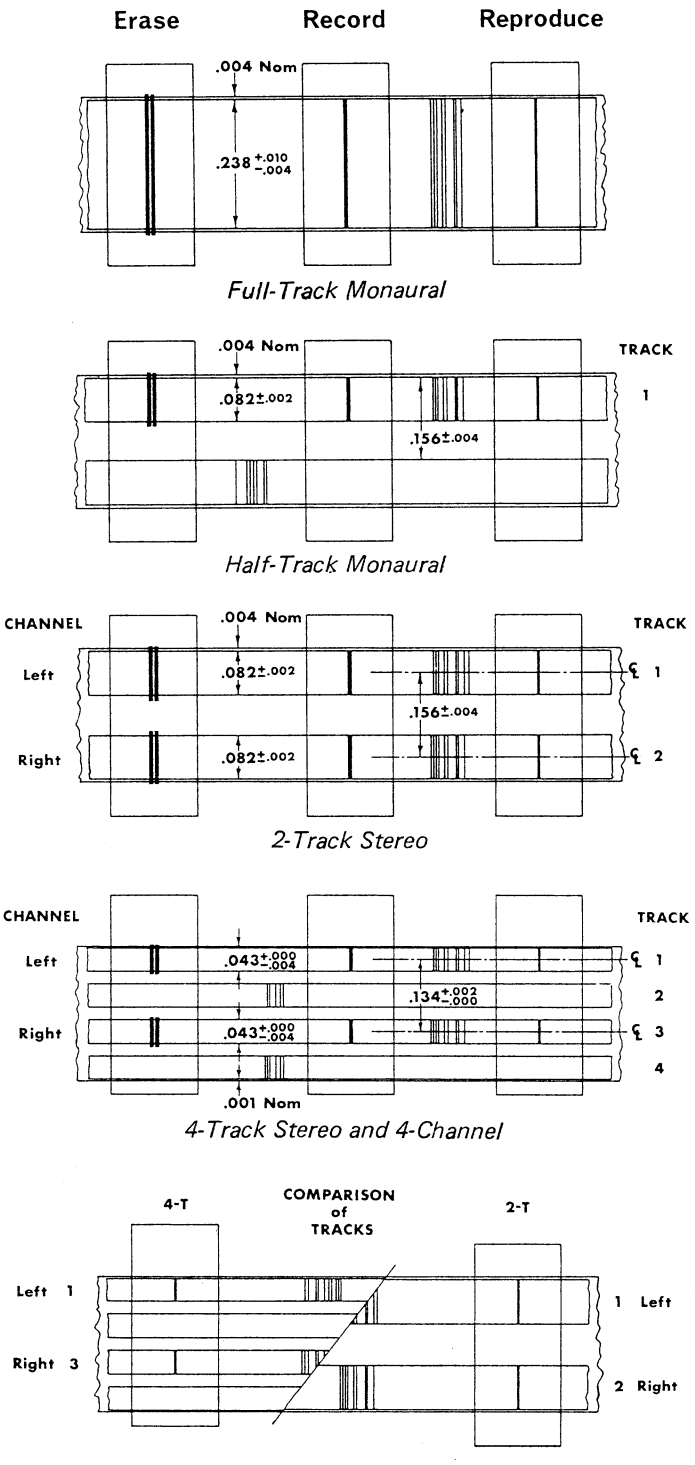


FIG. 5 - 1 POSITIONS OF HEADS AND TRACKS

In order to determine if the tape is running exactly where it should, the use of a colloidal iron suspension is recommended, such as Soundcraft's Magna-See. In using this solution, a 1000-cycle tone from the oscillator should be recorded at full level (0 db) on all tracks of your recorder. Note that this requires the tape to be recorded in both directions (except full-track or two-track stereo). Then a portion of the tape is developed in the colloidal iron suspension and examined. A pattern will clearly indicate the exact position of the recorded tracks on the tape. If the record head needs adjustment, it can be moved forward or backward by adjusting all three record head screws. When moving the head, these three screws should all be turned the same amount, or else serious mis-alignment or head tilt will result. A small adjustment should be made first and then rechecked by making a test with iron suspension again.

The reproduce head can be tracked by recording a steady tone (1.5 V @ 1 KHz) from an audio oscillator directly into the reproduce head leads (after disconnection from electronics). All three screws should be turned the same amount to avoid azimuth error. When the point of maximum output is reached (on both channels if machine is stereo), the heads are properly tracking. The azimuth should be rechecked as a final adjustment.

To check for inaccurate erase head alignment, record the signal as before and then erase the signal and again develop. If the tape is not properly tracking by the erase head, a small sliver of the signal will still be visible on the tape. The erase head may be moved in a manner similar to that used for adjusting the record and play heads, using the screws designated erase head. Normally, the erase head will not cause trouble since the erase gap is longer and tends to overlap on both sides on the recorded track. A small amount of misalignment is therefore tolerable. If severe mistracking is noticed, check to see if the tape is running properly in the guides. If the tape is pulled severely toward the front or the back, the tape is skewing (See Section 3.1.5).

Note: Poor erasure may also be encountered if the erase head current is low or if the circuit is open or shorted. If an examination of the plug, the cable, and the head connections show no abnormality, check the oscillator circuit itself.

5.1.4 Pressure Brushes

In order to reduce dropouts, lower scrape flutter, improve high-frequency response (with better tape-to-head contact), and minimize I M distortion, CROWN equipment incorporates a pressure brush. Normally the brush is applied to the record head—where tape-to-head pressure is lower, and above problems are more likely to occur.

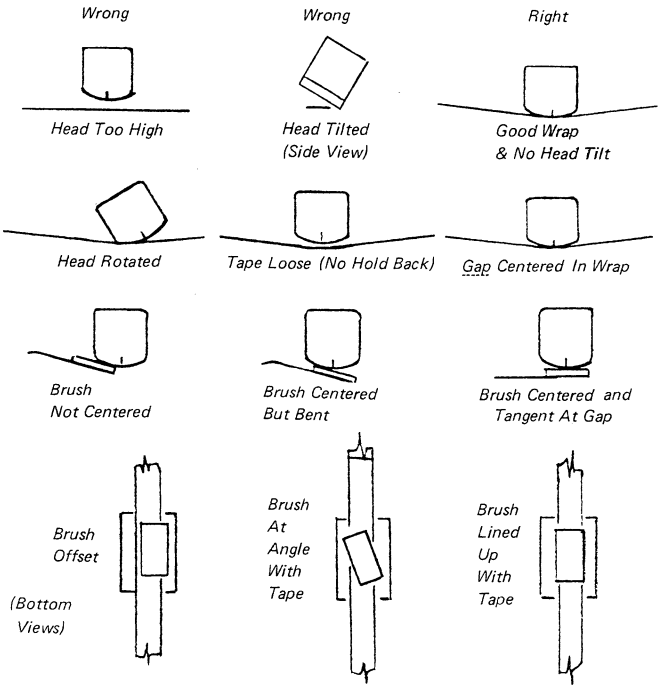


FIG. 5 - 2

Proper adjustment must be maintained, as a misadjusted pressure brush may result in poor-quality sound and/or permanent damage to the head (in the form of excessive or uneven wear. Adjustment should be checked as follows: (see fig. 5-2).

1. Check Head Position: The head position should be such that tape contact is maintained even if the pressure brush is held away from the tape. A 10 KHz tone should not decrease more than 1 or 2 db when the pressure brush is held back. Make certain that the tape is not skewed by whatever object (must be non-magnetic) is used to hold back the pressure brush. If an abnormal decrease is noted, one of several things may be at fault.
   a. Worn heads.
   b. The head position may be too high, or the head may be tilted.
   c. The head may be rotated so that the gap is not centered in the area of "wrap."
   d. Reel holdback tension may be too low, causing the tape to be loose as it moves over the head.

On multi-track recorders, all tracks should be checked.

2. Adjust the Pressure Brush: After conditions causing the drop in level have been corrected, the pressure brush should be released and checked for alignment.
   a. The edges should be parallel to tape travel and centered on the tape.
   b. It should be tangent to the head at the gap.
   c. Pressure against the head should not be excessive or the head will wear rapidly.

5.1.5 Tape Skew

Unwanted tape movement of an irregular nature at right angles to normal tape movement is called skew. Very slight amounts of skew will probably always be present, and will cause no trouble. If skew becomes excessive, several factors should be checked.

1. The tape itself may be at fault: Tape which has been stretched or creased can hardly be expected to follow a straight line. This is especially true with ½ mil tapes.
2. Misalignment may cause skew: The tape should be the same distance from the panel at all guiding points along its travel. (Use the tape guides as a reference.)
   a. Reel flanges should be the proper distance from the panel and motor shafts should be exactly perpendicular to the panel surface.
   b. The capstan should be exactly perpendicular to the front panel.
   c. The pressure roller should also exert pressure evenly across the entire area of contact with the capstan. A slight crowning however, is permissible in the center of the pressure roller.
3. Holdback Tension: Lack of holdback tension in the payoff reel will aggravate any tendency for tape skew.
4. Take-Up Tension: When excessive will aggravate any tendency for the tape to skew.
5. Uneven pressure across the pressure brush may cause the tape to skew.

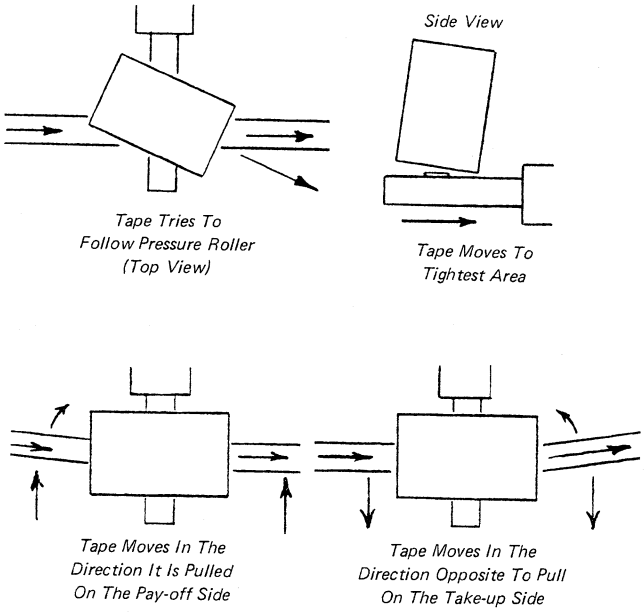
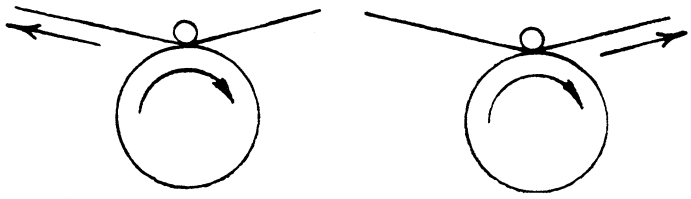


FIG. 5 - 3 FACTORS AFFECTING SKEW



FRONT VIEWS

FIG. 5 - 3 (concl.)

If the machine has been running for an extended period in a misaligned condition, sharp grooves may be worn into the guides, head covers, etc. These grooves may then tend to guide the tape improperly, even after the misalignment has been corrected. Such parts should be replaced.

5.2 THE TAPE SENSOR (See Schematic Fig. 6-1)

The tape sensor is designed to stop the machine whenever the machine is in the "PLAY" mode.

The sensor does this by releasing the main solenoid which deactivates the stack switch assembly. Since the main solenoid is not used in any other mode the tape sensor does not operate for any other mode. Therefore, it is necessary to manually stop the machine when fast winding.

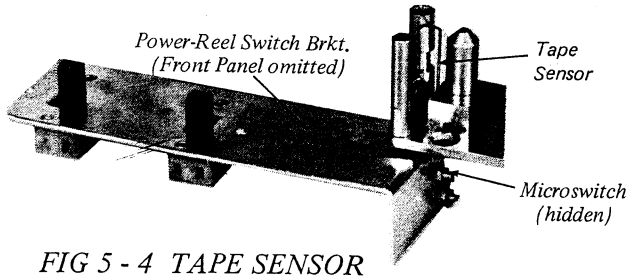


FIG 5 - 4 TAPE SENSOR

Located behind the pay-off-reel end of the head assembly, the sensor is composed of a microswitch fitted with a tape contacting lever. (Fig. 5-4) Whenever tape is not present the switch lever swings up and the switch opens.

The sensor should be adjusted so that the lever is parallel to the tape (to avoid skew) and the switch point is well above the position of the lever when tape is threaded.

The sensor may be used for signaling "end of tape" to external apparatus when wired as indicated with the remote control wiring (dotted, optional).

5.3 CONTROL SWITCHES (Pushbuttons)

The control switching is composed of a group of four interlinked, externally-accessible pushbuttons which initiate all the machine's modes of operation (see Fig. 5-5).

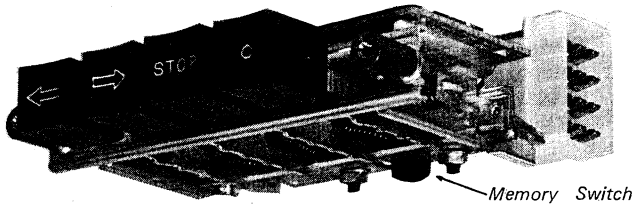


FIG. 5 - 5 CONTROL SWITCH ASSY.

The four commands that can be given with these buttons are fast rewind (⇦), fast forward (⇨). STOP, and PLAY. When either of the fast modes are engaged the PLAY command is electrically interlocked–preventing such a hazardous transition. The only command which may then ensue is STOP which mechanically releases the fast commands causing the switch to return to a standby-braking mode. Holding in the STOP button gives increased braking potentials for a slightly faster stop. For most application the standby brakes will prove more than adequate for rapidly halting the tape motion.

The fast-forward modes and the play mode actuate a direction memory switch (SW-4) which dictates the subsequently available braking-differential mode. That is if the machine goes in a forward mode (⇨ or play) the memory switch is set for forward braking with higher braking on the pay-off motor (B3). The memory switch will remain in this mode until it is reversed by a rewind command–switching to rewind brakes with higher brakes on the take-up motor (then paying off, B2).

Since the memory switch is not directly capable of knowing the direction of tape travel (but rather by inference) the fast modes are deliberately mechanically interlocked thru the STOP command to eliminate the possibility of carelessly out smarting the machine while "jockeying" tape. (Jockeying is the name given to tape handling that makes direct transitions between the two fast modes).

The STOP command is the only command that is not interlocked in any way. When in the PLAY mode the STOP command removes the solenoid power which causes the machine to stop. This command may be remotely given when wired out to a remote jack (optional); however, the STOP command for a fast mode must be given at the machine to mechanically release the corresponding fast-mode button.

The PLAY command is electrical (of momentary contact type) and may also be given remotely (optional). The main solenoid is electrically self-latching through the stack switch which acts as a memory for the PLAY command.

Whenever using the remote PLAY-STOP function on an appropriately wired machine the direction-memory switch should be set to forward by pressing PLAY at the machine. Otherwise the brakes will be reversed when stopping–resulting in loop dropping.

5.4 TAPE LIFTER AND PRESSURE ROLLER SOLENOID AND PULL-IN CIRCUITRY.

5.4.1 General

A D.C. solenoid is used to simultaneously operate the tape lifter, pull in the pressure roller (into the PLAY position) and actuate the stack switch contacts.

5.4.2 Tape Lifter

The guides and heads have been positioned in such a way that the tape will not contact the heads except in the play mode. Therefore, a tape lifter assembly is required. The basic consideration is that the lifting surface be perpendicular to the panel, and lift the lifter enough to provide sufficient tape wrap across the head surfaces when the transport is in the play mode. The rubber between the lifter rocker arm and the panel should not be compressed as this may jam the entire solenoid mechanism. (see Fig. 5-6).

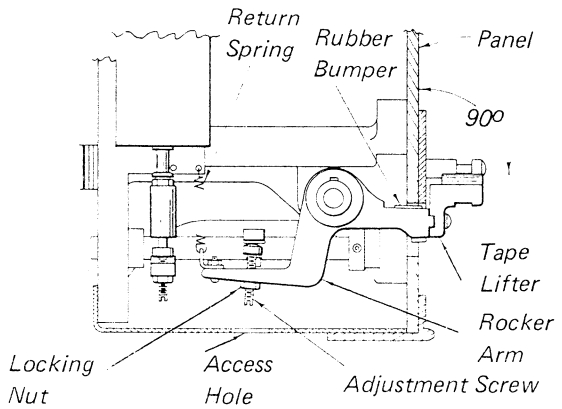


FIG. 5 - 6 TAPE LIFTER

5.4.3 Pressure Roller

In order to obtain the best wow performance and good timing characteristics, the pressure roller tension must be set from 10 to 12 lbs. This indicates the pressure between the pressure roller and the capstan, and can be measured by pulling straight down on the right hand end of the pressure bar with a spring balance until the tape just stops moving

while the machine is in the play mode of operation. This adjustment also affects the timing of the machine (see section 5.9).

To set the pressure roller pressure turn the adjustment screw shown in Fig. 5-7. The locking nut must be loosened before attempting adjustment. The solenoid has two adjustments which interact. Ordinarily it should not be necessary to adjust the upper one. The assembly on the solenoid plunger is adjustable to control the amount of travel or drop of the pressure roller. Whenever this is adjusted, the lower adjustment (pressure) must be readjusted to compensate for the movement of the former.

With solenoid de-energized, all moving parts must return freely to rest positions (via return springs). Major bearings are Oilite, with lubrication rarely required.

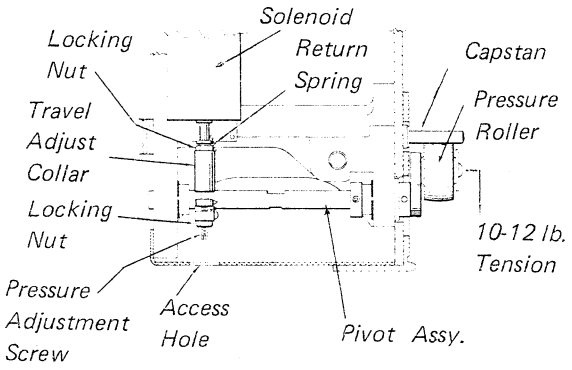


FIG. 5 - 7

PRESSURE ROLLER ADJUSTMENT

5.4.4 Electrical: (see Schematic Fig. 6-1).

The solenoid is employed in an electrically self-latching circuit. It remains seated after the original momentary PLAY command which caused seating has been removed.

The contact (SPST) located just above the solenoid (see Fig. 5-8) in series with R5 is used to provide latching current. If R5 were not employed the solenoid would become overheated by the large current necessary to cause pull-in and seating.

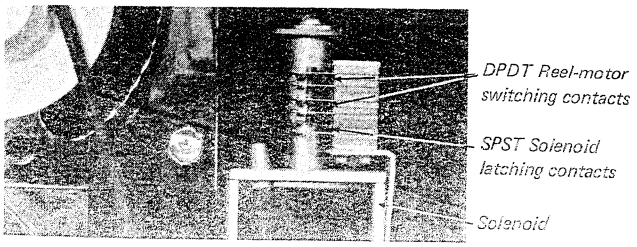


FIG. 5 - 8 STACK-SWITCH ASSY.

The remaining contacts of the stack switch provide the necessary switching of reel motor voltages.

In the PLAY mode AC voltages are applied to both motors for the smoothest tape handling. The voltage applied to the RWD motor through R3 is slightly less than the voltage applied to the FWD motor for optimum handling tensions.

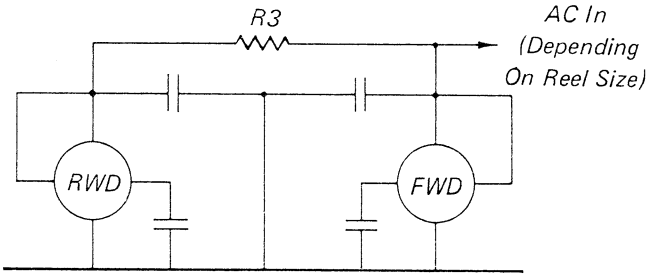


FIG. 5 - 9

If the stack switch contacts are not properly adjusted their life will be appreciably shortened, and erratic machine behavior (braking failures) will result. Therefore use care not to accidentally deform these contacts when inside servicing the machine.

When adjusting or changing leaf contacts, careful alignment and proper contact pressure must be effected. A minimum of 4 grams of contact pressure is necessary between each pair—with solenoid relaxed *and* energized.

The addition of a CUE lever (option) often requires readjusting of the assembly.

5.5 REEL MOTORS

The reel motors are AC torque motors having oilite bearings. The oil holes are accessible through the transport top (see Section 4).

The reel motors (pay-off and take-up) are part of a self-contained assembly composed of the mounting plate, motor, motor capacitor, and power plug. Pay-off and take-up motors are identical. The direction of rotation is determined by the wiring of the power connector on the wiring harness (see schematic Fig. 6-2). Should a motor capacitor fail, the motor will have very little torque.

During RWD and FWD wind modes, full 117 VAC power is applied to the pulling reel motor, and 10 VDC applied to the trailing reel motor (see Fig. 5-10).

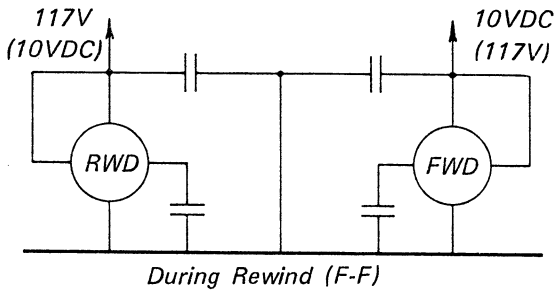


FIG. 5 - 10

5.6 ELECTRICAL BRAKING

5.6.1 Braking Systems Theory

When bringing the reels to a stop, a differential braking action must be used. Differential action means that the reel which is paying out the tape must have a greater braking action applied to it. The take-up reel should have less braking.

See Figure 5-11a. This is the situation that would exist if the tape was stopped shortly after starting the fast winding mode. Here, we have a heavily loaded pay-off reel on the left. Due to its momentum, it tends to continue turning after the brakes are applied. The take-up reel (right) has very little momentum after the right reel stops almost immediately and the left reel continues to run, a loop will form and tape will be spilled unless differential braking is used. (i.e., applying more braking to the pay-off reel and/or less braking to the take-up reel.)

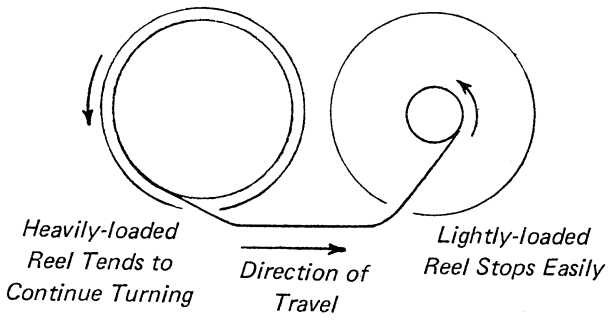


FIG. 5 - 11a

Some manufactures of tape recorders have solved this problem by eliminating the braking completely from the take-up reel. However, this produces a great amount of tension on the tape unless very soft braking only is applied and reel size is limited to 7 inches.

The tendency to stretch tape is increased as the end of the reel is approached. See Figure 5-11b. Since heavier braking must be applied to the pay-off reel as seen above, this reel will now tend to stop very quickly. The take-up reel which is now heavily loaded, will not stop immediately. The tape may be stretched; and if the differential is too great, the tape will even break under tension. Here then, we have the limits for differential braking:

1. The differential must be great enough to prevent a loop from forming under the conditions in Figure 5-11a.
2. The differential must not be so great that the tape is stretched or broken under the conditions in Figure 5-11b.

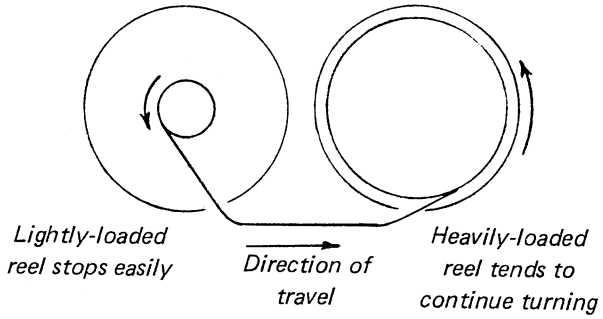


FIG. 5 - 11b

Because fast winding is desired in both directions, the function of pay-off and take-up must be reversible. In Figure 5-11c, tape is traveling from left to right. The left reel is the pay-off reel and should have the higher braking.

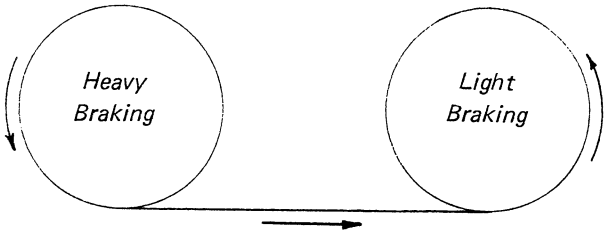


FIG. 5 - 11c

In Figure 5-11d, the tape is running from right to left. Here the right reel is the pay-off and should have the higher braking.

