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HORIZONS INCORPORATED

CLEVELAND, OHIO

6

INSTRUCTION MANUAL
UNDERWATER PRESSURE-TIME RECORDING SYSTEM

[redacted]

11 Mar[redacted] [redacted]53,

3

15 Contract Nonr 78000

Submitted to: Office of Naval Research
Navy Department
Washington 25, D. C.

5 Submitted by: Horizons, Inc[redacted],
Cleveland, Ohio

10 Written by: by Jerome F. Lowenstein and
John T. Burwell, Jr.,

COPY NO. 7 of 14 COPIES

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DIAGRAMS, TABLES AND PHOTOGRAPHS

I. General Description

The equipment is a two channel recorder, complete with piezoelectric blast gauges, signal cables, preamplifier, recording apparatus, Q-step calibrator, and automatic sequence control for the quantitative recording of underwater blast pressures. It is composed of 7 basic units:

(1) hydrophones and cables,

(2) high input impedance preamplifier and Q-step calibrator,

(3) Regulated power supply,

(4) sequence control equipment,

(5) 1000 cycle/second tuning fork frequency standard,

(6) magnetic tape recording apparatus, 0-5000 cycles/second,

(7) 1000 volt-amp Sola Constant Voltage Transformer.

One channel is used to record the signal received from the blast gauge, and the other channel is used to record the output of the 1000 cycle/second tuning fork frequency standard as well as the 60 cycle "speed lock" signal used to control the play back speed. The pressure-time recording channel may be used to record blast pressures up to 3000 psi with a response flat within 3db from 0.04 to 5000 cycles/second. The entire equipment is semi-automatic, requiring only two 24 volt direct current signal pulses for remote controlled operation. These timing signals are applied prior to the blast being recorded. One complete recording unit, serial No. 1, operates in the volume mode while two units, serial No. 2 and No. 3 use the thickness mode. The preamplifier units for the two modes differ only in the padding capacity used. If desired, the output of the preamplifier may be connected to an oscilloscope having a sweep period of 15 seconds and a d.c. amplifier, thus making possible visual observation of blast pressures.

The equipment includes playback units for both channels but does not incorporate means for playing back under the control of the speed-lock. Thus, for a rapid check on the operation of the entire recording operation, no supplementary equipment is required. If, however, accurate playback of data is desired, additional equipment including Playback Demodulator Model 381 is required. A 1000 V.A. Sola Constant Voltage transformer is supplied with each recorder to provide the necessary ± 1% voltage stabilization.

II. Description of Units

A. Thickness Mode Hydrophones and Cables

Three thickness mode barium titanate high sensitivity hydrophones Model XH1 are supplied with recording units No. 2 and 3, with cable lengths of 250 and 1000 feet. In addition, one glass dummy is supplied with each. These gauges average 225 $\mu\mu c$/psi. The crystals of this underwater blast gauge is enclosed in a brass housing in such a manner as to permit the blast pressure to act on the crystal face through the 1/4" thick brass diaphragm but prevents the pressure from being applied to the crystal sides (pressure relief) as shown in Figure 5. This utilizes the thickness modulus of barium titanate which has the largest modulus value and permits the highest output per unit area of the crystal.

To improve the dielectric temperature characteristics of pure barium titanate, additions of 3% $PbTiO_3$ or 5% $CaTiO_3$ have been made to the commercial grade $BaTiO_3$ used in the manufacture of these elements. Each recorder has associated with it gauges of both materials as shown in Figure 12. This table also lists the room temperature and 0°C gauge calibration, length of cable and serial number of associated recorder.

Each gauge has been individually calibrated up to 1800 psi in a quick release pressure chamber. Their respective coulomb sensitivities are shown in Figure 12 as well as capacity and other pertinent data. The gauge response is linear with pressure up to the maximum calibrating pressure of 1800 psi.

The overall dimensions of the thickness operated gauge is 1.5 inches diameter by 3 inches long, including the housing and 1/4" thick diaphragm of brass. See Figure 5 for the machine drawing and Figure 9 for the photograph of the gauge affixed to its cable. The cable is water sealed to the housing by a compressed rubber sandwich (Wilson seal) and this inner chamber (end of cable-connection to high crystal lead) is potted with G. E. No. 227 cable joint compound for additional moisture protection. These gauges will withstand a hydrostatic water pressure of at least 1500 psi without leakage. The diaphragm seals the crystal cavity with a compressed o-ring located inside the bolt circle diameter.

The crystal cavity is 0.156 inch deep by 0.650 diameter for mounting the two piezoelectric $BaTiO_3$ discs which are 0.066-0.070 inches thick by 0.605 diameter. This cavity is sealed from the cable-end cavity by a small hermetic seal so that possible leakage at the cable will not damage the gauge proper.

The bottom $BaTiO_3$ crystal has a 1/8 inch hole through its center to permit the high lead to pass through to the hermetic seal and the cable. The crystals are connected in parallel and generate a positive charge with positive pressure.

The difference between cavity depth and total crystal thickness is adjusted by addition of 0.004 inch lead foils which are placed as shown between diaphragm and crystal, crystal and crystal, and housing and crystal to provide good acoustic coupling and take-up due to dimensional errors when the brass diaphragm is screwed down tight placing the entire assembly under pressure by approximately 0.002 inch. The center foil and its short lead is the high lead. The other faces of the crystals are grounded to the housing (and diaphragm).