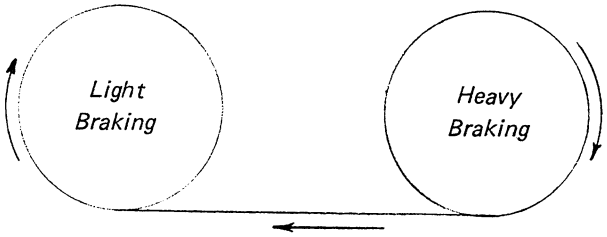


FIG. 5 - 11d

Summary:

1. Differential must be provided to prevent a tape loop from forming (too much slack).
2. Differential must not be so great that there is undue tension on the tape (tape too tight).
3. Function of brakes must be reversed when direction of travel is reversed. (pay-off reel should always have heavier brakes regardless of which reel is the pay-off reel).

5.6.2 Electrical Braking System

The electrical braking system operates by feeding direct current through the reel motors (alternating current causes the motors to turn and direct current causes the motors to "freeze." D.C. is provided for the motors in both the stop and the standby modes. However, with the stop button depressed (or hi brakes) the current is higher. This is done by shorting out a series resistor (R2). The differential action is provided by placing a lesser voltage on the "taking up" motor than on the "paying-out" motor. (see Figure 5-12).

Since the stopping torque of such a motor with DC applied is proportional to its rate of rotation, the stopping tape tension due to the electrical differential will tend to be greater at the start of the braking interval than when the tape is nearly stopped. This requires that the amount of electrical differential be less just after brakes have been applied, than a fraction of second later; i.e., that the ohmic value of thy differential resistor increase with time as the tape is halting. To provide this effect, a device with a strong positive-temperature-coefficient is used -an incandescent lamp assembly (I1 and I2).

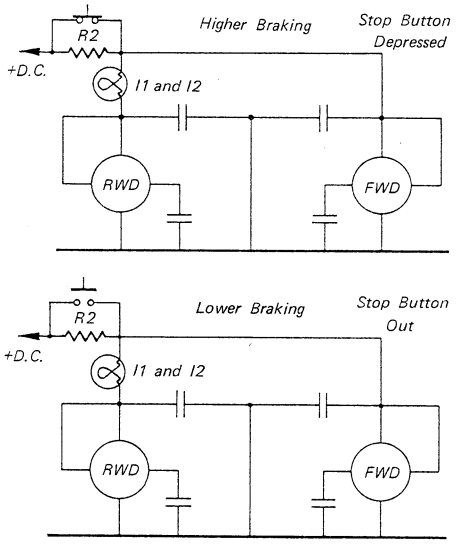


FIG. 5 - 12

5.6.3 Checking the Braking (see Schematic Fig. 6-1)

First manually engage the modes of braking in question. Then check the relative braking of each motor by turning each motor by hand and noting the amount of opposing torque. The paying-off reel for a respective mode should always have the more braking. If the taking-up reel is constantly found to have no braking the differential lamps have probably opened. Otherwise, check switching, brake-supply wiring, and motors (See sections 5.3, 5.4, and 5.7).

5.7 POWER SUPPLY

The power supply provides AC and DC voltages to external electronics, brakes, solenoid and motors.

The secondary of transformer T-1 (66 VCT) is used to power an SP or SX electronics if attached thru J1, the Power Socket. Other taps (20 VCT and 6.6 VCT both at 250 ma) are wound on the same secondary but are not made externally available. The primary of T-1 is tapped at 80 VAC and is used to power the reel motors in the PLAY mode. The 80 VAC is applied directly for large reels and dropped to approximately 51 VAC by R1 for small reels.

The AC common lead of T-1 forms the center top of an 80 VCT winding which develops +50 VDC for the brakes, solenoid, and fast-wind payoff motors. This supply is highly filtered by C2 to eliminate any possibility of 120 Hz AC hum fields occuring around the motors or solenoid.

5.8 SPEED SHIFT

5.8.1 Operation Principles

Changing capstan speeds is accomplished by changing the drive belt to a different groove in the motor pulley. Either of two speeds may be selected from the front panel.

Proper operation requires that the knob be pulled all the way to the rear or all the way forward. If this is not done, the belt may only rub and not shift. The same condition will exist if a speed change is attempted while the belt is not in motion.

There are actually four positions of operation for the mechanism:

1. Extreme forward position
2. Forward resting position
3. Rear resting position
4. Extreme rear position

In the two extreme positions, the actual belt shifting is accomplished while the resting positions allow the rod to move away so that no rubbing will occur.

Shifting to the slow speed: (See Fig. 5-13a)

1. Assume the capstan to be running and the belt to be in the center groove (7-½ ips.) Under these conditions, the speed shift control rod will be pulled forward.
2. To change speed, the speed shift knob is pushed in as far as possible. This causes the shift loop to be pushed to the rear, pushing against the drive belt and forcing it to the lower groove.
3. At the same time, the detent snaps to its rearward position.

4. When the speed shift knob is released, the control rod will be pushed forward by a control rod spring, until it is stopped by the detent. This will allow the shift loop to move away from the belt slightly so that it will not rub.

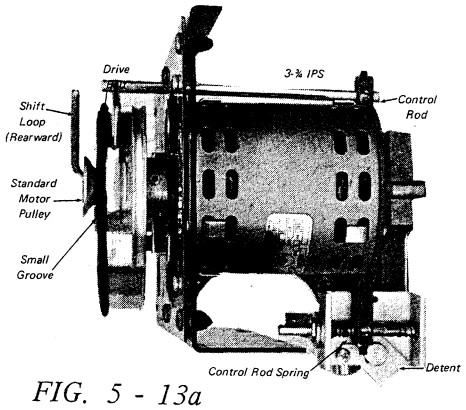


FIG. 5 - 13a
SPEED SHIFT OPERATION

Shifting to the Fast Speed: (See Fig. 5-13b)

1. The speed shift knob is pulled all the way forward.
2. This will cause the shift loop to move to its extreme forward position. This will force the belt forward slightly—just far enough for it to catch on the two flats between the 3-¾ ips and the 7-½ groove.
3. As the motor continues to turn, the belt will be lifted by the flat and then ride into the 7-½ ips groove.
4. At the same time, the detent will snap into its forward position (illustrated).
5. When the speed shift knob is released, the control rod will be pulled back by a control rod spring, until it is stopped by the detent. This will allow the shift loop to move away from the belt slightly so that it will not rub.

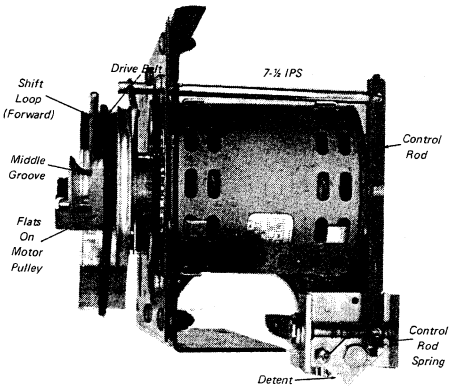


FIG. 5 - 13b
SPEED SHIFT OPERATION

Similar operation of the special 15 - 7½ ips shift may be noted, although the motor pulley is larger.

For 15 IPS on CX and CI models, move the drive belt to the largest-diameter groove (with machine-power off). Make certain that the shift mechanism is in Fast-Out position.

5.8.2 Adjusting

The shift should be adjusted (See Fig. 5-13a,b) so that:

1. The speed shift loop does not strike the chassis back panel, or trap the belt against the motor pulley, when slipped to the "fast" position.
2. The speed shift loop must not rub on the belt in the operating positions.
3. The speed shift loop should be as close to the motor pulley as possible for more efficient shifting.
4. Overtravel must be such as to ensure shifting.

Speed Reducers require manual shifting of belts (see Section 3.5 and Fig. 3-3).

5.8.3 7½-15 FPSS

On machines equipped with the optional 7½-15 front panel speed shift, a special drive pulley (CPN 7866) is used. Shifting between these speeds is accomplished as described in par. 5.8.1.

On CX and CI models with 3-speed equalization, the 3¾ speed requires moving the drive belt by hand to the small-diameter groove in front of the 15 IPS groove (see Fig. 5-13C). Again, the shift must be in the Fast-Out position.

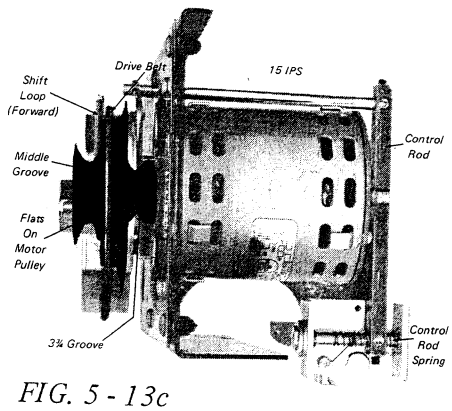


FIG. 5 - 13c
SPEED SHIFT OPERATION

5.9 TIMING

Timing is individually factory adjusted for each speed and should not need further attention for the life of the machine. However, upon changing the pressure roller, capstan, or drive motor, the timing should be checked.

One satisfactory method of checking the timing is to measure off a length of tape, preferably of several minutes duration, and use a stop watch to accurately time the rate of tape movement. In the manufacture of CROWN recorders, a tape is used which has been very accurately adjusted to speed compatible with the industry and a 60 cycle tone from the power line recorded on the tape. This tape is then played on the machine being tested and the output is compared on the oscilloscope with the actual power line frequency. If the timing is perfect, the interaction between the recorded signal and the power line signal will be very slight. The rate of interaction between the two signals or beat can be counted. If there is one beat per second, the recorder is one second off per minute or one minute per hour.

The factory method of timing adjustment is to accurately machine the motor pulley grooves until the timing is exact. If timing is slow or erratic, the trouble may be caused by a faulty motor, a loose drive belt, a highly-polished capstan, improper pressure-roller tension, or extremely-high holdback tension. If timing is too fast, it is possible the pressure-roller pressure is too low and the tape is being pulled by the take-up reel instead of the capstan. If is suggested that, if poor timing is not due to these causes, the recorder be returned to the factory for complete retiming.

5.10 FACTORY SERVICE

5.10.1 Parts

Many of the parts are standard items stocked by most supply houses. However, there are several which appear to be standard parts but are actually different. Although standard parts may be used in an emergency, best results will be with factory parts. Some of the parts are available only from CROWN.

When ordering parts, be sure to give both the model number and serial number (stamped on the back chassis near the flywheel) in addition to the part number. Rated firms will be billed, otherwise shipments will be C.O.D.

5.10.2 Factory Repair

For major repairs, such as head replacement, repairs which might involve timing, or any other repairs requiring special equipment, it is suggested that the recorder be returned to the factory. An efficient service department is maintained at the factory. Address all requests for this service to the service manager, giving full details. He will promptly advise you concerning the necessary steps to take.

Under no circumstances should a recorder be returned to the factory for service without first obtaining the consent of the service manager. The factory reserve the right to refuse shipments which are not authorized by us. All authorized shipments must be sent to us by Railway Express or truck freight, prepaid and insured at total value. The factory will return your serviced machine by Railway Express or truck freight, collect, and will add C.O.D. charges in the event that the cost is not covered by registered warranty.

Emergency repair information may be supplied by direct contact with the service manager.
Direct Dial (219) 523-4919 (Elkhart, Indiana U.S.A.).

Section 6

TRANSPORT SCHEMATICS and PARTS LIST

PRO-700 PARTS LIST U-Series

CKT. NO.	CROWN NO.	DESCRIPTION	NOTES
BULBS			
I1, I2	2611	Incandescent No. 304	
CAPACITORS			
C1	2460	2.75 mfd 330VAC Oil	
C2	2573	1000 mfd 60V Elec.	
C3, C5	2523	4 mfd 370VAC Oil	
C4	2529	2X.5 mfd 600V Oil	
CONNECTORS			
J1P	2143	Amp 480085-1	Connector Pins
J1C	2144	Amp 480086-1	Are Crown No. 2444
J2	2432		
J3P	2148	Amp 480083-1	
J3C	2149	Amp 480084-1	
J4	1747		
J5P, J6P, J7P	2051	Amp 480134-1	
J5C, J6C, J7C	2052	Amp 480135-1	
J8P, J9P	2150	Amp 480087-1	
J8C, J9C	2151	Amp 480088-1	
FUSES			
F1	1748	3AMP 3AG	
MOTORS			
B1	2420	Drive Motor	
B2, B3	2478A	Reel Motor	
RECTIFIERS			
CR1, CR2	2941	1N5402	
CR3	2851	1N4003	
RESISTORS			
R1	2507	75 Ohm 30W OR-30	
R2	2759	25 Ohm 30W OR-31	
R3	2713	30 Ohm 10W HLM-10	
R4	2787	250 Ohm 15W SER-15	
R5	2397	50 Ohm 15W SER-15	
SOLENOID			
K1	2748	Main Solenoid	
SWITCHES			
SW-1, SW-3	2749	SPDT Slide	Used As SPST
SW2, 4, 5, 7, 8	40082	Control Switch Ass'y	
SW4	2778	Memory	Mounted on 40082
SW6	2399	Solenoid Stack Switch	
SW9	2521	Auto. Stop Micro Switch	
TRANSFORMER			
T1	2746	Power	

NOTE: When ordering parts always include SERIAL and MODEL NUMBER of the Machine.

MECHANICAL PARTS	CROWN NO.	NOTES
Power-Reel Switch Ass'y	40081	
Push Button Control Switch Ass'y	40082	
Power Transformer Ass'y	40212	
Drive Motor Ass'y	40078	
Drive Motor Fan	2652	
Drive Motor Mount Screw	2280	
Drive Motor Depressed Washer	1295	
Drive Motor Grommet	1605	
Drive Motor Pulley	7766	Oversize
Drive Belt	6720	
Speed Reducer Ass'y 1 7/8 IPS	40107	
Speed Reducer Pulley	6114	
Speed Reducer Ass'y 1 7/8-15/16 IPS	40108	
Speed Reducer Pulley	7059	
Speed Reducer Belt	6724	
Reel Motor Ass'y	40054	
Reel Flange Ass'y	47288	
Reel Flange Pin	1667	
Reel Flange Cover	2571	
Solenoid Ass'y-wired	40088	Includes Switch, Resistor, and Lamps
Solenoid-Plunger Ass'y	40086	
Spring-Capsule Ass'y	47248	
Solenoid Adjust Screw	2385	
Electronic Chassis Ass'y	40095	Wired With Harness
Chassis Only	7671	
Capstan-Flywheel Ass'y	16136	
Capstan Housing Ass'y	40043	
Capstan Bearing	1722	
Rocker Arm Adjust Screw	P6188	
Flywheel Guard Ass'y	47335	
Speed Shift Ass'y	40046	Does Not Include No. 1583, P7530, 1828, and 7689
Speed Shift Knob	1583	
Speed Shift Loop	P7530	
Speed Shift Rod	7689	
Speed Shift Loop Adjust Screw	1828	
Tape Lifter Ass'y	40074	
Pressure Brush	47278	
Rocker Arm Lifter Rod Ass'y	47282	
Pressure Bar Ass'y	47280	
Pressure Roller	6255	
Pressure Roller Cap	6196	
Pressure Roller Shaft	6254	
Pressure Roller Plastic Washer	6252	
Pressure Roller Screw	2269	
Head Cover Ass'y	47377	
Pressure Bar Cover Ass'y	40101	
Cover Retainer Clip	P6818A	
Black Toggle Cap	2346	
Rear Center Chassis	40050	
Speed Reducer Panel	40072	
Transport Top	7510	
Center Chassis Brace	7698	
Transport Bottom	7672	
Capacitor Corner Chassis	7512	Left From Rear
End Cover	7515	Right From Rear
Front Panel	7718	

Reel Knob	7001	
Push Button (Forward-Reverse)	2108	
Push Button (Stop)	2106	
Push Button (Play)	2107	
Torque Rod Bearing	6951	
AC 2-Wire Cord	1387	
AC 3-Wire Cord	2321	
8 X 3/8 Slotted Hex Chassis Screw	2708	
10-32 X 5/8 Oval Head Panel Screw	2120	
Nylon Panel Washer	2119	

HEAD ASSEMBLY HARDWARE

Base Plate Ass'y (includes guides & goal posts)	47312	
Tape Guide	6695	
Triangular Headmount Plate	6706	For RECORD, PLAY and F-T, 2T. ERASE HEADS.
Erase Head Bracket (¼ T.stereo and half track mono)	7854	
Erase Head Bracket (4 channel)	7853	
Neoprene Blocks	1818	
Flat Head Socket Screw (use for 6706)	1887	
Head Mount Clip	2175	
Heavy Spacer Washer	1349	
Thin Spacer Washer	1297	
No. 6 Star Washer	1823	
6-32 Hex Nut	1889	

REPLACEMENT HEADS

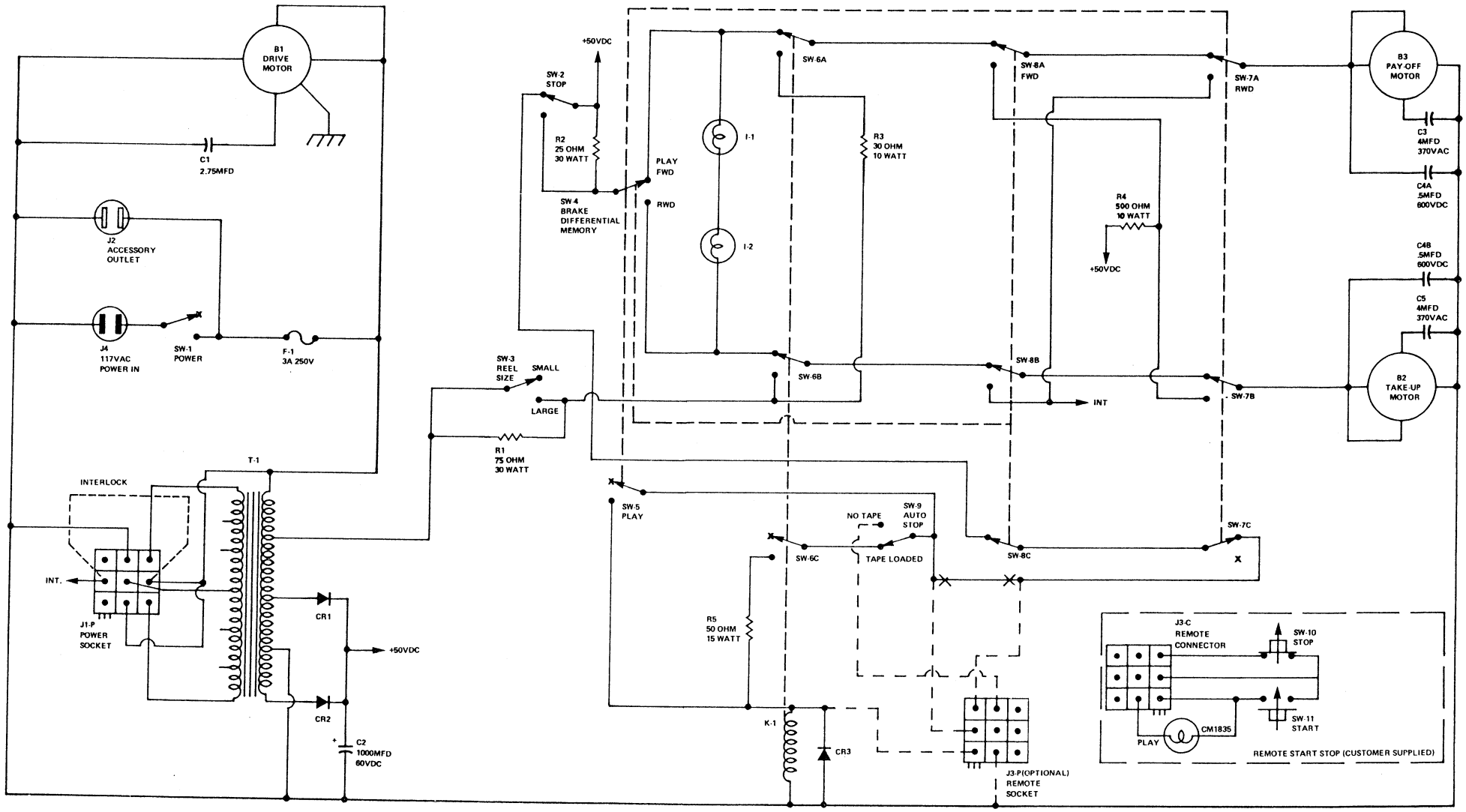
Model SX711, CX711		
Play Head	2266	Also used on SP711
Record Head	2267	
Erase Head	3059	
Model SX712, CX712		
Play Head	2418	Also used on SP712
Record Head	2485	
Erase Head	3167	
Model SX722, CX722		
Play Head	2901	Also used on SP722
Record Head	2173	
Erase Head	3058	
Model SX724, CX724		
Play Head	2171	Also used on SP724
Record Head	2172	
Erase Head	3166	
Model CX744, CI744		
Play Head	2501	Also used on SP744
Record Head	1205	
Erase Head	3166 (2)	
Model SX724-P2, CX724-P2		
Play Head	2171	Quarter-track stereo
Play Head	2901	Half-track stereo
Record-Erase Head	1197	
Model SX722-P4, CX722-P4, SP722-P4		
Play Head	2171	Quarter-track stereo
Play Head	2901	Half-track stereo
Record-Erase Head	2494	Not used on SP722-P4
Model SX724-P4 chan.		
Play Head	3088	
Record Head	2172	
Erase Head	3166	

HEAD LEAD ASSEMBLIES

		CROWN Part No.
SX722 & SX724	Stereo playhead lead assemblies	40112
SX722	Stereo erase-record head lead assembly	40113
SX724	Stereo erase-record head lead assembly	40114
CX711 & CX712	Mono playhead lead assembly	40115
CX711 & CX712	Mono–erase-record head lead assembly	40116
SX711 & SX712	Mono–playhead lead assembly	40117
SX711 & SX712	Mono–erase-record head lead assembly	40118
CX724	Stereo erase-record head lead assembly	40119
CX722	Stereo erase-record head lead assembly	40120
CX722 & CX724	Stereo play head lead assembly	40121
CX744	4 Channel Stereo erase-record head lead Ass'y	40122
CX744	4 Channel Stereo playhead lead assembly	40123
SP744	4 Channel Stereo playhead lead assembly	40124

HEAD ASSEMBLIES (Includes all Cables, Guides, Etc.)

SX711	Head Assembly	40125
SX712	Head Assembly	40126
SX722	Head Assembly	40127
SX722-P4	Head Assembly	40128
SX724	Head Assembly	40129
SX724-P2	Head Assembly	40130
CX711	Head Assembly	40131
CX712	Head Assembly	40132
CX722	Head Assembly	40133
CX722-P4	Head Assembly	40134
CX724	Head Assembly	40135
CX724-P2	Head Assembly	40136
CX744 & CI744	Head Assembly	40137
SP711	Head Assembly	40138
SP712	Head Assembly	40139
SP722	Head Assembly	40140
SP722-P4	Head Assembly	40141
SP724	Head Assembly	40142
SP724-P2	Head Assembly	40143
SP744	Head Assembly	40144



NOTE:
1. SW-5, SW-7 and SW-8 mechanically connected to SW-4.
2. SW-7 and SW-8 mechanically interlocked.
3. SW-2 releases either SW-7 or SW-8.
4. All switches shown is relaxed (standby) position.
5. R1 was 50 ohm; R4 was 250 ohm, 15 w.

MI-227D

Fig. 6-1

PRO-700 MAGNETIC TAPE TRANSPORT U,V SERIES SCHEMATIC

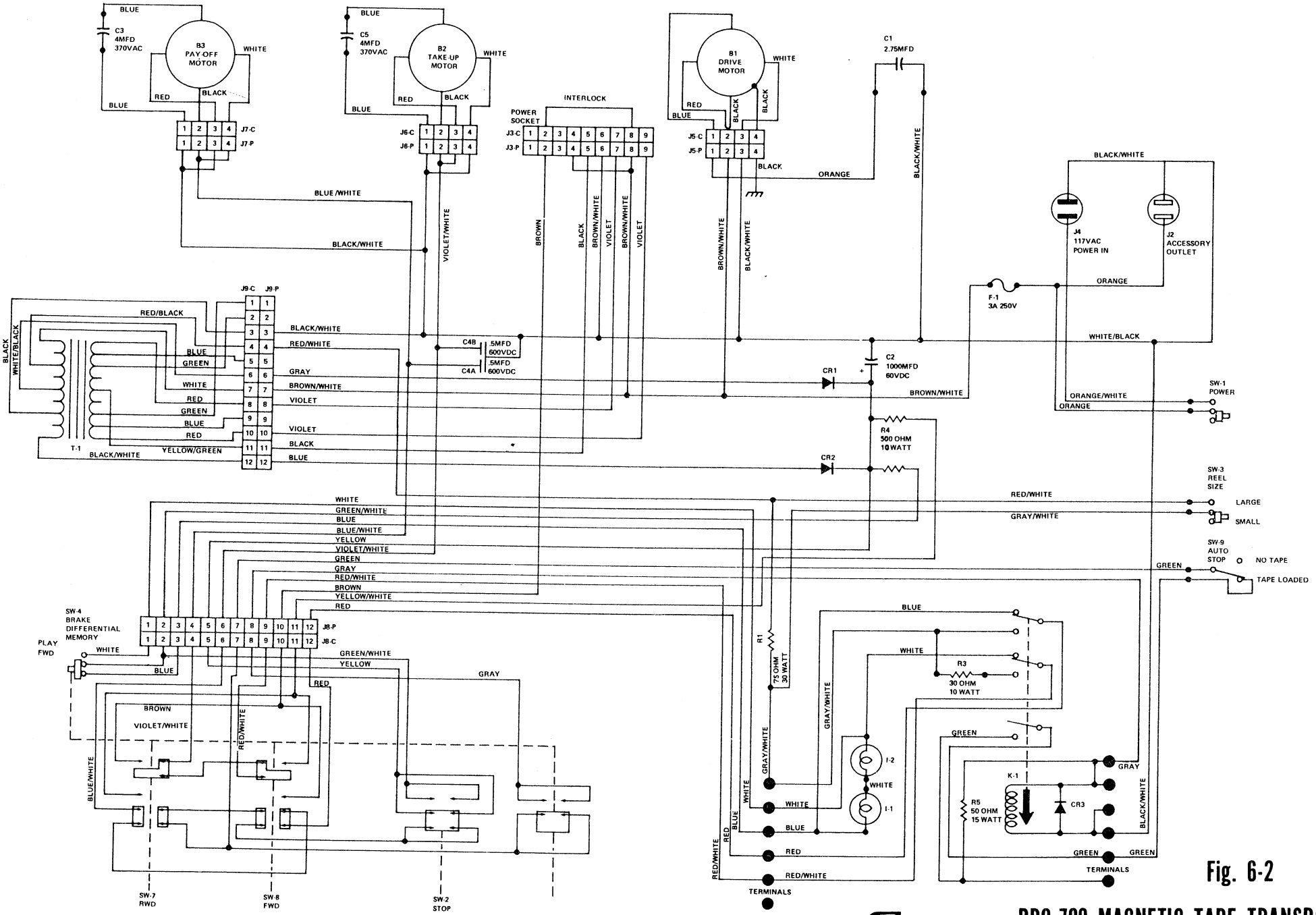
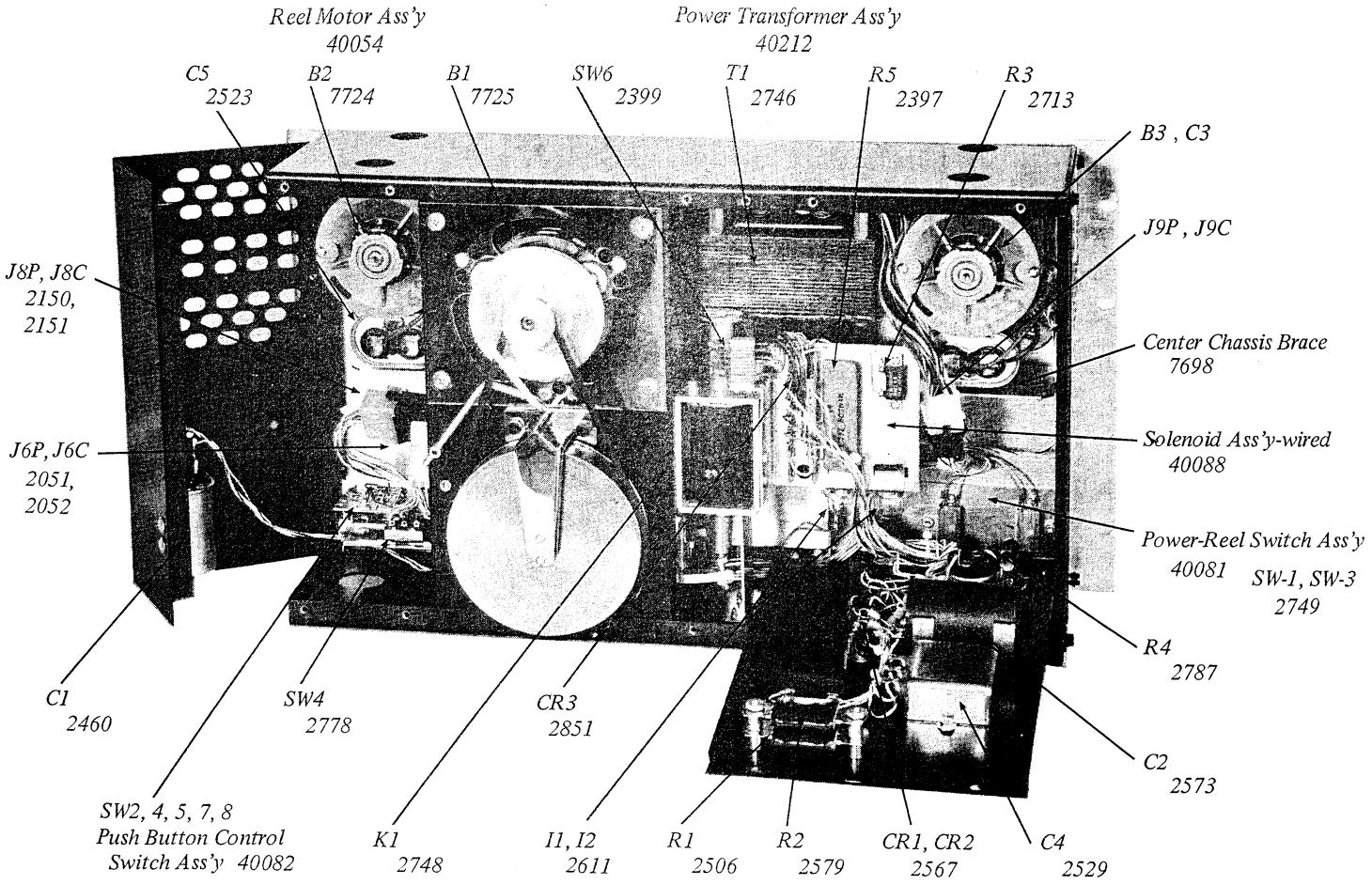
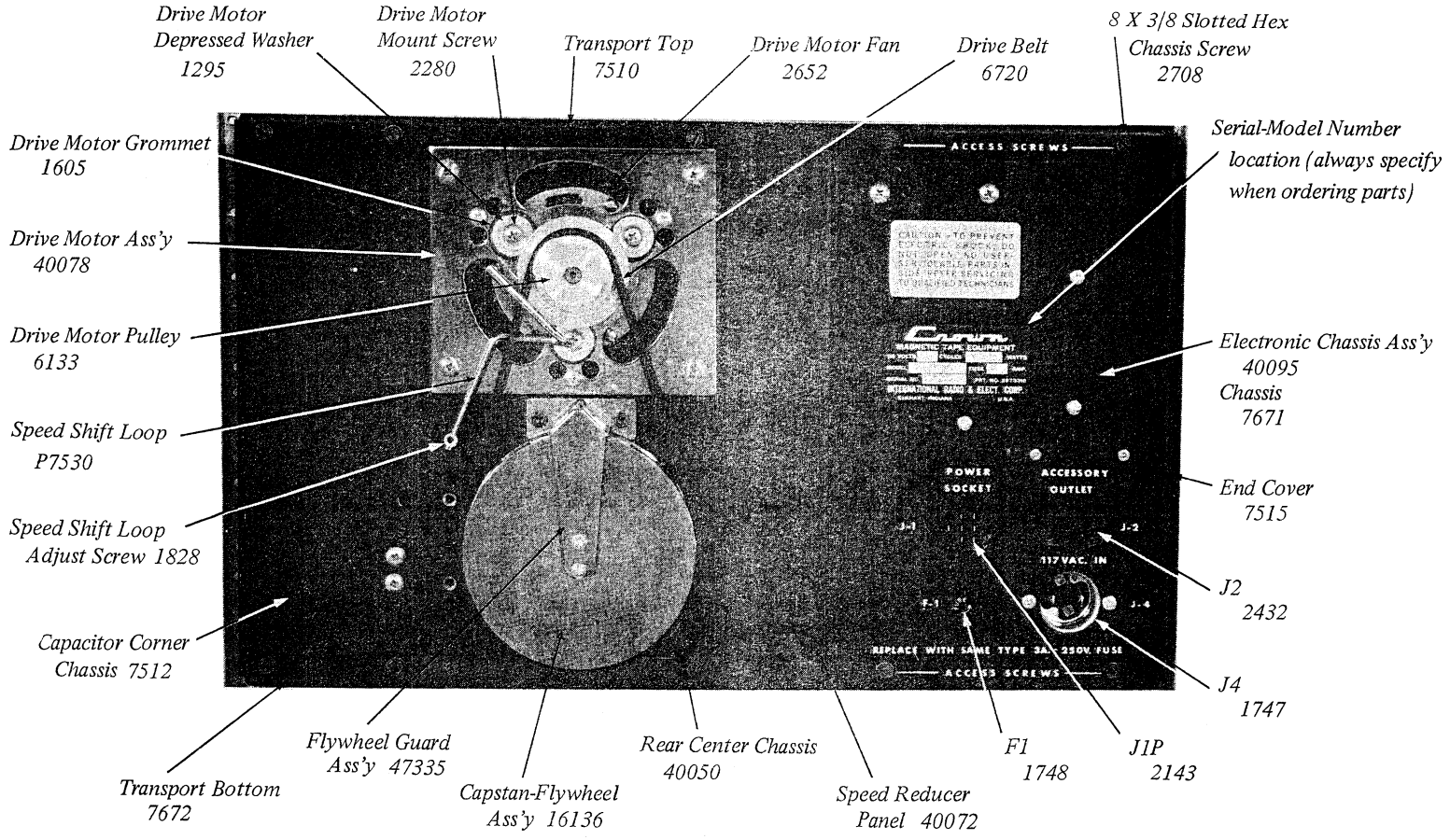


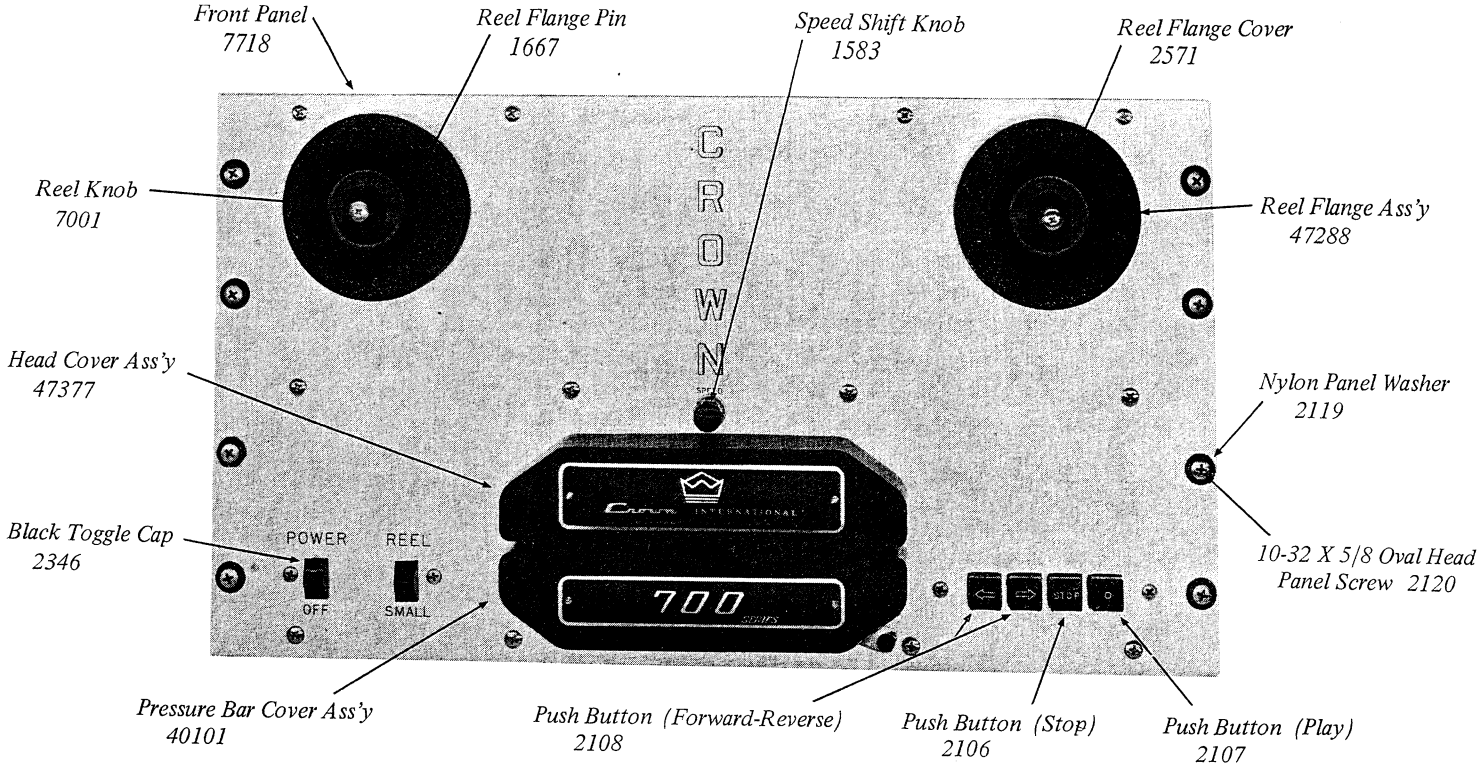
Fig. 6-2

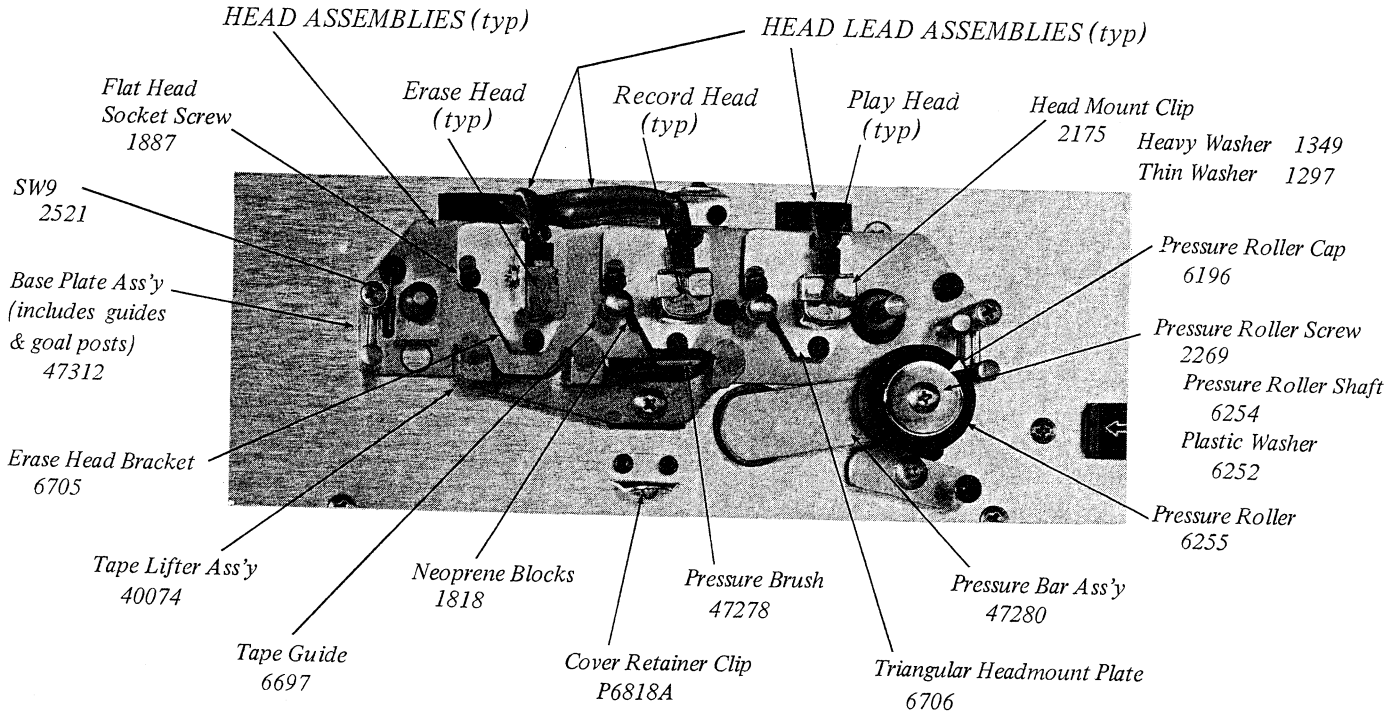
Crown PRO-700 MAGNETIC TAPE TRANSPORT

MI-231A U,V SERIES SCHEMATIC WITH INTERCONNECTIONS


Reel Motor Ass'y 40054
Power Transformer Ass'y 40212
C5 2523
B2 7724
B1 7725
SW6 2399
T1 2746
R5 2397
R3 2713
B3 , C3
J9P , J9C
J8P, J8C 2150, 2151
Center Chassis Brace 7698
J6P, J6C 2051, 2052
Solenoid Ass'y-wired 40088
Power-Reel Switch Ass'y 40081
SW-1, SW-3 2749
R4 2787
C1 2460
SW4 2778
CR3 2851
C2 2573
SW2, 4, 5, 7, 8 Push Button Control Switch Ass'y 40082
K1 2748
I1, I2 2611
R1 2506
R2 2579
CR1, CR2 2567
C4 2529


Drive Motor Depressed Washer 1295
Drive Motor Mount Screw 2280
Transport Top 7510
Drive Motor Fan 2652
Drive Belt 6720
8 X 3/8 Slotted Hex Chassis Screw 2708
Drive Motor Grommet 1605
Serial-Model Number location (always specify when ordering parts)
Drive Motor Ass'y 40078
Drive Motor Pulley 6133
Electronic Chassis Ass'y 40095
Chassis 7671
Speed Shift Loop P7530
End Cover 7515
Speed Shift Loop Adjust Screw 1828
J2 2432
Capacitor Corner Chassis 7512
J4 1747
Transport Bottom 7672
Flywheel Guard Ass'y 47335
Capstan-Flywheel Ass'y 16136
Rear Center Chassis 40050
Speed Reducer Panel 40072
F1 1748
J1P 2143
ACCESS SCREWS
POWER SOCKET
ACCESSORY OUTLET
117 VAC. IN

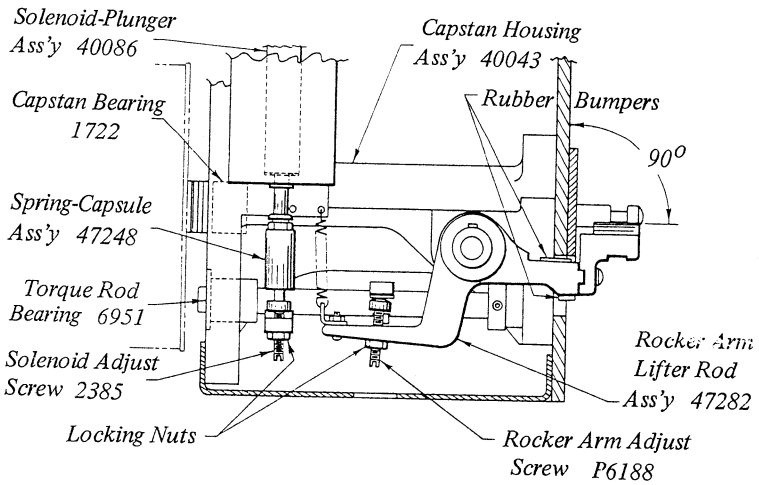




Machine Mode		Typical Voltages		
		TU Motor (B2)	PO Motor (B3)	Sol. (K1)
RWD Brakes	Hi	52VDC	13VDC	0
	Lo	31VDC	9VDC	0
FWD Brake	Hi	13VDC	52VDC	0
	Lo	9VDC	31VDC	0
Play	During Command	LG SM 80VAC 58VAC	LG SM 72VAC 52VAC	54VDC
	After Command	80VAC 58VAC	72VAC 52VAC	36VDC
RWD		10VDC	117VAC	0
Fast FWD		117VAC	10VDC	0

Test Conditions: Line Voltage = 117VAC
Reels Unloaded and Free.
Auto Stop switch SW-9 held down.
Meter = 20,000 Ω /volt VOM.

VOLTAGE CHART



SX ELECTRONICS

ILLUSTRATIONS

7.1 DESCRIPTION AND SPECIFICATIONS

7.1.1 General Characteristics

The SX electronics is a dual Solid State record/reproduce amplifier. Its purpose is to accept and condition input signals to properly drive magnetic tape recording heads and to provide tape reproduce facilities with proper equalization.

The SX record/reproduce amplifier uses all silicon planar transistors and the highest quality construction throughout, (see fig. 7-4).

7.1.2 General Specifications (See also Section 7-4)

Audio Inputs	Two per channel. Either input will accommodate high impedance mic or line level.
Preamplifier Response	Flat from 10Hz to over 50KHz exclusive of required equalization.
Audio Output	Low impedance high level output, +4 dbm; 2.45 into HI-Z with "0" level on VU
Metering	Two 5" lighted VU's read input-output signals or bias.
Power Supplies	Electronically regulated positive and negative supplies.
Bias Frequency	100KHz ± 5%.
Power Source	66 VCT. This supply is normally derived from the associated transport.
Power Drain	Approximately 10 watts.

7.1.3 Input — Output Specifications

Inputs	Notes	Input 2	*Recommended Input Levels Min. db	Max. db
Line	1, 2, 3	100k	-24	+25
Mic	4, 5	350k	-64 or -44	-26 or -6

Outputs	Notes	Maximum Output Z	Minimum Load Z	Output Level
Line Out	6	600 ohms	note 6	+10db to Hi-Z +4dbm
Front Panel Monitor Jack	6, 7	600 ohms	note 6	+10db to Hi-Z +4dbm

*Odb is same voltage as 1mw into 600 (Odbm)

NOTES:

1. Maximum input level limited only because gain setting becomes difficult at extremely high levels due to the very small amount of rotation required. If levels over +25dB are encountered, an external divider is recommended.

2. Plugging into Line disconnects Mic input.

3. Input Z becomes 50K at maximum CW position of input control.

4. In general, low quality microphones such as most crystal, ceramic and low cost dynamic units are not recommended for professional sound recording. For professional results use a professional microphone.

5. Mic gain may be semipermanently altered by means of jumpers on the main boards (see fig. 7-1). Removal of the jumpers lowers the gain by 20dB and increases the maximum input level. If overload is a problem remove the jumpers.

6. The output may be shorted, however, it is not recommended practice to simultaneously short both outputs Line and Monitor jacks as this doubles the loading on the output amplifier.

7. High or Low Z headphones may be used.

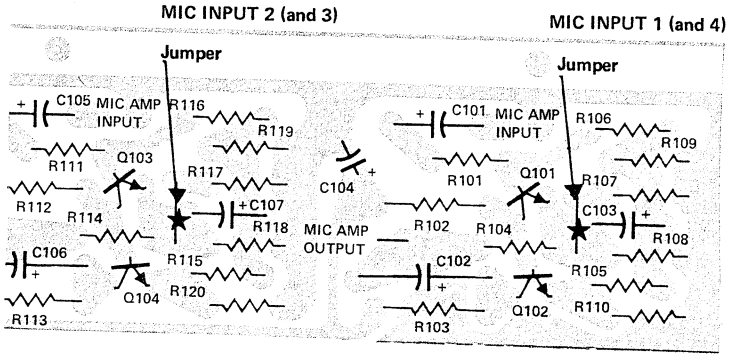


FIG. 7-1 MIC STAGE JUMPERS

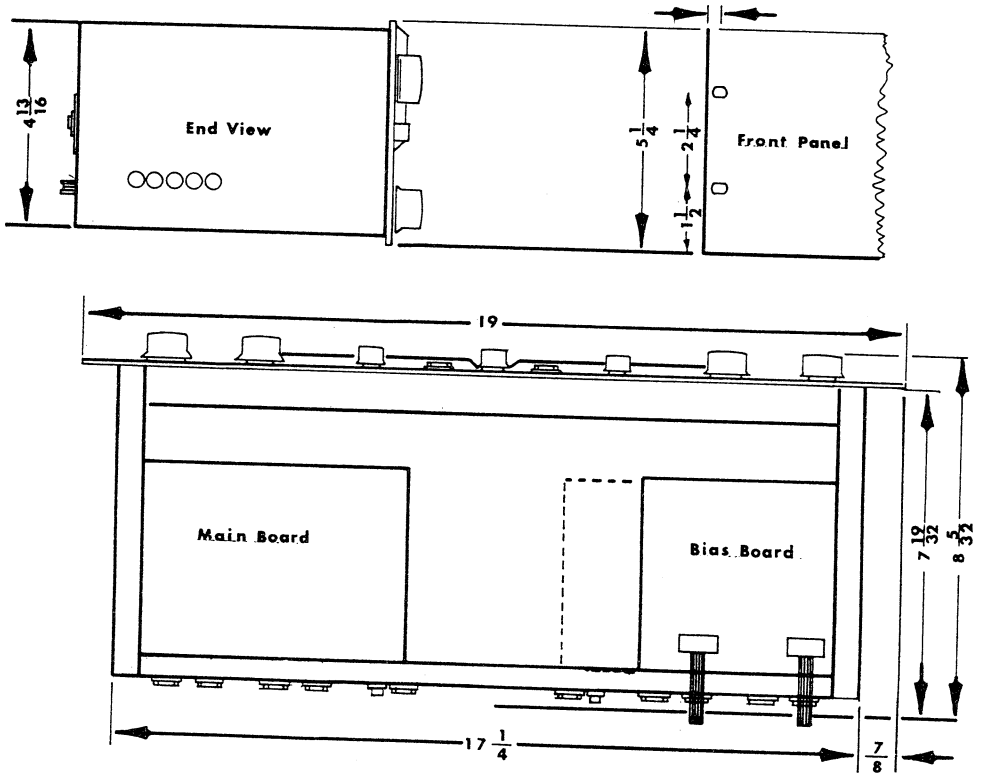


FIG. 7-2 MOUNTING

7.1.4 Mechanical Specifications

Record Interlock	Interlocked mechanically, electrically and visually.
Circuit Boards	Translucent glass epoxy.
Chassis	Anodized aluminum.
Front Panel	1/8" anodized aluminum with silk-screened markings.
Weight	7 Lbs.
Dimensions	5-1/4'' H x 19'' W x 7-19/32'' D behind panel (see fig. 7-2).

7.2 INSTALLATION

7.2.1 Mounting

The SX electronics is designed on a 19'' rack mounting format, however it may be placed in custom mountings. Very little ventilation is needed for the electronics, however access should be allowed for input and output cables. (Refer to fig. 7-2 and section 2.2).

7.2.2 Connecting Cables

Each reproduce head has a numbered cable which terminates in a pin plug. Under the electronics covers on the main circuit boards are located the input connectors. The channel number corresponds to the head cable number. (See fig. 7-3).

The record/erase head cables terminate in 4-way Amplock connectors. The connectors on the sub front, under the covers, near the Record Switch. Once again each cable is numbered as to the channel to which it belongs. (See fig. 7-3).

The power cable plugs into the 9-way Amplock connector on the back of the transport chassis.

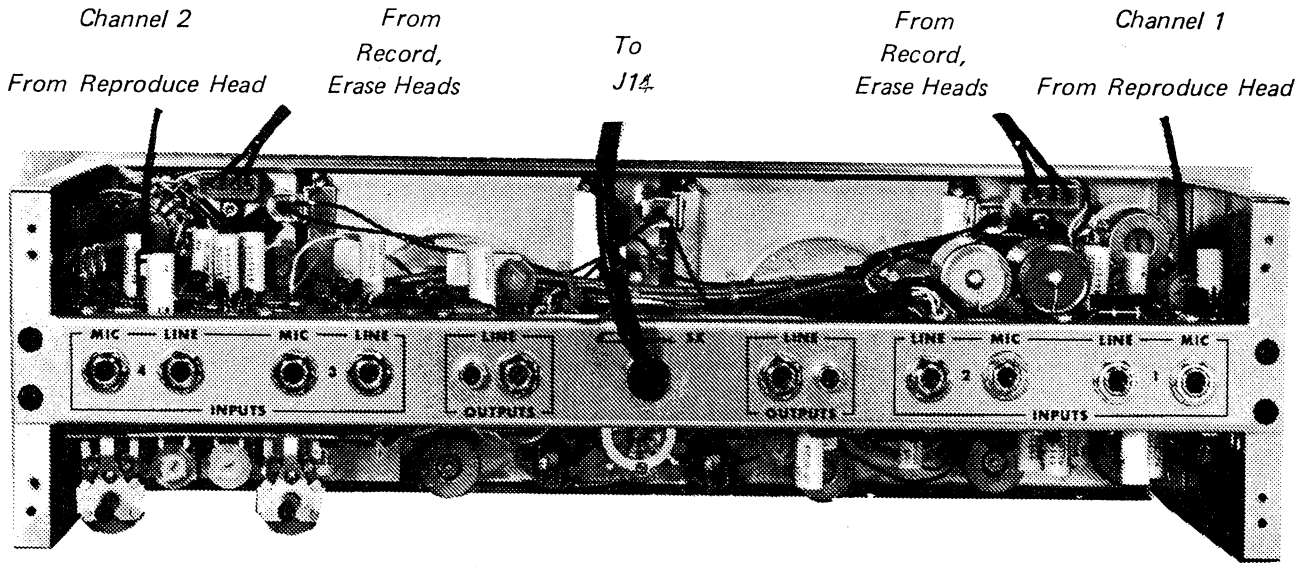


FIG. 7-3 SX BACK

7.2.3 Connecting Inputs

The controls on the SX electronics are symetrical on each side of the center line. Controls on the left, control the left channel (channel 1) while controls on the right control the right channel (channel 2). The only exception is the equalization control which is common to both channels. The following instructions apply to one channel only. It should be understood that inputs, outputs, and controls for the other channel are identical. (See fig. 7-3 and 7-4).

Input #1

Either a high-impedance unbalanced microphone or a high-level, line-type signal may be plugged into Input #1. When a plug is plugged into the line input for Input #1, it will automatically disconnect Mic 1 input.

Input #2

The inputs for #2 are identical to those for Input #1.

Note: Low impedance balanced microphones may be used by employing the matching input transformer available as an accessory. (See Section 8).

7.2.4 Connecting Outputs

Two jacks are provided for the Line Output of each channel of the SX electronics. One jack is the standard ¼" phone type and the other is the RCA pin jack type. (See specifications section 7.1.3 for output levels and impedance).

7.3 OPERATING INSTRUCTIONS (See Fig. 7-4)

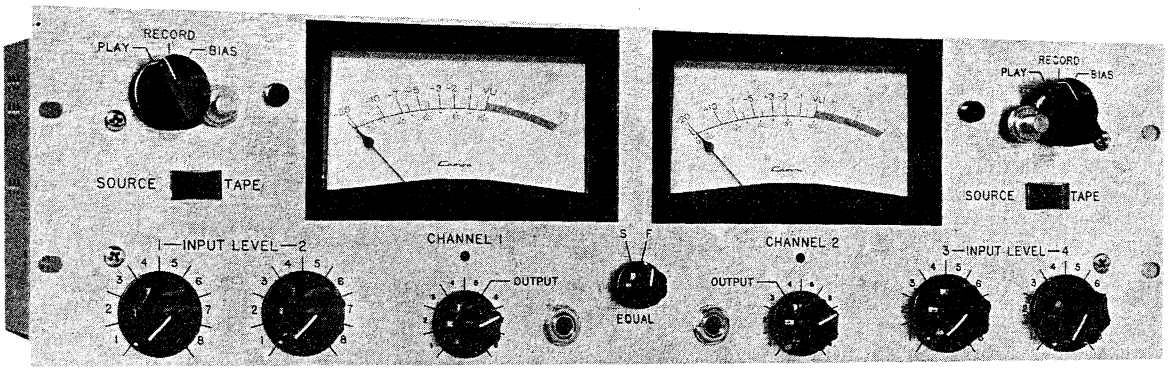


FIG. 7-4 SX FRONT

7.3.1 Setting the Controls for Recording

Source-Tape	Place the switch in the Source position.
Input #1 and Input #2	Adjust Inputs #1 and #2 for the proper recording level as indicated on the meter. With proper setting, the meter will read "O" VU and go into the red only occassionally on the very loudest peaks.
Monitor Jack	If you desire to monitor the signal to be recorded, headphones may be plugged into one of the front panel phone jacks. The tip on the jacks are connected to Channel 2 and the ring to Channel 1.
Output Level	This control should be set for convenient listening level and/or proper output to auxilliary equipment.
Equalization	This switch should be set according to the speed being used "S" refers to the slower of the two recording speeds and "F" to the faster.
Record Switch	Depress the record lockbutton and rotate the record switch all the way to the bias position.

The bias is adjustable on the rear of the machine. Two small knurled shafts at the left of the machine (when viewed from the back) allow approximately +3, -5dB of bias adjustment range. Bias should be adjusted to the settings recommended for the tape and speed being used. A general rule to use is to adjust for the highest possible setting that does not noticeably attenuate the highest frequency. This will normally result in the least amount of distortion and the widest dynamic range. Critical adjustment may be made for flatest response if proper test equipment is available. After setting the bias, the record switch should be rotated to the Record position. This allows the incoming signal to be monitored. Note that recording will still take place with the switch in the "Bias" position. The only difference being in the signal fed to the meter.

Normally, with a machine equalized for 7-½ and 3-¾ ips, the BIAS setting is "O" for 7-½ ips and "-2" for 3-¾ ips. (See P. P. sheets).

To begin recording momentarily press the Play button on the transport.

To check the recording process (A-B Test), the Source-Tape switch may be switched from Source to Tape. When this switch is in the Tape position, the actual recording will be reproduced (delayed slightly due to the spacing between record and play heads). Normally no noticeable change in volume or quality should occur when switched from the Source to Tape position except at very low tape speeds. Note that the Output Level control has no effect on the meter reading or the recording level in either of the switch positions. Its only effect will be to adjust the level at the monitor and output jacks.

7.3.2 Setting the Controls for Reproducing

Equalization	Set according to the speed being used.
Record Switch	Place in the "Play" position. Be sure that both record switches are in the Play position to prevent possible damage to a valuable recording. Note: It will be impossible to engage the fast forward or rewind if either channel is in the record mode.
Source-Tape Switch	Place the switch in the "Tape" position. The meter will monitor the level of the tape. To start the tape in motion, press the "Play" button on the transport.
Output Level	Adjust the volume to desired level at the headphones or to the auxiliary equipment.

7.5 CIRCUIT DESCRIPTION

7.5.1 General

The circuitry of the SX electronics is most easily described if it is broken up into functional units. These functional units are indicated on the block diagram in Fig. 7-5. The schematics and parts list are placed in section 12.

Many of the units are contained on a common board referred to as the main electronics board. The main board consists of two mic amps, the buffer amp, the output amp, the record amp, the meter amp and the playback amp. The bias oscillator is on a board by itself and the power supply is on a board by itself.

7.5.2 Mic Stages

Mic input stages consist of a direct coupled pair of very high gain low noise epitaxial planar silicon transistors. This pair employs heavy negative feedback for linearity and control along with a bootstrapped input for high input impedance. The output impedance is very low and capable of driving to a clipping level in excess of +14dB. The outputs are fed by way of the line input jack to the top of the input level controls.

The microphone inputs stages are designed to accommodate a wide range of input levels. A dual gain feature is employed so that the operator may select the amount of gain to suit his particular needs. (See fig. 7-1 and Note 5 in section 7.1.3).

7.5.3 Buffer Amp

The buffer amp is employed to isolate and mix inputs and provide approximately 14db of gain for the line inputs. It consists of three direct coupled silicon transistors with DC feedback for gain stability and linearity. The output of this amplifier is fed to both the record amplifier and the Source-Tape switch.

7.5.4 Output Amp

The output amp employs five direct coupled silicon transistors in a high feedback circuit with complementary output transistors. The circuit provides high level, distortion free, transformerless output. This unit will drive a 600 ohm line to a level of +20dbm before clipping. Normal output is +4dbm for "O" VU. A bias trap is located in the line output to remove any bias "Bleed thru".

7.5.5 Record Amp

The record amplifier is a three-stage amplifier providing necessary gain, impedance match and pre-emphasis equalization for the recording process. High frequency pre-emphasis is provided by an RLC network in the emitter circuit of Q105. Low frequency equalization is provided by an RC network in the feedback loop from Q107 to the emitter of Q105. The record level is adjusted by means of a constant current resistor in the output of the amp. Voltage drive is provided and then converted to current drive. At no time will the amplifier be current limited within the dynamic range of any known recording tape.

7.5.6 Reproduce Amp

The reproduce amplifier consists of a proven circuit of three high gain low noise silicon planar transistors. Feedback equalization is employed around the three direct coupled stages with a degenerative gain control. Circuitry is such that the equalization gain, and distortion performance are almost entirely independent of transistor characteristics. NAB equalization is provided by the RC network in the feedback loop to the emitter of Q128. The bass responses are adjustable by means of R201 or R202. L106 and C141 provides a notch filter at the bias frequency. The output of the reproduce amp is fed directly to the Source-Tape switch.

7.5.7 Bias Oscillator

The bias oscillator consists of a pair of push-pull connected power transistors operating into a highly efficient ferrite cup core assembly. The circuit produces a very clean low distortion 100KHz signal for bias and erase. This results in the lowest possible erase noise. Bias is coupled to the heads by means of the internal bias adjust and the rear panel bias adjust and mixed with the audio signal at the output of the bias trap consisting of L103 and C115. Erase voltage is coupled to the erase head by way of C119 which is an adjustable trimmer.

7.5.8 Power Supply

A regulated power supply is employed to make the SX electronics independent of line voltage variations and to ensure stable operation in all modes. The power supply board contains all the components to rectify and control the necessary supply voltages to the rest of the circuitry. The +30 supply is adjustable by means of R182. The output of the +30 supply is highly regulated and very well filtered. The negative supply is referenced to the positive and is adjusted with it. Additional filtering and decoupling of the power supply lines are employed within the various circuits where needed.

7.5.9 Meter Amp

The meter amplifier is a direct coupled complementary pair whose gain is feedback stabilized. R163 is the meter gain adjust. The meter is in a full wave diode bridge which is overload protected by diodes CR112-114.

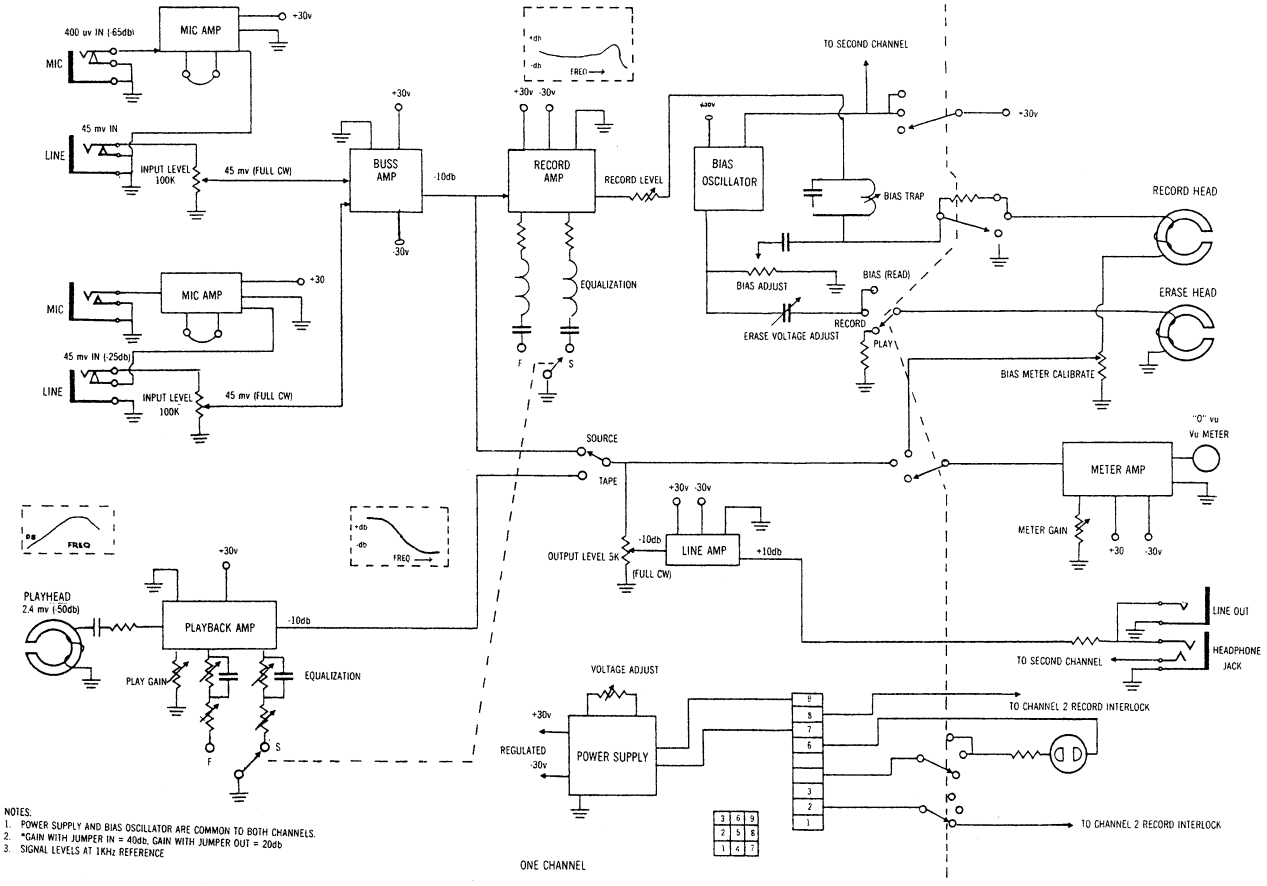


FIG. 7-5 BLOCK DIAGRAM

ACCESSORIES

ILLUSTRATIONS

8.1 Casing

There are a variety of sizes of carrying cases available for CROWN recorders ranging from 14 to 28 inches of panel space. In addition a console and an oiled-walnut enclosure are available. (See accessory sheet).

This section will give some tips for inserting the recorder into one of these cases. If you observe these tips you should be able to avoid smashed fingers and frayed nerves.

If you buy a case as an accessory it will come with side rails mounted. This makes installation relatively easy. Keep the recorder mounted on its rails in one piece, flip the case on its back, carefully lift the recorder over the case and lower it into the opening, onto the rails. Now it is a simple matter of removing the front panel screws, sliding the rails out, and fastening the unit to the new rails. One note of caution - if the case is a 19-C enclosure, extreme care must be taken when lowering the recorder into the case. The plastic covering of the sides overhangs the rails a bit and means less clearance. The plastic is soft and easily damaged. Never attempt to ship the recorder in a 19-C, it is **not** a shipping case. (See fig. 8-1).

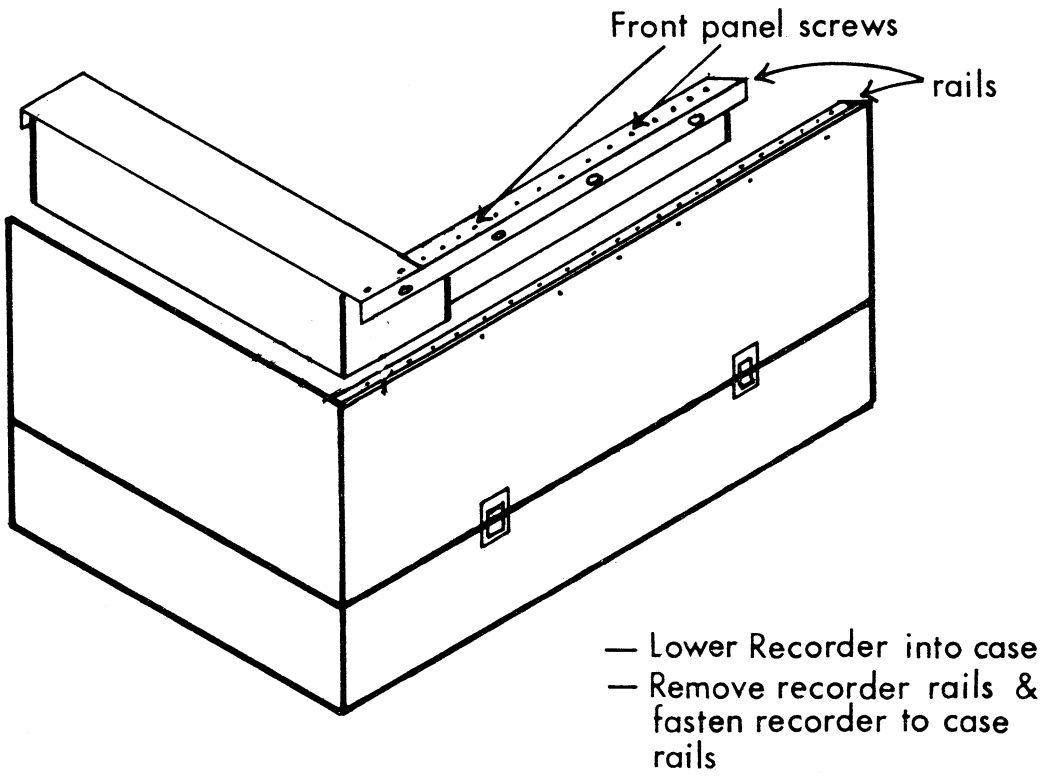


FIG. 8-1 CASING

If you purchased the recorder in a carrying case you will only have one set of rails. The casing procedure is a bit different. Always keep the recorder on the rails, (in one piece) otherwise head cables are subject to stress and liable to break. The best procedure is to place the case upright and remove the screws from the **sides** of the case. The recorder can be "walked" out of the case. Getting it back in again may be more difficult. It may be necessary to "lift" the recorder with a thin screw driver or an awl, through the side holes, to line up the case holes and the holes on the rails. This is a bit tricky and may require a "third hand." (See fig. 8-2).

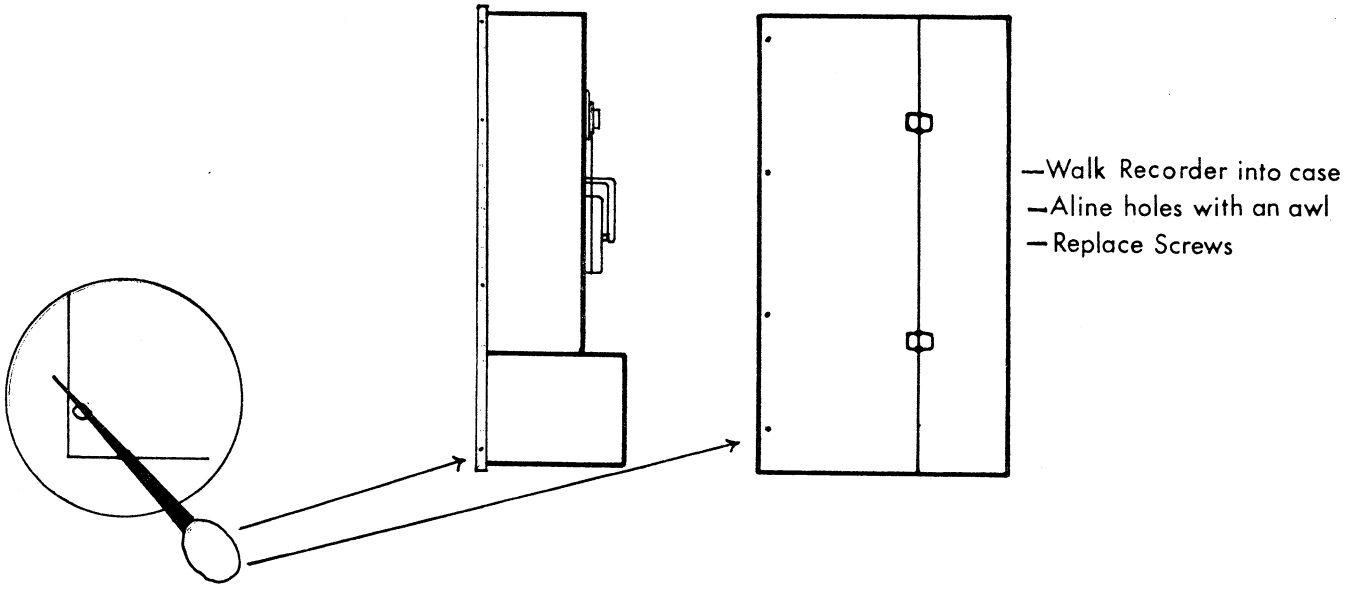


FIG. 8-2 CASING

The choice of case size depends on which accessories you wish to install with the recorder. For example you might want a tape counter and a D-60 monitor amp. This would require an additional 3-½ inches of panel space. Also, additional space may be filled with blank panels. (See accessory sheet.)

8.2 Remote Control

8.2.1 SX 800-RC-40

For the PRO 800 deck the RC-40 remote control unit is available. This operates in conjunction with the logic circuit of the 800 deck and provides all functions (except record) from a remote command point. The RC-40 is supplied with a 20' cable.

8.2.2 SX 700-RC-7A

For the PRO 700 deck the RC-7A is available as an accessory. This can be installed on the field by a competent technician, and is available from the factory. It is a minor modification of the transport which provides the stop and start commands from a remote point. The RC-7A kit available from CROWN is a complete kit of parts and instructions, for the modification of the transport only. The customer needs to provide a control box and cable.

8.3 Matching Transformers

There are three transformers available for the SX electronics which increase the versatility of the electronics. The transformers serve to match different types of program lines to the electronics.

8.3.1 SMIT

The SMIT is designed to match a Lo-z balanced line microphone (studio quality) to the unbalanced Mic inputs of the SX. It is connected right into the mic line. (See fig. 8-3).

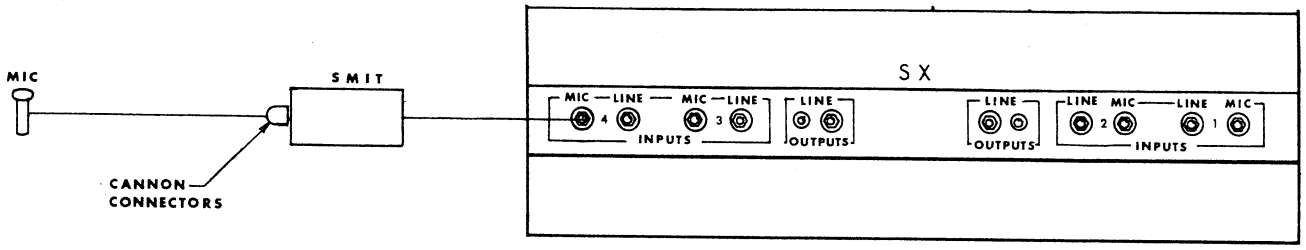


FIG. 8-3 SMIT

8.3.2 SBIT

The SBIT is designed to match a 600 ohm balanced line (relatively high level, -20db to +4db) to the unbalanced input of the SX. It can be plugged into either the MIC or LINE input depending on the level of the signal and how much gain you want from the SX. Since this is a bridging function (20,000 ohm to 600 ohm) there is some loss through the transformer. (See fig. 8-4).

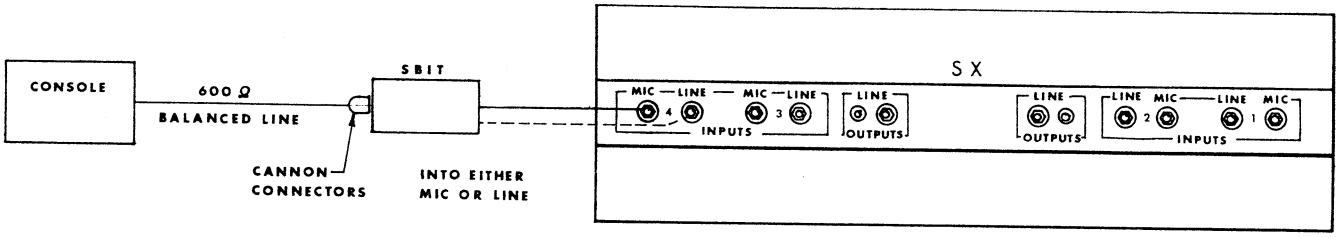


FIG. 8-4 SBIT

8.3.3 SLOT

The slot has two uses. It can be used to match the unbalanced 600 ohm output from the SX to a balanced 600 ohm line. It can also function as a loading input transformer to match a 600 ohm balanced line to the unbalanced SX input. (1: 1) See fig. 8-5.

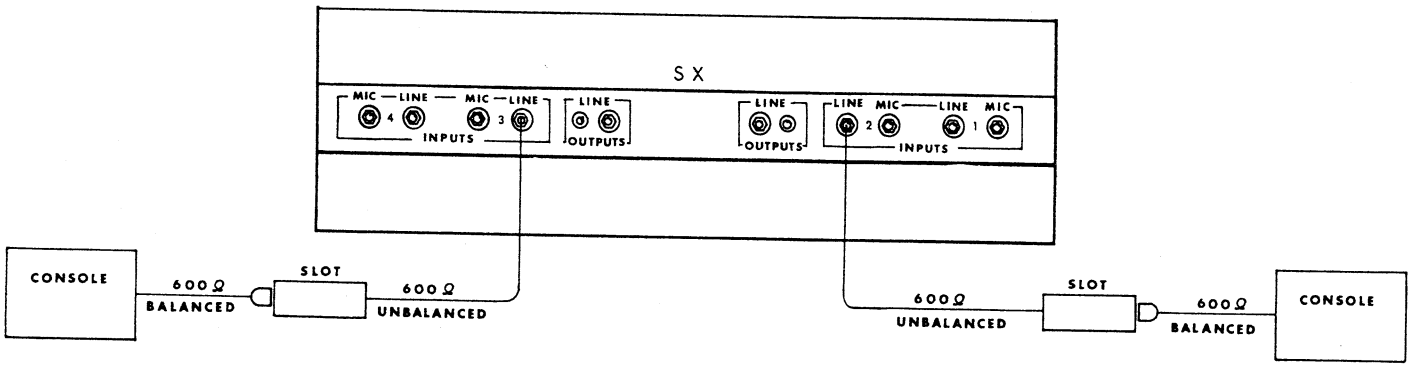


FIG. 8-5 SLOT

SPECIAL APPLICATIONS

ILLUSTRATIONS

9.1 Introduction

This section deals with the actual hook-up of the SX recorder and how to use it with external equipment. Simple block diagrams illustrate typical hook-ups with a variety of different systems. The preamp (or combination pre-amp amp, or receiver) is the heart of the hi-fi system, and exact hook-up procedures for associated equipment will depend somewhat on the specific facilities and functions of the pre-amp. The tape recorder is part of the "associated equipment", therefore our illustrations will be of the general or most frequently encountered hook-ups. (For the specific details of your system, see the manuals for the pre-amp.) We will start with the simplest functions of the SX and work up to some of the more complex functions.

9.2. SX as Tape Player

9.2.1 With Head Phones

This is the simplest function for any recorder, that of a tape player. The only additional equipment needed to play a tape on the SX is a set of head phones, which can be plugged into either front panel jack. High or low impedance phones can be used. (Electrostatic head phones cannot be used as they are very low impedance and require power amplification). See fig. 9-1.

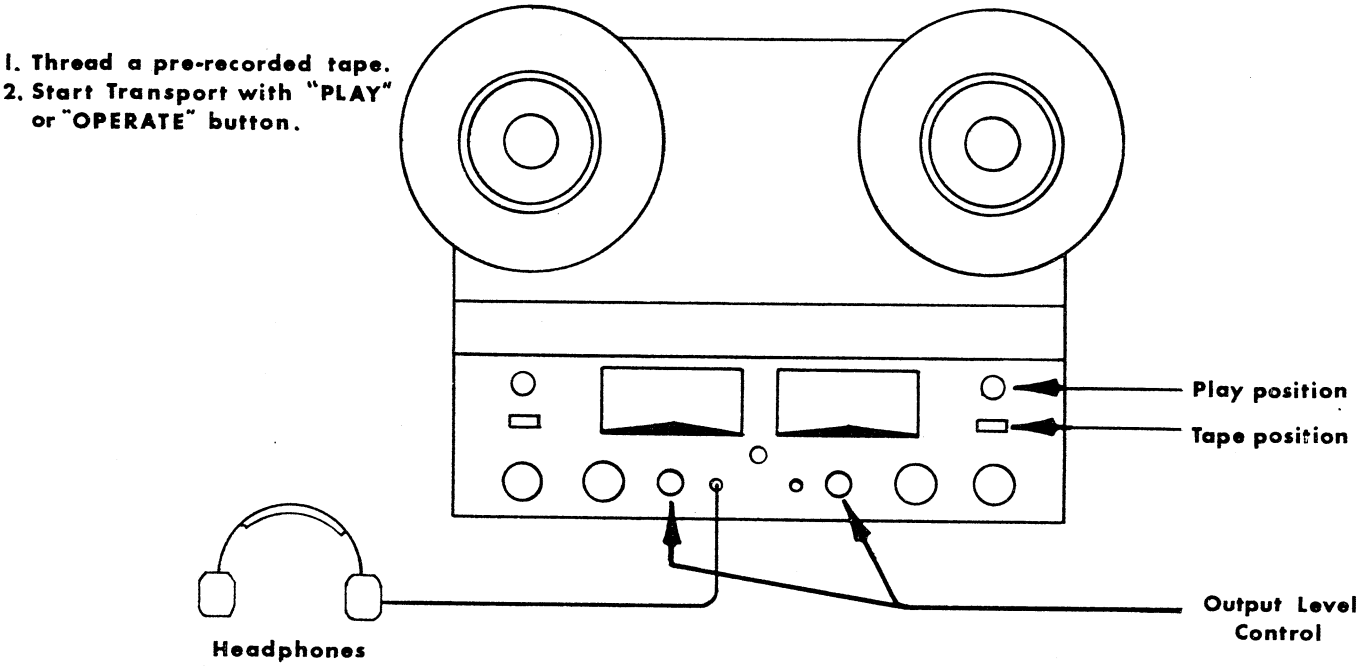


FIG. 9-1 SX WITH HEAD PHONE

9.2.2 With Amp

The next step would be to substitute a power amp and speakers for the head phones. See fig. 9-2. All adjustments remain the same.

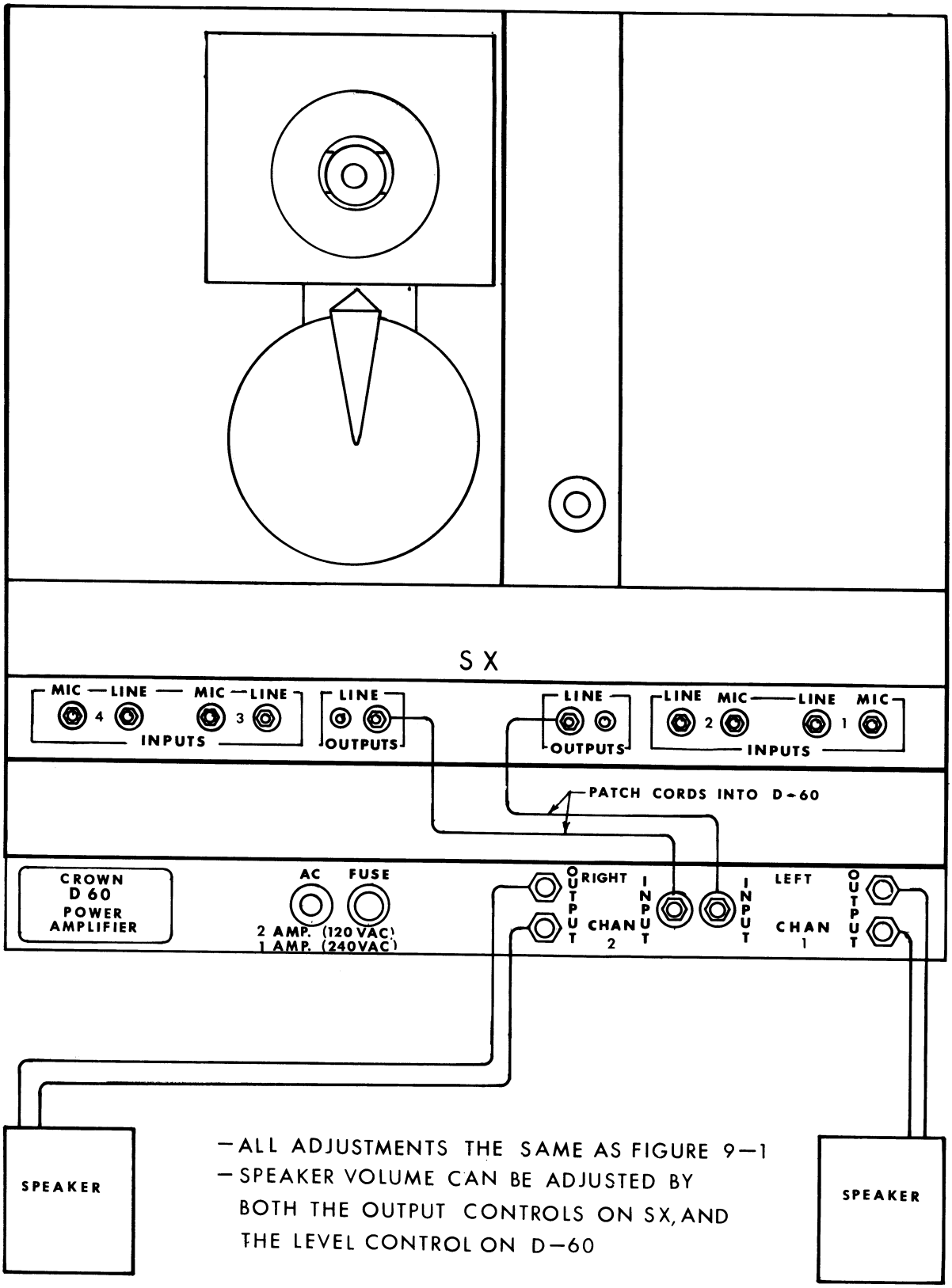


FIG. 9-2 SX WITH MONITOR AMP

9.2.3 With a Hi-Fi System

The function of the SX into a pre-amp is the same as the preceeding hook-up. There are several additional

considerations; the pre-amp now offers tone controls, loudness control, balance, filters, etc. The normal method of volume control would be to adjust the output level controls on the SX to full CW, then adjust the volume control on the pre-amp for proper listening level. If the signal from the SX is too loud in relation to signals coming from other equipment (tuners, etc.) the SX output levels may be turned CCW until the proper balance is achieved. See fig. 9-3.

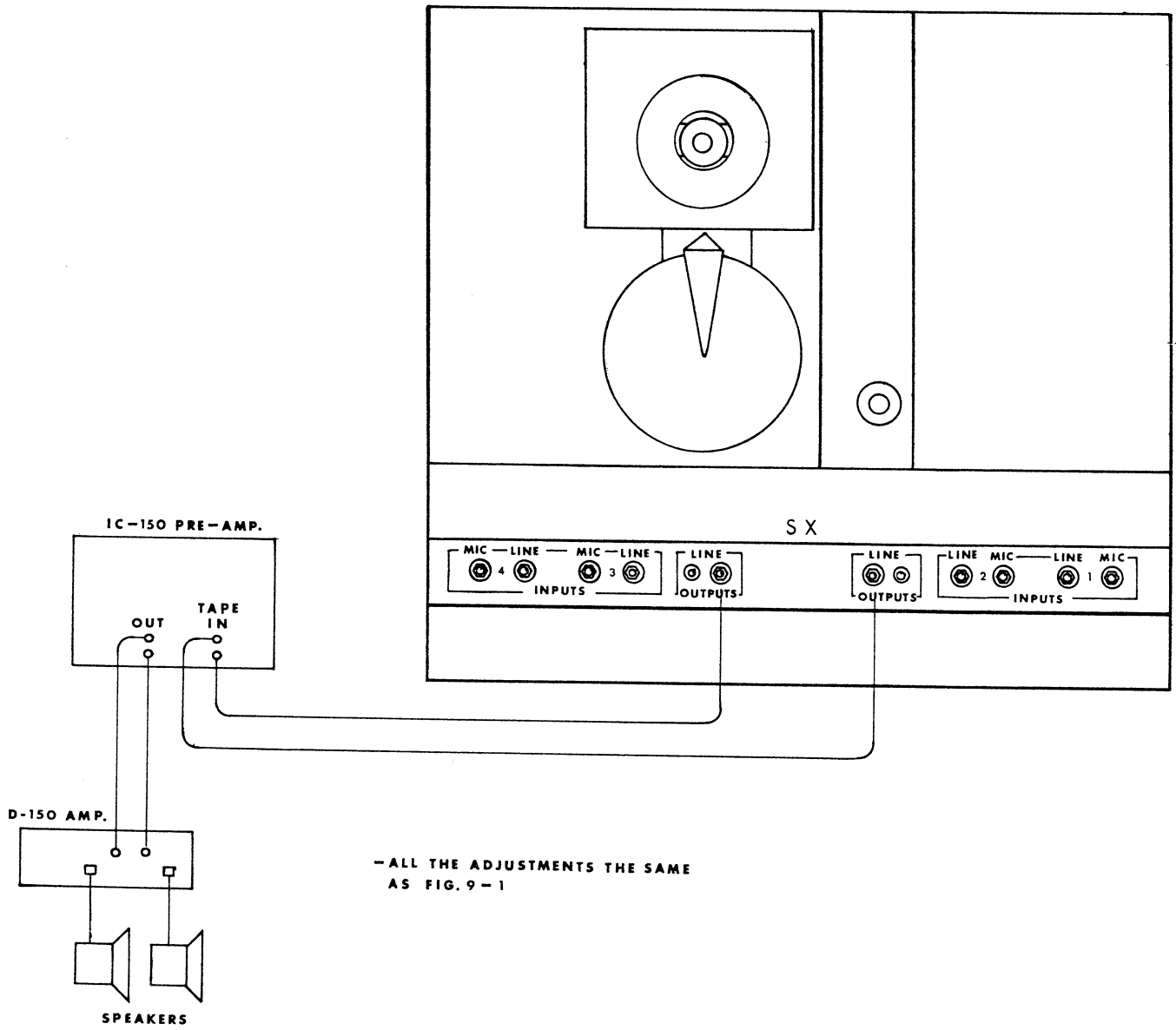


FIG. 9-3 SX WITH A HI-FI SYSTEM

9.3 The SX in the Record Mode

9.3.1 Simple Recording and Monitoring

The SX can function by itself as a recorder with the addition of head phones for monitoring. Simple monitoring can be used, either the hook-up in figure 9-1, or 9-2. The only difference between recording and playback with the SX is that in recording there are two signals to control instead of just one. In recording the incoming signal level must be adjusted to a proper level (usually less than "O" VU on the meter) with the input level controls. This is the most important function as it determines the over-all quality of the recording. The out-going signal (the one coming off the tape just recorded) is adjusted the same as in hook-up 9-1. When the recording process has started you may select either the incoming signal (SOURCE) or the playback of the recorder signal (TAPE) for monitoring. The SOURCE-TAPE switch performs this switching; either will be heard in the monitor system. The "tape" signal will be slightly delayed from the "source" signal. See fig. 9-4.

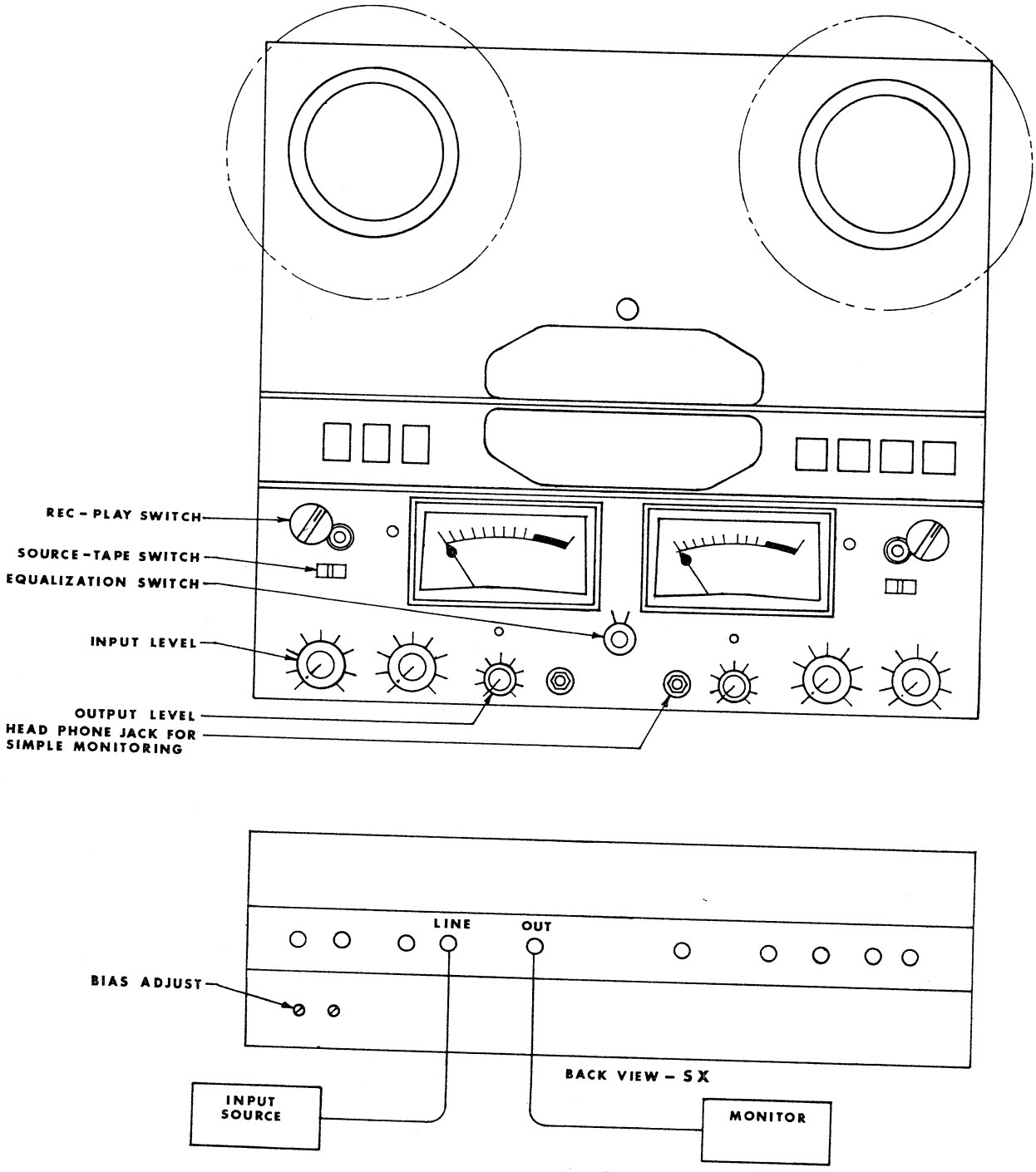


FIG. 9-4 SX IN SIMPLE RECORDING HOOK-UP

9.3.2 Recording in a Hi-Fi System

One function that most pre-amps offer is that of tape monitoring. Basically this is a system for being able to listen either to the signal going **to** the recorder or the signal coming back **from** the recorder. This selection is done at the pre-amp with the "tape" or "tape monitor" button. It can only be utilized with a recorder that has three heads. The three heads enable the operator to listen to the playback while he is recording. The following example will illustrate a situation of making a recording from a record. (All the record steps from 9.3.1 are preliminary.)

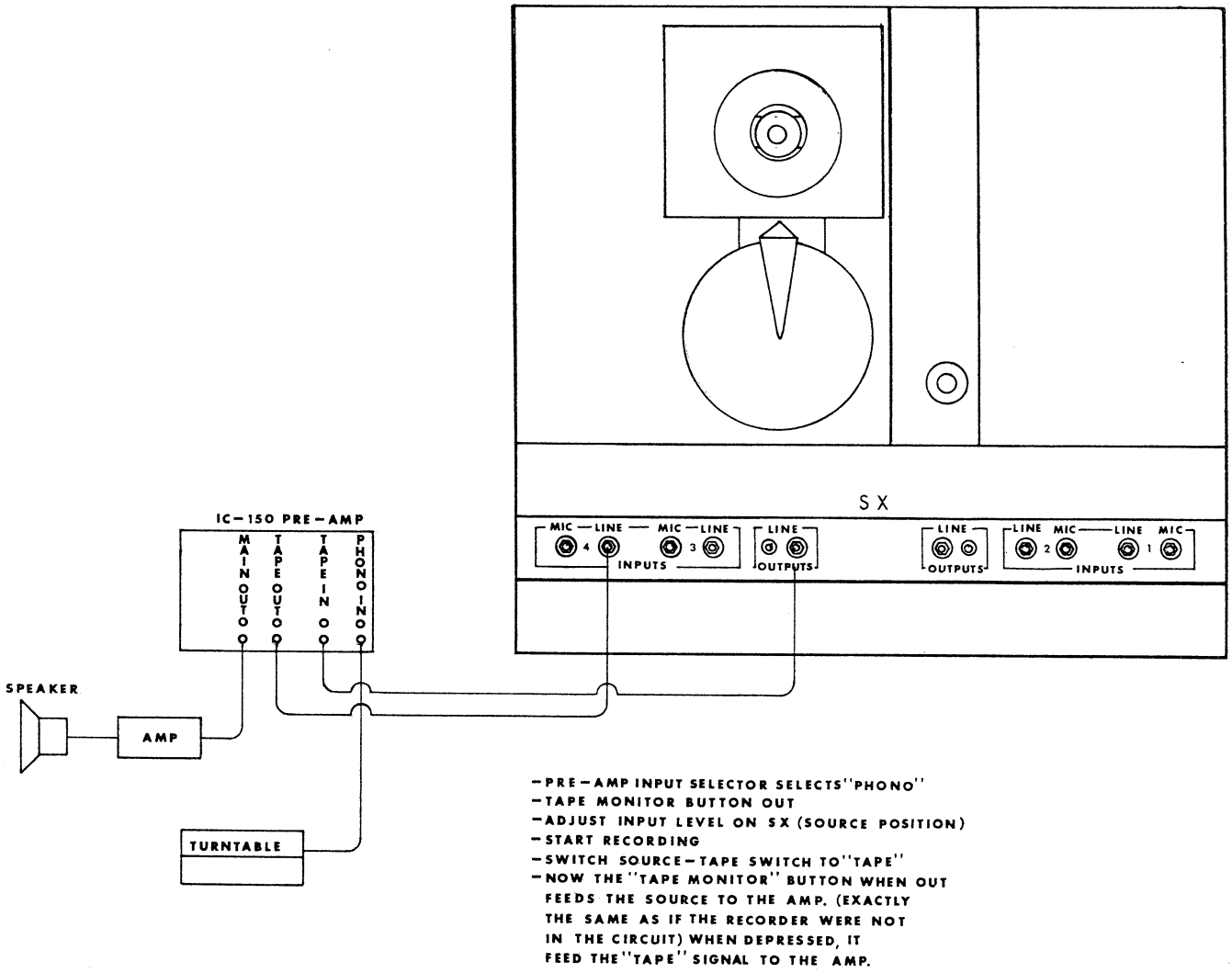


FIG. 9-5 RECORDING WITH SX IN A HI-FI SYSTEM

9.4 ADDITIONAL FUNCTIONS

9.4.1 Mixer

With the input sources as described under the section on recording, the SX electronics may be used as a mixer. The Line Output may then be fed to public address systems, broadcast consoles, etc. Program material fed to the line output will then depend upon the position of the Source-Tape switch. One channel could act as a program source being set to tape with its Line Output patched into the line input of the remaining channel which would be used as a mixer set on "source". See fig. 9-6.

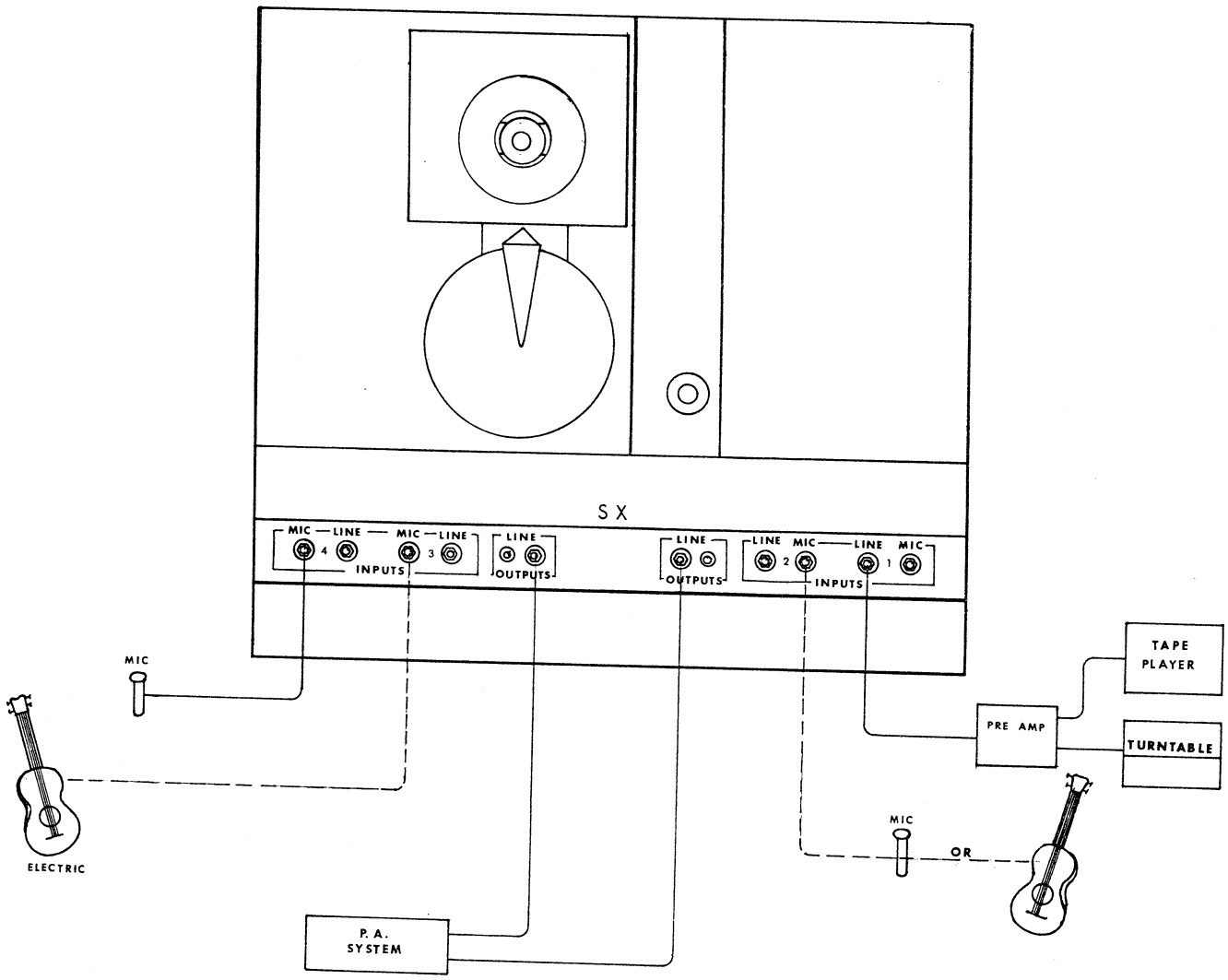


FIG. 9-6 TYPICAL MIXER HOOK-UP

9.4.2 Modes of Recording Using Reproducing Delay

a. Simple Delay — A simple delay is readily obtained by reproducing the tape while recording. The delay is equal to the distance between the record and the reproduce heads divided by the tape speed.
b. Double Delay — A double delay is achieved by patching the simple delay of a single channel into the second unused channel where it is re-recorded and again reproduced. This second reproduction is doubly delayed.
c. Source + Simple Delay — In this instance a simple delay is formed by one channel and the other is used to mix it with the original source which must be parallel patched into both channels. The second channel is then set to Source.
d. Simple Delay + Double Delay — Set second channel of Source plus Simple Delay set-up to reproduce the tape.
e. Multiple Delay — Set recording channel to tape and using a "Y" connector patch its Line Output back to one of the Inputs. The amount of "echo" will then be adjustable by both the output level control and the input control. CAUTION: Too much echo produces undesirable feedback effects.
f. Crosscoupled Multiple Delays — By crosscoupling (Patching) the reproduce outputs of each channel into the input of the other recording amplifier a sound can be made to bounce back and forth between the two channels. The remaining inputs may then be used for either a single or a stereo source.

9.4.3 Sound-on-Sound Recording

With multiple recordings great care must be taken to keep the distortion as low as possible. If the record level is allowed to go too high, the distortion will become progressively worse at each stage, until it becomes quite noticeable. On the other hand, if the record level is too low, the gain controls will be needed to be advanced too far during the reproduction and tape hiss will be heard. It is suggested that the record level be monitored very carefully and kept slightly below normal. It is also suggested that multiple recordings be done in the least number of stages possible.

The first stage of multiple recording may consist of recording on the left channel only. One or both inputs to the left channel may be used and the recording monitored normally.

For a second stage, the tape must first be rewound. A new input may be combined with the signal originally recorded as it is transferred from the left channel to the right where it is recorded again. It is usually desirable to monitor the left channel as it is being reproduced to facilitate syncronization.

The functions of the left and right may then be reversed for a third stage, if desired. See fig. 9-7.

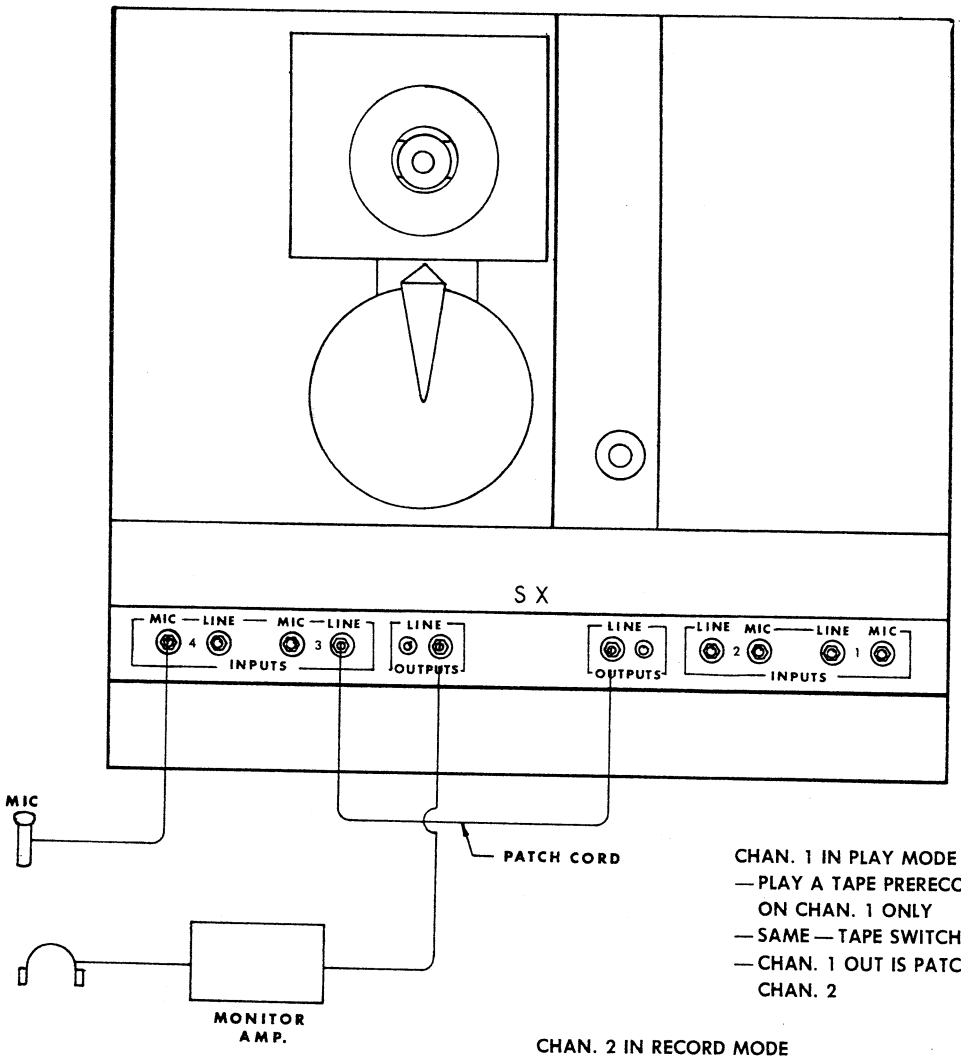


FIG. 9-7 SOUND-ON-SOUND HOOK-UP

PERFORMANCE AND TESTING

ILLUSTRATIONS

10.1 General Theory

10.1.1 Introduction

The CROWN tape recorder has three main units

1. Transport
2. Head Assembly
3. Electronics

The transport contains main power supplies, take-up motor, pay-off motor, drive motor, capstan assembly, tape lifter housing, and the head assembly.

Head Assembly: Is made up of the head mounting plate, tape guides, and three heads — Play, Record and Erase - with facilities for adjusting the heads.

The Electronics: Contains the circuitry for electronic operation of the tape recorder in the Play and Record modes.

This discussion will involve the Electronics unit and the Head Assembly in their relationship physically and electronically with each other and the tape.

Part one of this manual will give a brief technical summary of important aspects of Magnetic Tape Recording.

Part two will give a series of performance tests to check the overall operations of the recorder.

10.1.2 Reproduce Equalization and the Reproduce Head

In an ideal situation, the signal picked up by the play head will double in amplitude if the frequency is doubled. (An increase of 6db per octave will occur). This is assuming that the record level has been held constant.

This happens because the voltage generated is proportional to the rate-of-change of flux. If the frequency is doubled, the flux changes twice as fast, and the voltage has doubled.

In order to compensate for this 6db per octave rise, the preamp must include a 6db per octave drop. The resultant output would then be flat.

However, other factors affect the curve, and must be taken into account. Such factors as gap losses and spacing losses tend to decrease the high frequency response. The final curve will, then, follow a 6db drop at the low frequency end, and then begin to level off in the area where high frequency losses begin to become effective. (Some modification to the curve is required at the extreme low end of the response also).

CROWN "SX" recorders are equalized for speeds of 7-½ and 3-¾. (15 or 1-⅞ available on special order).

The electronics unit, whether stereo or mono, is equipped with playback equalization controls for electronically setting a prescribed play curve (or response) in the electronics to compensate for the characteristics of the head (deviations from ideal) conditions. The following curves show the steps of playback equalization:

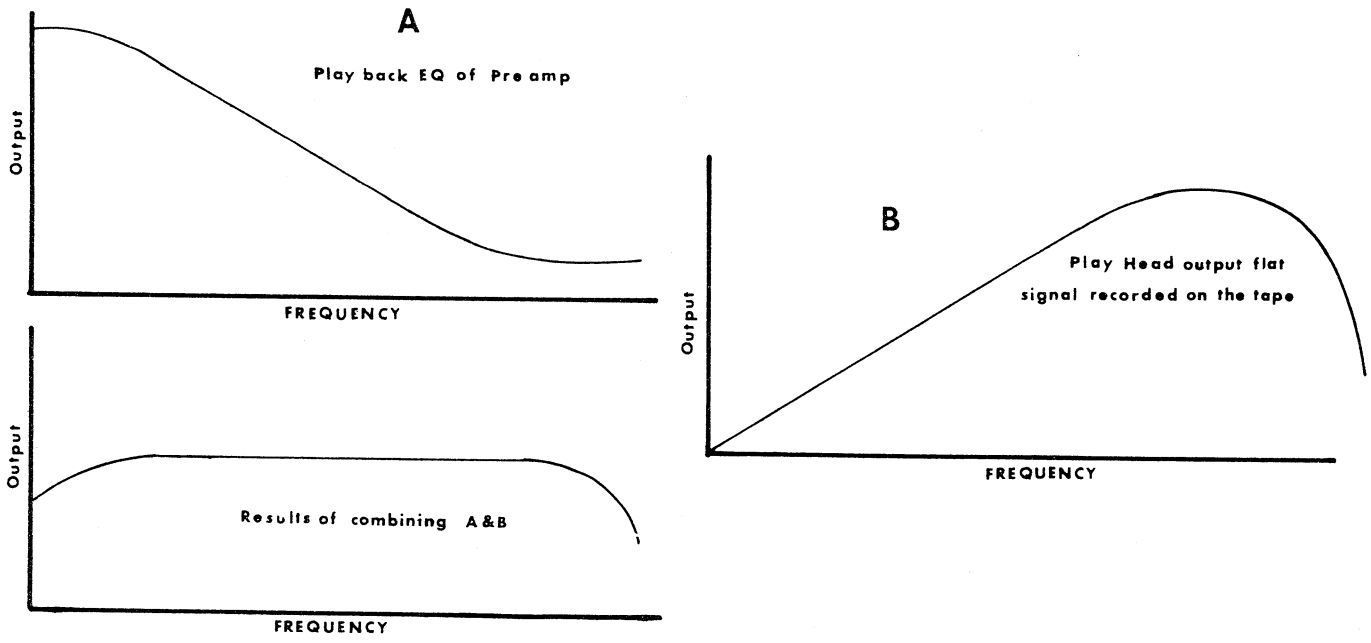


FIG. 10-1 REPRODUCE EQUALIZATION CURVES

10.1.3 Record Equalization

In order to realize the best possible high frequency response, equalization must be used in the record circuit to offset certain losses. Losses might include the erasing effect of bias, penetration losses due to the thickness of the oxide coating, self-demagnetization losses due to the magnetic nature of the medium, head losses through the gap, and eddy current losses.

Record equalization in CROWN recordings is accomplished by providing additional gain in the frequencies subject to recording losses.

In order to obtain the desired composite curve, two separate correction curves are considered. The mid equalization provides a gradual rise beginning at a point slightly beyond 1khz. The peak equalization provides a sharp rise at the upper response limit.

Sometimes the peak frequency can be adjusted slightly higher thus giving a slightly better frequency response. If the peak is adjusted too far out, serious roll-off will occur at the high frequency end. If the peak frequency is set too low, there will be an unusually high boost somewhere below the maximum frequency and serious roll-off following this peak. We have chosen the specification on our recorders so that the highest frequency we specify as flat is very nearly the proper setting for the peak frequency adjustment. IT MUST BE REMEMBERED, HOWEVER, THAT IN RUNNING A FREQUENCY RESPONSE CURVE, THE LEVEL SHOULD BE KEPT 15 to 30db BELOW THE ZERO LEVEL AT 1KHz. If this is not done, tape saturation will be experienced at the frequencies where high frequency boost has been used. This will result in distortion and erroneous results.

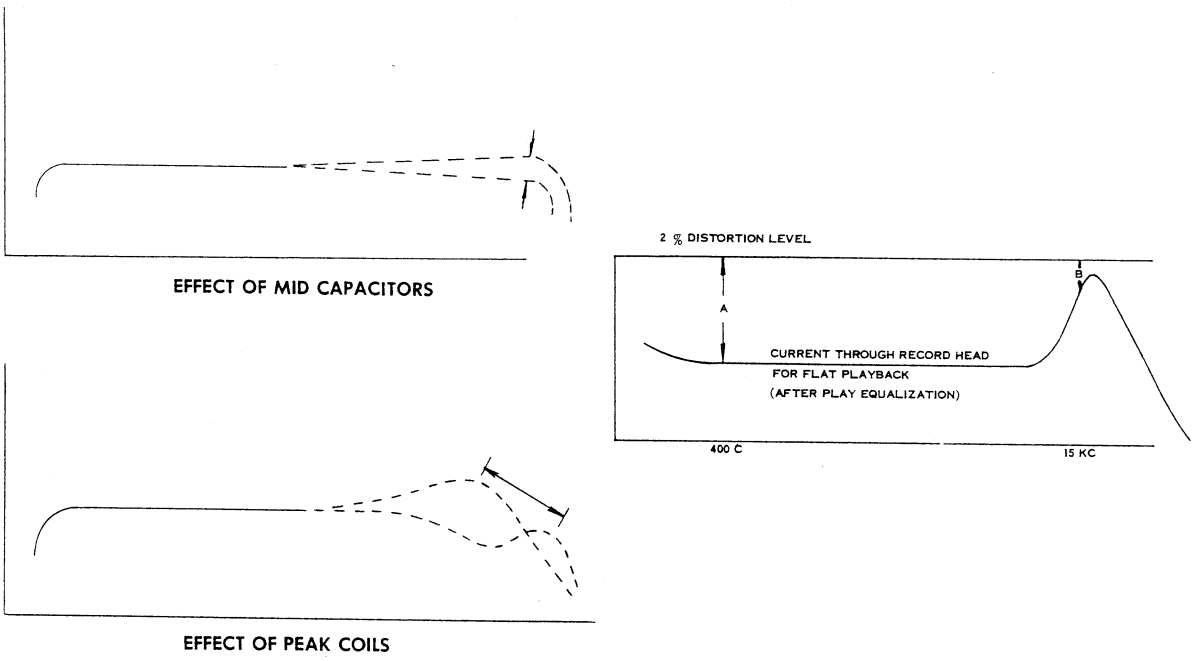


FIG. 10-2 RECORD EQUALIZATION CURVES

10.1.4 The Need for Bias in the Magnetic Recording Process

Magnetic tape is basically a non-linear medium; that is, the magnetism left on the tape is not always proportional to the current in the recording head. This non-linearity (or distortion) appears mainly as the signal passes through the zero axis. The appearance is much the same as that which occurs in an overbiased class "B" amplifier.

One simple method of biasing is to add enough direct current to the signal current to prevent it from ever reaching zero. Of course, the maximum signal level used will be less than half since the signal may not be allowed to reach saturation, or zero.

This may be accomplished a second way by previously saturating the tape in one direction. A direct current is then made to flow through the recording head as before. This direct current is then adjusted so that with no signal present, this DC will just overcome the original magnetism and leave the tape demagnetized. A signal current superimposed upon this will then magnetize the tape in a fairly symmetrical manner about the zero point. This will be true because in this process the tape is being recorded by **demagnetizing** varying amounts rather than by magnetizing it by varying amounts, and the **demagnetizing** curve is relatively free of distortion. With this type of bias, signal-to-noise ratios up to 30db may be realized. However, through the use of ultrasonic bias, signal-to-noise ratios will be obtained which can be made to exceed 60db.

Ultrasonic bias (which is the type used in all CROWN recorders) uses an alternating bias current which is relatively high in amplitude, and several times the frequency of the signal. The signal is then superimposed upon the bias. The ultrasonic bias allows the tape to be saturated in each direction as it moves past the record head gap. As it leaves the gap, it is demagnetized to a level which is dependent upon the signal, therefore utilizing the more linear demagnetizing curve BC rather than the non-linear curve AB. (See fig. 10-3).

The main effect of changing bias levels will be changes in distortion. As the bias level is increased, distortion will be decreased. As the bias is increased however, output will be reduced, especially at the higher frequencies. For optimum performance, therefore, the bias should be adjusted carefully. As the bias is increased (starting from zero), distortion will at first decrease rapidly. As the usable bias range is entered, the distortion will decrease more slowly. If this bias is increased much beyond this point, serious losses in high frequency response will result. It will be desirable to keep the bias as high as possible without causing the high frequency response to drop outside of the specified limits.

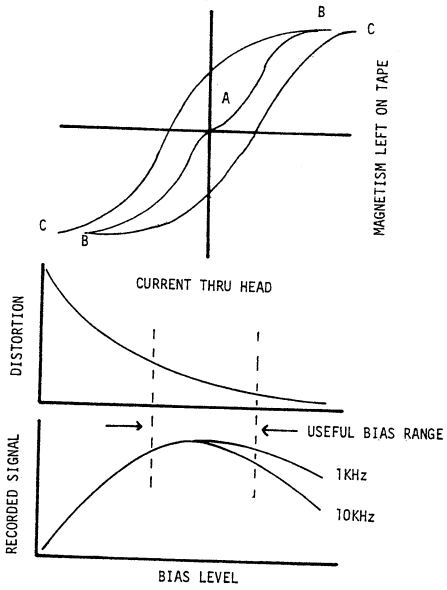


FIG. 10-3 BIAS CURVES

10.2 Performance Tests

10.2.1 General

The performance of your recorder can be checked quickly by making some general tests. For example, deterioration of playback and/or record can be determined by playing a pre-recorded tape, or making a simple A-B listening test while recording. By stopping the recorder and turning up the amp gain, excessive hum and noise will be apparent. Meter calibration can be checked by playing a pre-recorded tape and comparing meter readings. In addition, much can be learned by checking headwear and listening for mechanical problems.

Following is a complete step-by-step set-up procedure, in the event that your SX needs servicing. It should be emphasized that only proper test equipment and knowledgable personnel can achieve reliable results. If the results of the adjustments aren't understood, serious degradation of performance is likely to occur.

Before any electronic adjustments are made it is imperative that all mechanical functions of the recorder are normal. This would include pressure roller adjustment, tape lifter and pressure pad alignment, head alignment and any other function which directly affects the tape transporting process. In addition, the wow and timing should be checked. Please refer to the transport section which deals with these adjustments.

Following is a list of recommended equipment with some typical model numbers included.

- Demagnetizing Tool - Robins ME-66
- DC Voltmeter - Simpson Model 260
- Precision AC Voltmeter (capable of accurately measuring 100KHz) - Hewlett-Packard Model 400 E
- Audio Oscillator (low distortion) - General Radio Model 1309 A
- Distortion Analyzer - Hewlett-Packard Model 331 A
- Standard Alignment Tape - Ampex 01-31321-01 or Standard Tape Laboratory Cat. #2
- Resonate Probe - See figure 10-4
- Noise Filter (20Hz-20KHz bandpass) See figure 10-5
- 100KHz Bias Trap - See figure 10-6
- Frequency Meter - Hewlett-Packard 5210A

Optional:

- Flutter Meter - Micom 8100
- Oscilloscope - Telequipment Model S 54 A
- Monitor System

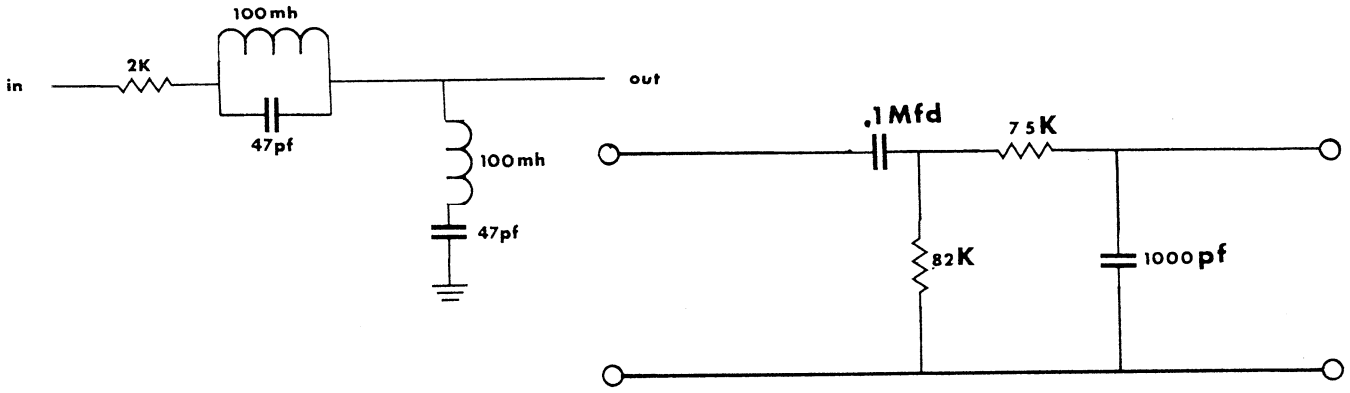


FIG. 10-5 20Hz-20KHz BANDPASS FILTER

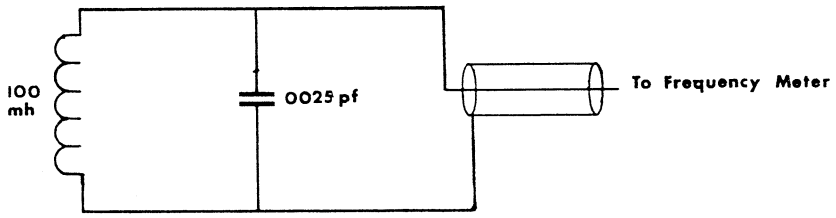


FIG. 10-4 RESONATE PROBE

PRECAUTIONS TO OBSERVE BEFORE MAKING ANY ADJUSTMENTS

1. Make sure heads are free of dirt and oxide.
2. Demagnetize heads **and** all tools that will come into contact with head assembly.
3. Make sure a new tape (of proper type) is being used for record checks.
4. Adjustments **must** be made in the specified order.
5. If a discrepancy occurs in any step, stop and remedy that problem before proceeding to next step.

10.2.2 Test Set-up

Following is a block diagram of a typical test set-up using the recommended equipment.

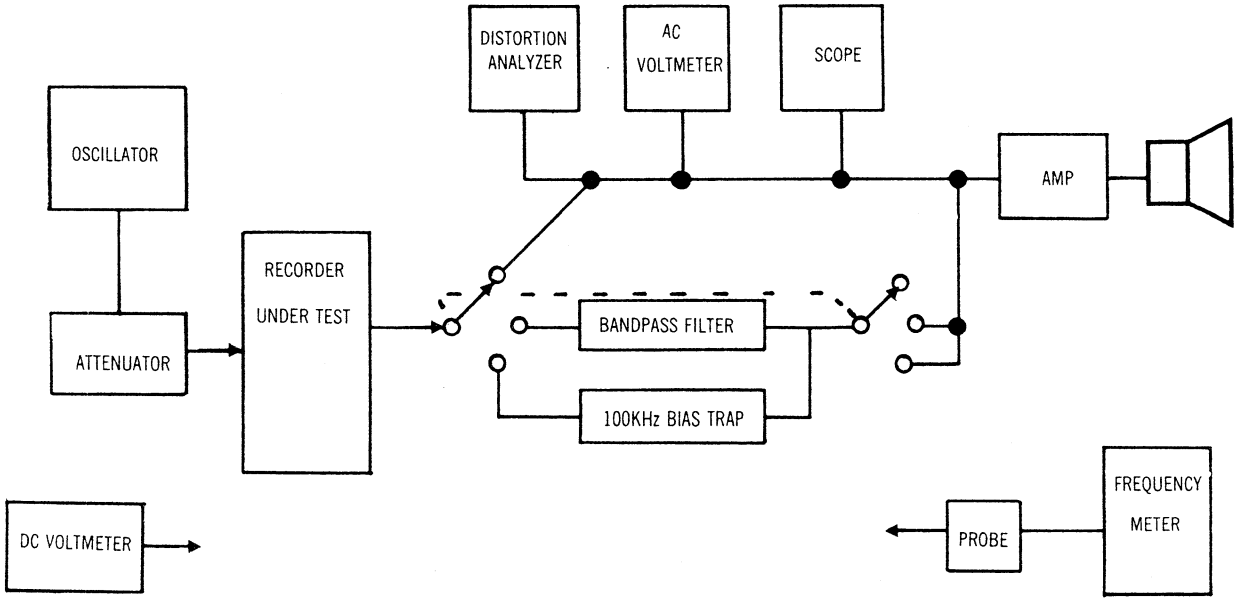


FIG. 10-7 TYPICAL TEST SET-UP

10.3 Set-up Procedure

10.3.1 Check Power Supply Voltages and Output Balance

A. Power Supply
   1. Set to + 30 volts, using R182, located on Power Supply Board.
   2. Check regulation — should be less than 2 mv ripple.

B. Output Balance
   1. Output DC balance is fixed; check with voltmeter. Typical reading would be very low + a few millivolts.

10.3.2 Meter Calibration

A. Buss Amp Gain
   1. Gain is fixed, should be approximately 14db from input to output.

B. Line Amp Gain
   1. Gain is fixed, +10db output, Hi-Z, +4dbm output into 600Ω.

C. Meter Amp Gain
   1. Set output level controls full clockwise.
   2. Feed in 1KHz signal, monitor output from SX on an External audio voltmeter.
   3. Increase input level control until output from SX is +10db into HI-Z.
   4. Adjust meter gain control (R163 Main Board) for "O" VU reading on front panel meters.

10.3.3 Check Electronic Performance

1. Feed in 1KHz "O" level signal. Check frequency response, distortion, signal-to-noise through the electronics (slide switch in "Source" position).
2. Feed 1KHz -60db signal into mic pre-amp. Check frequency response, distortion, signal-to-noise.

10.3.4 Reproduce Amp Gain and Equalization

A. Set play head tracking, tilt, height and tape wrap, zenith, and approximate azimuth.

B. **DEMAGNETIZE** Heads

C. Play Level — Play a standard "O" level 700Hz tape, adjust play level control (R199 on Main Board) for "O" VU reading on front panel meters.

D. Azimuth adjust — Play standard 15KHz Azimuth adjust tape, adjust azimuth screw for maximum output, both channels. Watch for split azimuth, an indication of a defective head. Split azimuth is apparent when the channels don't reach peak output together. Only 1.5dB between peaks can be tolerated for proper results.

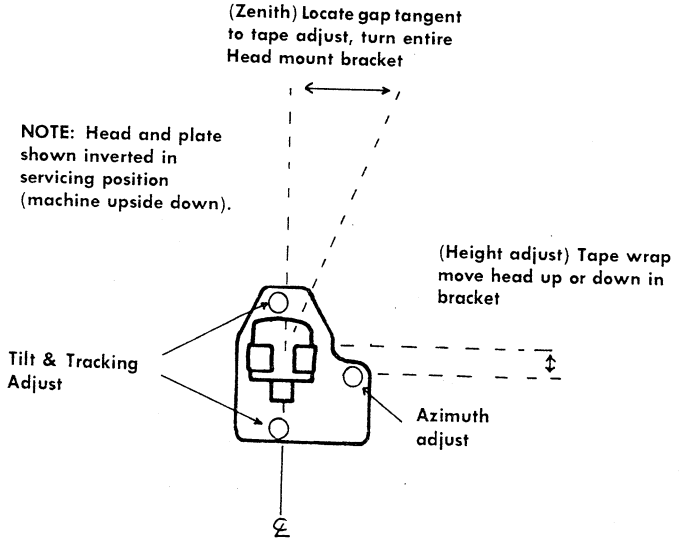


FIG. 10-8 HEAD ALIGNMENT

E. Play Equalization

1. Play a 700Hz (equalization reference) section of standard alignment tape, set a suitable reference on external audio voltmeter.
2. Switch tape to 10KHz section (equalization adjust).
3. a. **(Service method:)**

   Use appropriate equalization control (R203 or R204 on Main Board) to set output as follows: (All adjustments are made with a 7-½ ips standard alignment tape playing at 7-½ ips, switching only the equalization switch):

   — For 15 ips, set 10KHz -1db from 700Hz reference.
   — For 7-½ ips, set 10KHz Odb from 700Hz reference.
   — For 3-¾ ips, set 10KHz +6db from 700Hz reference.
   — For 1-⅞ ips, set 10KHz +12 db from 700Hz reference (only approximate.) .

   b. **(Direct method:)**

   Using standard alignment tapes for the appropriate speeds, set 10KHz for flat playback using appropriate controls (R203 or R204 on Main Board). Since there are no standard response curves for 1-7/8, satisfactory alignment can be achieved by disconnecting the playback and feeding a -50db signal directly into the electronics, and adjusting for a response according to the curves below. (See fig. 10-9).

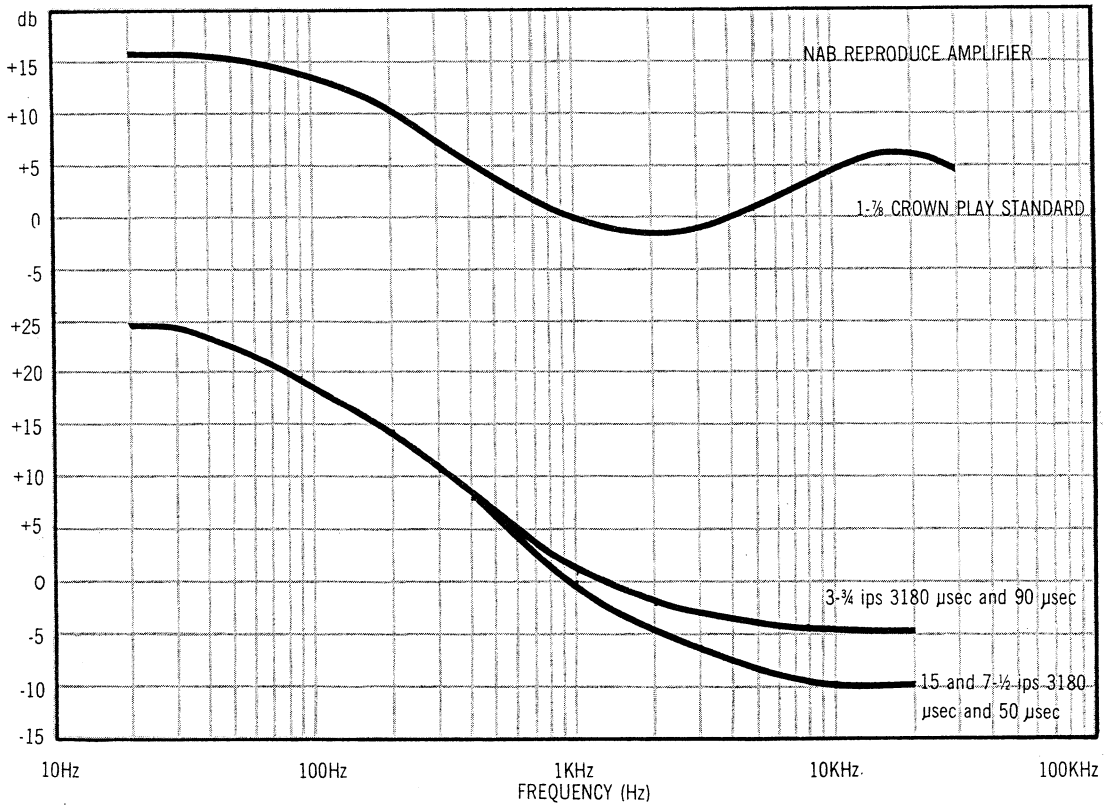


FIG. 10-9 REPRODUCE EQUALIZATION CURVES

NOTE: When using a full-track alignment tape on multi-track machines, a high output (+2 to +4db) may be noted at the low frequencies. This is due to a "fringing" effect and may be disregarded. Output will be normal when using a multi-track tape. Also, bear in mind that standard tapes frequently are slightly boosted at the highest test frequencies, in an attempt to compensate for self-erasure effects that occur gradually with aging. The relative age of the tape should be taken into consideration when attempting to adjust equalization.

F. Bass End adjust — Play 50Hz (bass end adjust) section, using bass and adjust control (R202 or R201 on Main Board), set output +.5db to +1db above 700Hz reference. Set bass end for both speeds.

G. Play standard "O" level tape again. Re-check play level as there is some interaction between level and equalization controls.

H. You can verify flat playback and proper equalization by playing standard play tape and noting the response curve. Response should be ±2db from 50Hz to 15KHz. If results are out of tolerance, the following possibilities should be considered:
   1. Worn or defective playhead which would require placement.
   2. Defective playamp. This may be checked by feeding a -50db signal into the playhead input and comparing output to standard play curves. Also check signal for distortion. (See fig. 10-9)
   3. Defective component in equalization circuit.
   4. Bass end out of tolerance — adjust R201 or R202.

10.3.5 Set Bias Oscillator, Pre-set Erase Voltage

A. Set oscillator to 100KHz ± 5K-O, (slug of T-1 on OSC board) (See fig. 10-10).

B. Pre-set erase voltage (setting only approximate).
   — full-track - 100V to 175V
   — half-track - 50V to 100V
   — quarter-track - 40V to 90V

   Refer to Proof of Performance sheets with machine or on permanent file in CROWN Factory Service Dept.

C. Adjust bias traps for a null at 100KHz.
   1. This can be done by connecting the audio voltmeter to the Q107 side of the record level control (R151 on Main Board) and adjusting the bias traps L103 (See fig. 10-10, and 10-11).

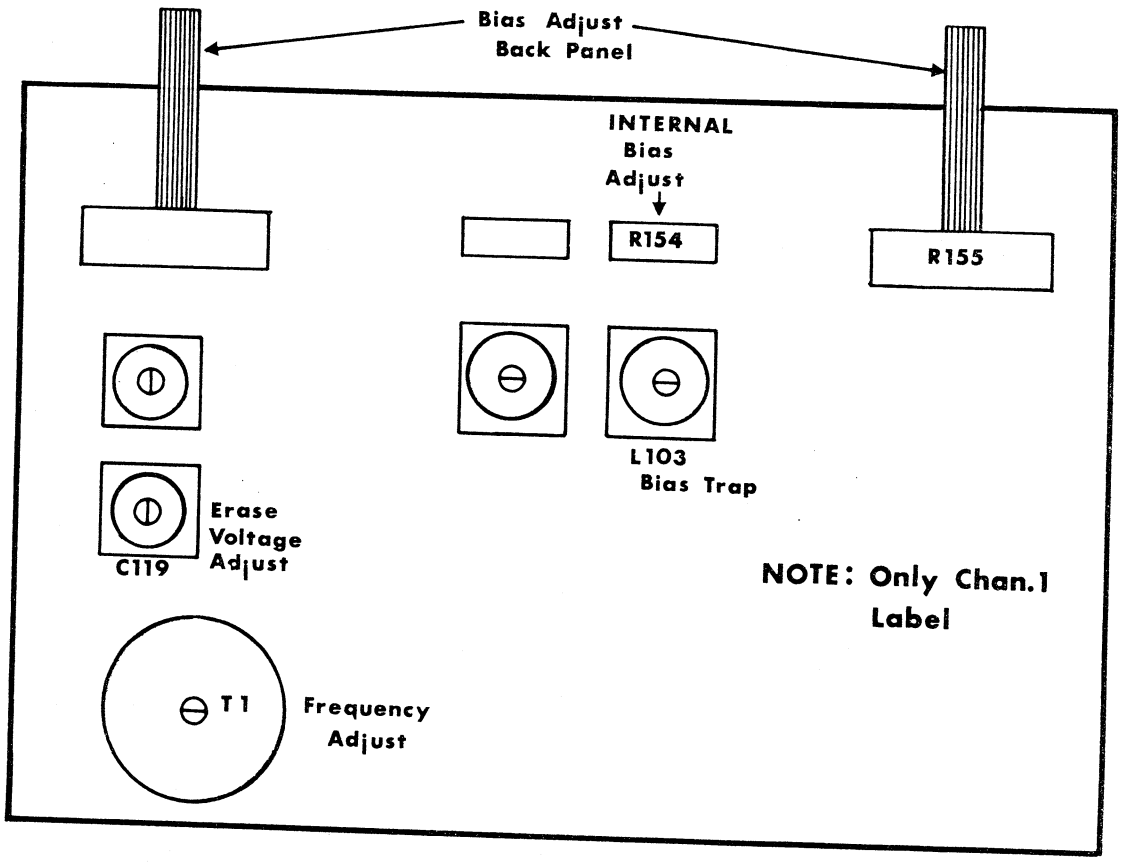


FIG. 10-10 OSCILLATOR BOARD OUTLINE

10.3.6 Check Erasure and Signal-to-Noise

A. Set tracking, tilt, height and tape wrap and zenith of erase head.

B. Insert bandpass filter (20Hz to 20KHz) between recorder and audio voltmeter. (See fig. 10-5)

C. Play pre-recorded erase tape (3% THD, 400Hz*) set reference on audio voltmeter.

D. Switch to record mode (no signal input) and measure output. Should be in the vicinity of -55db below 3% reference.

E. Maximum erase can be achieved by adjusting erase head tracking and erase voltage. Best procedure is to adjust erase voltage just to the point where clean erasure results. This prevents overloading the oscillator.

G. Using same set-up (reference to 3% THD tape *) put on a roll of virgin tape, start recording (inputs full counter-clockwise). Output can be measured as signal-to-noise in db below 3% THD, should be in the vicinity of -60db.

* 3% THD occurs with Scotch 202 at approximately +8db, with Scotch 207 at +11db.

10.3.7 Record Response and Level, Bias Meter Calibrate

A. Insert 100KHz bias trap ahead of audio voltmeter. (See fig. 10-6)

B. Use correct type of tape (Scotch 202 or 207).

C. Adjust record head tracking, height and tape wrap, tilt zenith and approximate azimuth.

D. Start recording at 700Hz "O" level signal, switch to "tape".
   1. Adjust the back panel bias control (R155) to produce peak in audio output off tape. Set bias right on peak in output.
   2. If clear peak cannot be obtained, adjust the internal bias control (R154) in the same direction through and slightly past the peak in audio. Then the back panel control can be adjusted for a peak in audio.

E. Set the bias meter calibrate control (R153) to read "O" VU with switch in "Bias" position. This is only a preliminary setting. Control R153 is mounted behind the Rec-Play switch and can be reached with a long small shaft screwdriver.

F. Adjust record level control (R151 on Main Board) so that 700Hz "O" level in, reads "O" VU in "tape" position.

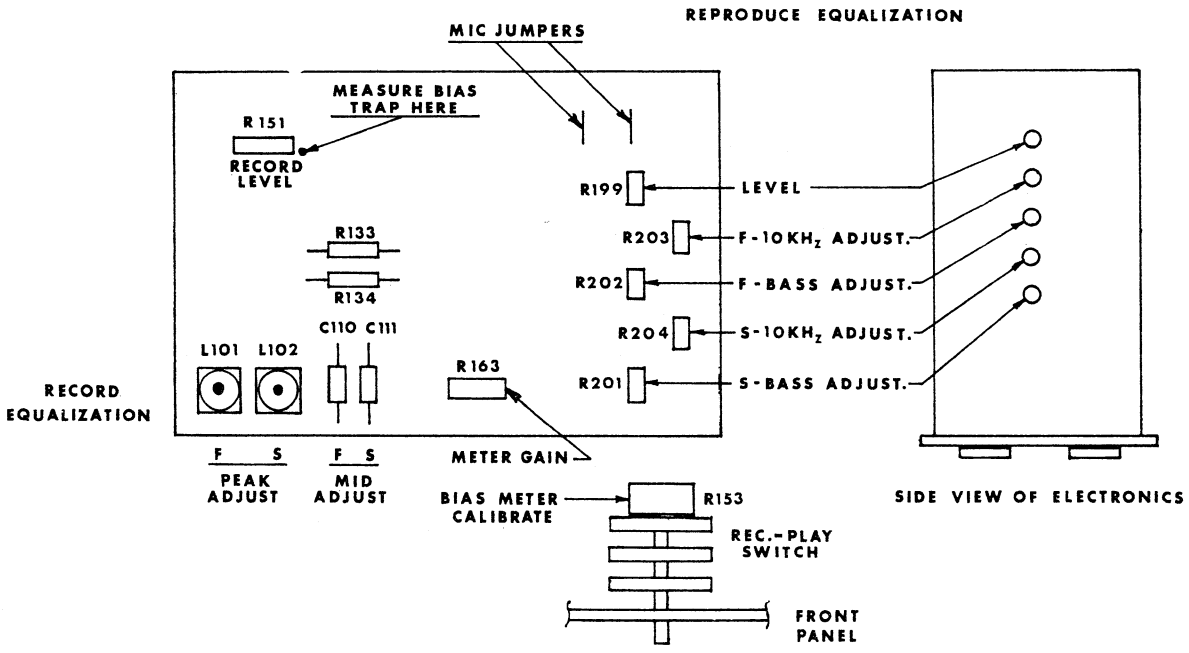


FIG. 10-11 MAIN BOARD OUTLINE

G. Record a 1KHz "O" level signal and check distortion. THD should be below 1% typically.

H. Reduce signal level 20db with attenuator and record a 15KHz signal. Adjust record head azimuth for peak output. Again be alert for split azimuth problems.

I. At proper record level (see chart below), set 1KHz reference on external audio voltmeter.
   1. Sweep frequency to confirm only if machine had potential to meet specs at high frequencies.
   2. Switch to slowest speed, set bias to proper setting (see chart below) and check response.
   3. At this point, response can be corrected or adjusted using back panel bias adjust and record equalization.

NOTE: The RLC record equalization network works as follows:
   — the capacitor changes the overall amount of boost in the upper mid-range frequencies (2KHz to 10KHz depending on speed). An increase in capacitance increases boost and conversely.
   — The coil is adjustable and changes the frequency of the highest frequency to be boosted.
   — The resistor changes the amount of the high frequency boost. Increasing the resistance, decreases the boost and conversely.

   4. When all channels are nearly the same and response is within specs, use bias meter calibrate control to set bias meter to proper setting (see chart below).
   5. Now switch to highest speed, change to proper bias setting (back panel control) and equalization position. Correct or adjust response using **only** equalization. It should be pointed out that the correcting setting for the bias is a compromise and not exactly optimum for both speeds.

Set-up Information Chart

Speed	Record Level	Bias Set Full; Half-Track	Bias Set Quarter, 4 Channel
15	-10	O VU	O VU
7-½	-20	O VU	O VU
3-¾	-20	O VU	-2 VU
1-⅞	-20	O VU	-3 VU

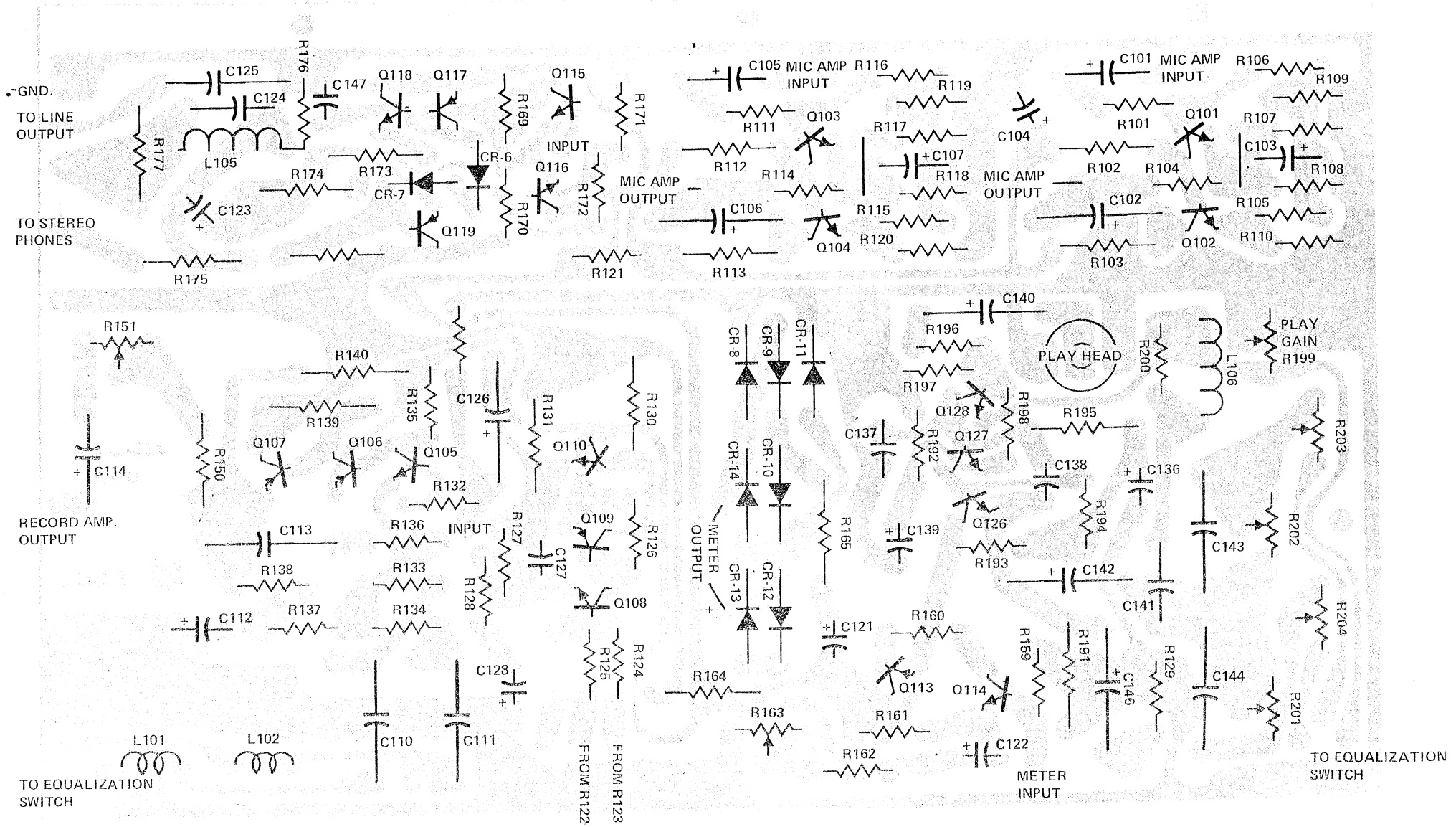
J. Bias swing — Only after proper bias calibration is obtained should bias swing be set.
   1. Use the internal bias control (R154) to set the range of the back panel bias adjust (R155). Final swing should be at least +2db to -3.5db.

K. Final Record Level.
   1. Record at "O" level 700Hz signal, set record level pot (R151) to read "O" VU in "tape" position.

10.3.8 Distortion Check

A. Insert bandpass filter between recorder and audio voltmeter. (See fig. 10-5)

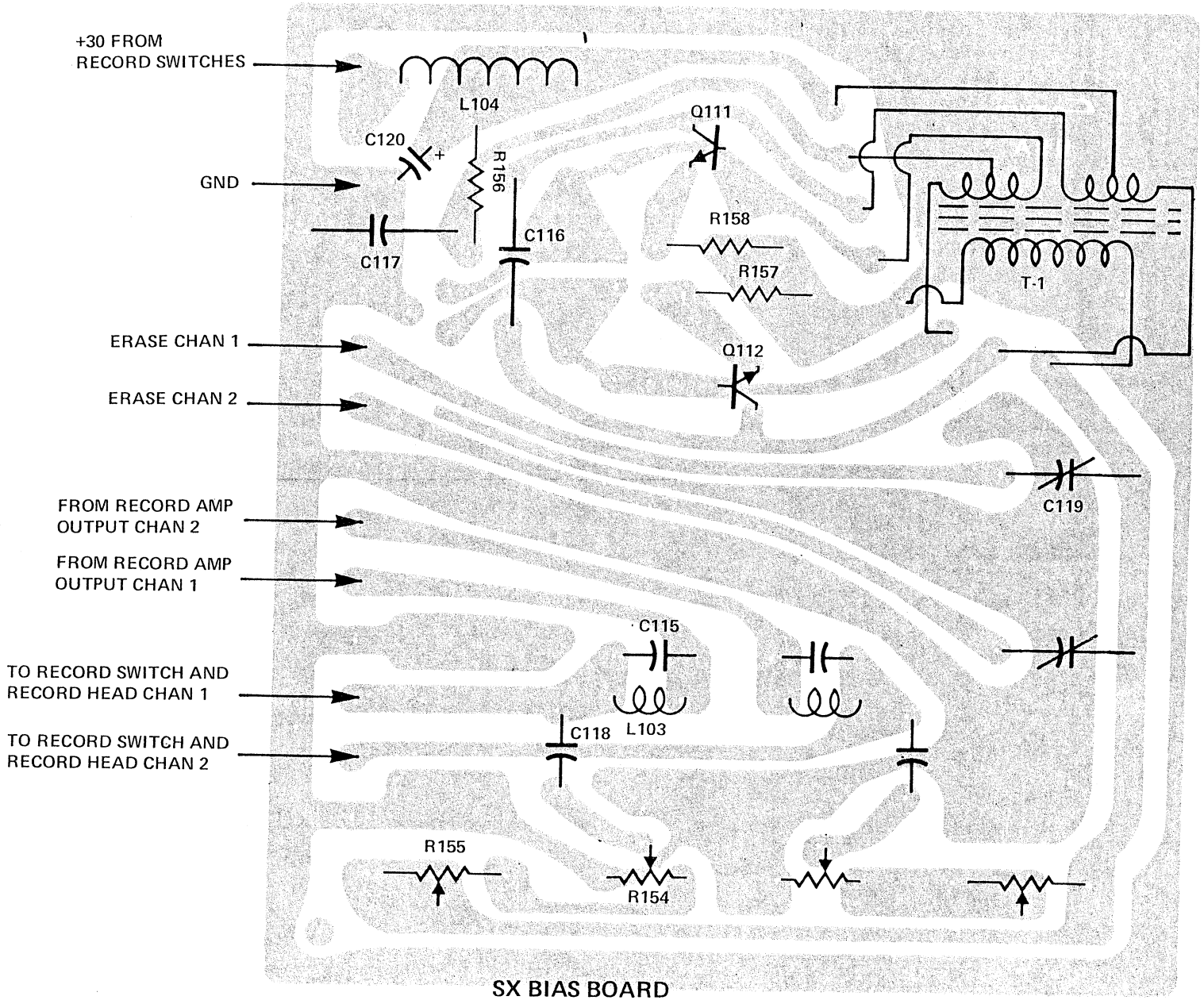
B. Record a "O" level, 1KHz signal, check distortion. Total Harmonic Distortion should be 1% or less.



SX MAIN BOARD

(TOP SIDE)

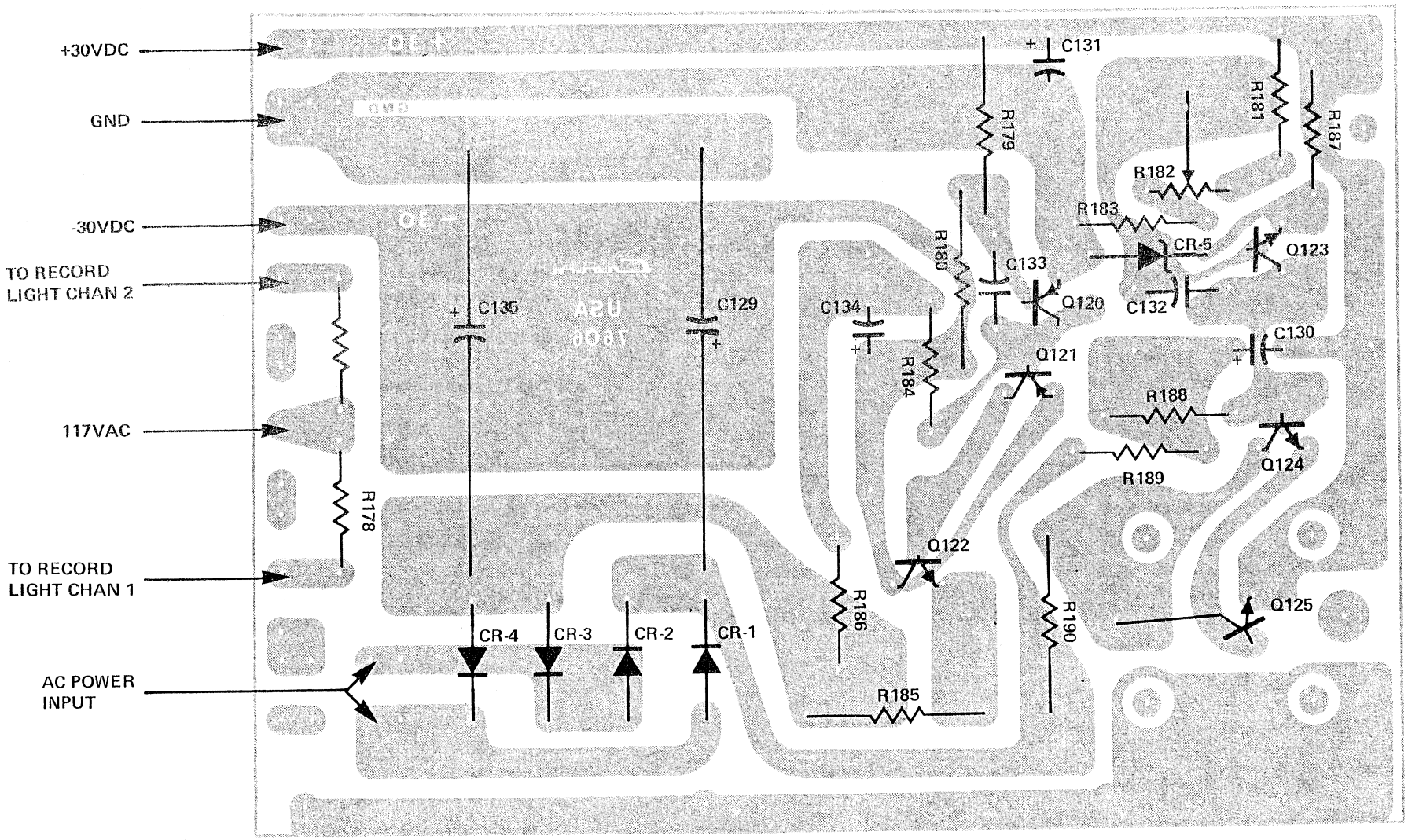
MI-218A



SX BIAS BOARD

(TOP SIDE)

MI-219A



SX POWER SUPPLY BOARD

(TOP SIDE)

MI-220A

NOTE: R179 & R180 ARE SHOWN IN REVERSE LOCATION

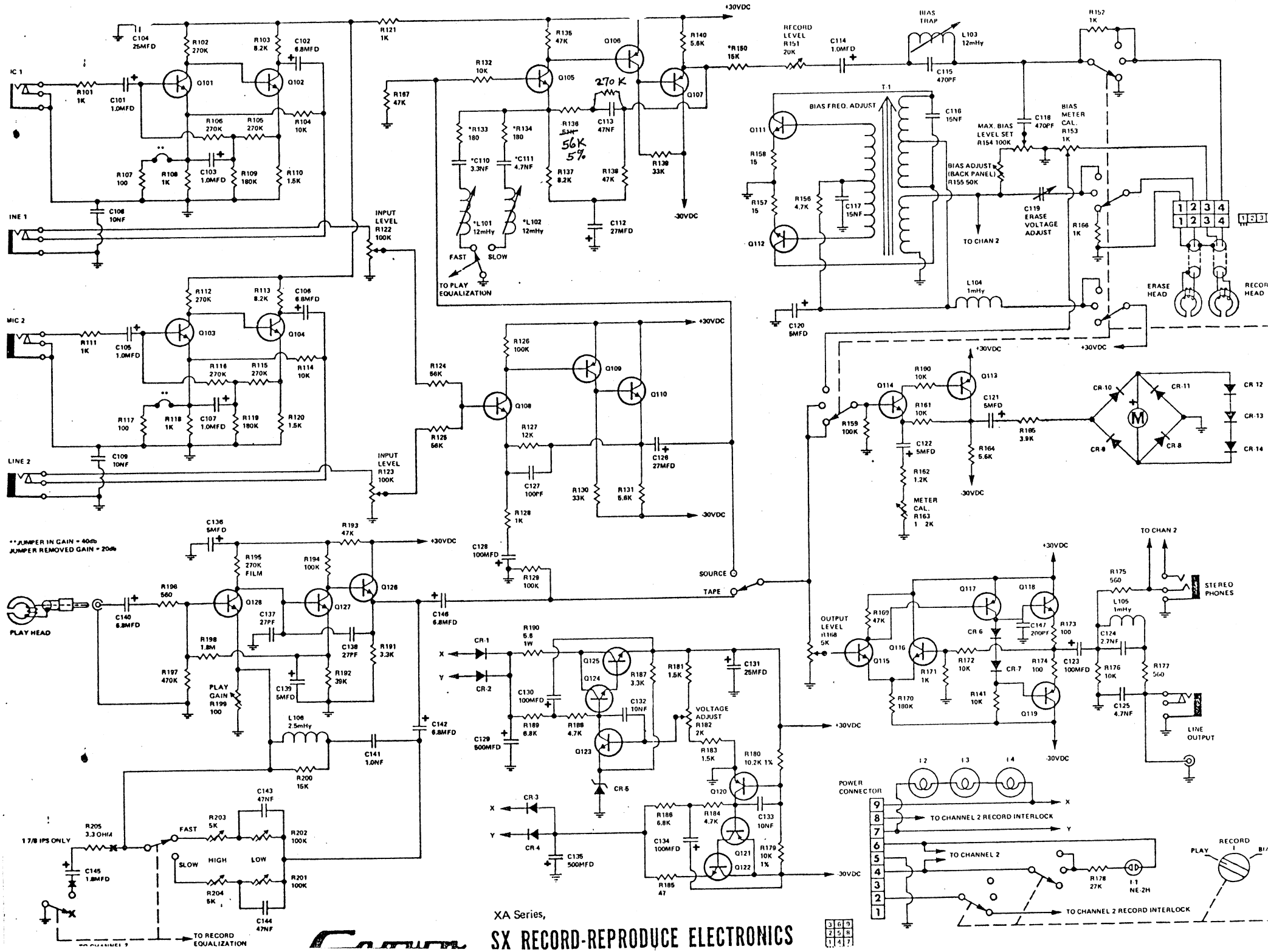
SX PARTS LIST

CKT No.	Part No.	Description	Notes
Bulbs			
11	2500	NE2H Neon	
12, 13, 14	2900	Incandescent No. 1822	
Capacitors			
C101, C103, C105, C107, C114	1750	1 mfd. 30v tantacum	
C102, C106, C140, C142, C146	3573	6.8 mfd. dipped epoxy	
C104, C131	2870	25 mfd. 35v vertical	
C108, C109, C132, C133	1751	.01 mfd. ceramic disc	
C110	1682	.0033 mfd. pacer	Value depends on speed
C111, C125	3178	.0047 mfd. filamatic mylar	C111 value depends on speed
C112, C126	3459	27 mfd. 10v tantalum	
C113, C143, C144	2977	.047 mfd. filamatic mylar	
C115, C118	2511	470 pf silver mica	
C116, C117	3288	.015 mfd. filamatic mylar	
C119	1256	trimmer	
C120, C121, C122, C136, C139	2868	5 mfd. 35v vertical	
C123, C128, C130, C134	2869	100 mfd. 12v vertical	
C124	3481	.0027 mfd. filamatic mylar	
C127	3410	100 pf. silver mica	
C129, C135	3408	500 mfd. 55v elec.	
C137, C138	2342	27 pf. silver mica	
C141	3480	.001 filamatic mylar	
C145	3079	1.8 mfd. 35v tantalum	Required for 1-7/8 ips
C147	3411	200 pf. silver mica	
Chokes & Coils			
L101, L102, L103	1661	12 mh variable	
L104, L105	2441	1 mh	
L106	1510	2.5 mh	
T1	3331	Bias osc. coil	Coil only — complete accessories include 1779, 1781, 1782, 1824, 1827, 1938
Connectors			
Power connector	7769	amp 480086-1 9-way	
Amp contacts	2444	amp 60535-1	
Play head connector	2978	Faston Tab	
Input-Output jacks	3423	shortins type	
Front panel output	3424	stereo type	
Record-erase jack	2052	amp 480135-1	

CKT No.	Part No.	Description	Notes
Meters			
M-1	3426	0-2004 AFS	
Potentiometers			
R122	2341	100k input control	
R123	2337	100k input control	long shaft
R155	2890	50k bias adj.	long shaft
R168	2336	5k output level	long shaft
R151	1712	20k vertical	
R153		1k bias calib	part of switch no. 2812
R154, R201, R202	1713	100k vertical	
R163	2871	2k vertical	
R182	2067	2k horizontal	
R199	2867	100k vertical	
R203, R204	1681	5k vertical	
Rectifiers			
CR1, CR2, CR3, CR4	2851	1N4003	
CR5	3277	1N968B	
CR6, CR7, CR12, CR13, CR14	3181	1N4148	
CR8, CR9, CR10, CR11	3447	1N270	
Resistors			
R101, R108, R111, R118, R121 R128, R171	2627	1k ¼w 10%	
R102, R112	1049	270k ½w 10%	
R103, R113	1005	8.2k ½w 10%	
R104, R114, R132, R160, R161, R172	2631	10k ¼w 10%	
R105, R106, R115, R116	2885	270k ¼w 10%	
R107, R117	2872	100 ohm ¼w 10%	
R109, R119, R170	2884	180k ¼w 10%	Earlier units used look for R170
R110, R120	2876	1.5k ¼w 10%	
R124, R125	2882	56k ¼w 10%	
R126, R129, R159, R194	2883	100k ¼w 10%	
R127	2878	12k ¼w 10%	
R130, R139	1623	33k ½w 10%	
R131, R140, R164	1042	5.6k ¼w 10%	
R133, R134	2873	180 ohm ¼w 10%	Value depends on speed
R135, R138, R167, R169, R193	2880	47k ¼w 10%	
R136	2881	51k ¼w 10%	

CKT No.	Part No.	Description	Notes
Resistors - Continued			
R137	2877	8.2k ¼w 10%	
R141, R176	1035	10k ½w 10%	
R150, R200	2632	15k ¼w 10%	
R152, R166	1053	1k ½w 10%	
R156, R184, R188	1640	4.7k ½w 10%	
R157, R158	1013	15 ohm ½w 10%	
R162	2875	1.2k ¼w 10%	
R165	1059	3.9k ½w 10%	
R173, R174	1007	100 ohm ½w 10%	
R175, R177	1030	560 ohm ½w 10%	
R178	1056	27k ½w 10%	
R179	2343	10k ½w 1%	
R180	2344	10.2k ½w 1%	
R181	1076	1.5k ½w 10%	
R183	1067	2.7k ½w 10%	
R185	1073	47 ohm 1w 10%	
R186, R189	1639	6.8k ½w 10%	
R187, R191	1051	3.3k ½w 10%	
R190	2355	5.6 ohm 1w 5%	
R192	2879	39k ¼w 10%	
R195	1997	270k ¼w lo noise film	
R196	2874	560 ohm ¼w 10%	
R197	2886	470k ¼w 10%	
R198	2887	1.8 meg ¼w 10%	
R205	3080	3.3 ohm ½w 5%	
Switches			
SW-1	2892	Play-record-bias	Also includes R153 bias calib pot
SW-2	2333	Equalization	
SW-3	3011	Source - tape	
Transistors			
Q101, Q102, Q103, Q104 Q105, Q108, Q114, Q115 Q116, Q127, Q128	2962	Tz-81 npn	Selected
Q106, Q107, Q109, Q113 Q117, Q119, Q120, Q121	2982	2N5383 PNP	Selected
Q110, Q126, Q118, Q128, Q124	2961	2N3859 A NPN	Selected
Q111, Q112	2975	2N2102	
Q122	2643	RCA-40327	Uses cooler 1756
Q125	2976	2N3054	Uses cooler 2635
Transistor pad	1250		

CKT No.	Part No.	Description	Notes
Mechanical parts			
Front panel	7019		
Sub-front	7037		
Jack panel	7750		
Bias shield	7752		
Chassis end	2930		
Electronic covers top	7917		
Electronic covers bottom	7918		
Meter bezel	1903		
Red plastic lens clip	2359		
Input knob	1578		
Output knob	2301		
Equalization knob	1668		
Record lock knob (left)	7057		
(right)	7056		
Source-tape slide knob	2346		
Record lock button	3365		
Record lock spring	1592		
Record lock pin	1667		
Pilot light accessory	1262		
Meter bracket (left)	2370		
(right)	2369		
Front panel chassis screw	2709	8/15 x 1/2 sheet metal	
Front panel rack screw	2120		
Front panel black nylon washer	2119	Use with 2120 screw	
Real chassis screw	2708	Slotted black hex head 8 x 3/8 sheet metal	


XA Series,
SX RECORD-REPRODUCE ELECTRONICS
+30VDC
-30VDC
INPUT LEVEL R122 100K
INPUT LEVEL R123 100K
MIC 2
LINE 1
LINE 2
PLAY HEAD
ERASE HEAD
RECORD HEAD
BIAS TRAP
BIAS FREQ. ADJUST
BIAS ADJUST (BACK PANEL) R155 50K
MAX. BIAS LEVEL SET R154 100K
BIAS METER CAL. R153 1K
ERASE VOLTAGE ADJUST
TO CHAN 2
TO PLAY EQUALIZATION
FAST
SLOW
SOURCE
TAPE
OUTPUT LEVEL R168 5K
METER CAL. R163 1 2K
PLAY GAIN R199 100
VOLTAGE ADJUST R182 2K
STEREO PHONES
LINE OUTPUT
POWER CONNECTOR
TO CHANNEL 2 RECORD INTERLOCK
TO CHANNEL 2
TO RECORD EQUALIZATION
1 7/8 IPS ONLY
** JUMPER IN GAIN = 40db
JUMPER REMOVED GAIN = 20db
270 K
56K 5%

MODEL T C TAPE COUNTER

8.3.1 DESCRIPTION

The model TC Tape Counter accessory serves as a convenient tape-location reference device. A 4-digit, push-to-reset, indicator counts the number of revolutions of the Take-up Motor, and is there by linked to the tape in all modes of transport operation (see fig. 8-3-1). Rapid return to "0" reference is possible with the push-to-reset button.

FIG 8-3-1

8.3.2 INSTALLATION

Normally, the TC will be installed at the factory, with no user-installation required.
Since the counter mechanism occupies a separate rack-mounted chasses, the height of a typical machine increases by 1 3/4".
Field-installation of the TC may be effected on all PRO Transports, and many older units having 3/8" of T.U. Motor Shaft (at the rear).

8.3.2.1 All PRO700 and PRO800

The T.U. Motor Shaft will accept the threaded end of the small drive-pulley supplied with the TC kit.

Although a clearance hole is normally provided for this pulley, earlier transports may require modification of the corner cover (see fig. 8-3-2).

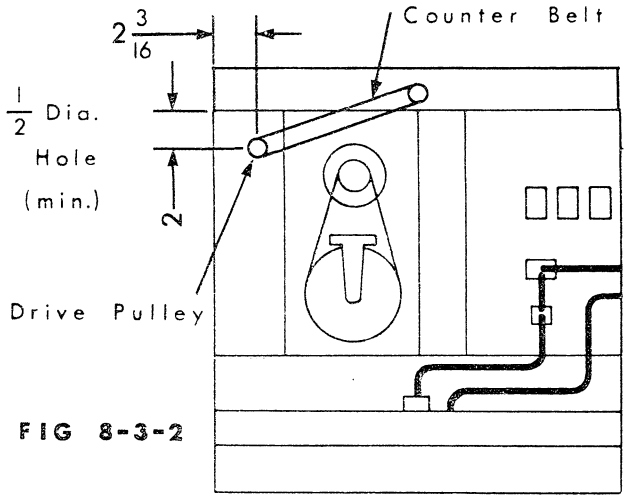


FIG 8-3-2

The drive pulley is then carefully threaded into the rear-end thread shaft of the motor -- tightening by holding reel flange. Stringing the drive belt between pulleys completes the TC installation.

8.3.3.3 T-series 700, G-series 800

A special drive-pulley with 5/16 bore must be supplied with the kit -- specified when ordered by model and S/N of your machine. A modification of motor cover may be necessary on some transports as well.

8.3.3 OPERATION

Usually, the white reset-button is depressed at the beginning of a given tape -- establishing a "0" reference. Thereafter, desired locations on the tape must be noted as a convenient means of returning to a taped selection.

8.3.4 MAINTENANCE

Occasional cleaning of the small counter drive--belt and pulley grooves comprises the major maintenance for smooth operation. All bearings in the TC mechanism are lubricated for life -- no oiling required.

8.3.5 THEORY AND PARTS LIST

The numbered wheels of the counter mechanism are driven by a stepped-gear arrangement to provide decade operation. The input motion is bi-rotational -- being a one-to-one drive from the T.U. Motor Shaft through a flexible belt. Special cogs within the counter enable a zero-reset action with a push of a button. All counter parts are of low-friction, non-wearing plastic with oilite bearings and stainless shafts.

8.3.5.1 User-Replaceable Parts

7194A	Counter Ass'y
3024	Spring Coupling
3016	Heyco bushing
40398	Drive pulley ass'y
40395	Driven shaft ass'y
7833	Counter belt, thin