Precautions

(1) Do not subject the gauge to temperatures in excess of 60°C (140°F).

(2) Take 1/4 to 1/2 turn on cable seal before water submersion. (If seal feels firm, do not tighten further as excessive pressure can cause rubber gasket to damage or cut through cable.

(3) Diaphragm screws need <u>no further</u> tightening.

(4) Return all gauges to Horizons Incorporated for repair.

<u>Volume Mode Hydrophones.</u>

Three volume mode barium titanate, high sensitivity hydrophones are supplied for use with recorder No.1 (see Figure 10). A similarly constructed glass dummy is also supplied. These gauges average 200$\mu\mu$c/psi.

There are four polarized crystals 0.750 diameter by 0.100 inches thick connected in parallel in this gauge. Figure 4 shows the method of construction. The four crystal discs are separated by three brass discs 3/4 inch diameter and 0.050 inches thick for providing connections to the crystal faces. The bank of brass and $BaTiO_3$ discs are glued together under pressure with Duco cement into a compact stack after the parallel connections have been soldered into the 0.030 diameter lead holes provided in the edge of the brass discs. The fired silver outside electrodes of the 1st and 4th crystal are at ground potential and have the lead wires soldered on directly. The stack height is approximately 0.55 inches.

The assembled stack is soldered to the cable and the entire assembly dipped in an epoxy* resin for a distance of 1 1/2" down the cable. This provides a waterproof protective covering allowing no pressure relief surfaces, thus utilizing the volume piezoelectric mode of $BaTiO_3$. A layer of air-drying silver paint is applied to this first coat for electrostatic shielding and is connected to ground by filing away the first coat near a ground wire so the paint makes contact. A second plastic coat is applied over the silver. This plastic sets at room temperature to form a firm resilient coating.

For reasons discussed in the previous section these $BaTiO_3$ crystals are also made with 3% $PbTiO_3$ or 5% $CaTiO_3$ additions. See Figures 12 and 13 for

* Araldite AN-101 Ciba Company, Inc., N. Y., N. Y.

further characteristics.

Each gauge has been individually calibrated as above at room temperature and is essentially linear up to maximum calibrating pressure of 1800 psi. The gauge will operate satisfactorily at hydrostatic pressure of 2500 psi or greater.

Precautions

(1) Do not subject the gauge to temperatures in excess of 60°C (140°F)

(a) Should the gauge be accidentally depolarized due to excess heat, it can be repolarized at room temperature by applying 3500 volts for 12 hours. Positive voltage is applied to the high lead.

Figure 13 shows the variation of KA with temperature for both the thickness mode and volume mode gauges with both lead and calcium titanate additions.

B. Preamplifier and Q Step Calibration

The preamplifier unit is a split cathode resistor cathode follower having an input impedance of the order of 300 megohms and accepting a 50 volt input signal without overload. The gain of the preamplifier is adjustable to any of six values, 1/1, 1/2, 1/4, 1/6, 1/8, and 1/10 of full output depending upon the expected maximum blast pressure. Simultaneously the magnitude of the calibrating voltage is varied as the reciprocal of the above ratios, so that the magnetic recorder itself always receives a constant calibration voltage Vc, regardless of the pressure setting.

The plate current of the preamplifier is indicated on the 0-5 milliampere panel meter. The Q-step calibration circuit is composed of resistors R9 through R15, capacitors C3 through C6 and relay RY5. With the relay de-energized the calibrating capacitor C3 (0.02µfd) is placed across the line from the blast gauge and makes up a part of the 0.047 µfd total capacitance across the input circuit. To calibrate the circuit the relay is energized, thus shorting the line to ground and charging the calibration capacitor, C3 to the predetermined voltage appearing across R9. The relay is then de-energized removing the short on the line and again connecting the capacitor across the line. A step voltage Vc is thus applied to the preamplifier. The height of this pulse is to be used in calibration. The total RC of the input circuit determines the exponential rate of decay.

Let

Vc = calibration voltage (input to magnetic recorder)

Vs = voltage to which Cs is charged (See Table I)

Cs = calibrating capacity 0.02 μfd ± 1%

Cc = gauge + cable capacity

Co = padding capacity

Ct = total capacity across preamplifier input, 0.047 μfd.

(1) $Ct = Cc + Co + Cs = 0.047$ μfd

(2) $Vc = (Cc + Co + Cs) = VsCs$

(3) $Vc = \frac{VsCs}{Cc + Co + Cs} = \frac{0.02 \times 1.25}{0.047} = 0.532$ volts into preamplifier

(4) $Vp = \frac{(KA)\ P}{Cc + Co + Cs}$

(5) $\frac{Vp}{Vc} = \frac{(KA)\ P}{Cs\ Vs}$

(6) $P = \frac{Vp\ (CsVs)}{Vc\ (KA)}$ obtained from 3) and 4)

Note: KA = gauge constant (μμc/psi)

P = pressure in psi

Vp = voltage produced by P

Thus, it is seen that the determination of the blast pressure is independent of the gain of the recording system. It is only necessary to ratio the heights, Vp and Vc, of the final recorded data. The pressure reading is also independent of variation of the time constant of the circuits except as it affects the low frequency response.

Two time constants associated with the preamplifier stage are of importance in that they affect the low frequency response of the stage. The input impedance Ri of the circuit and the capacitors Cg, Cc, Co and the 0.25 μfd coupling capacitor have a time constant RiC_T of $(\sim 300 \times 10^{6})\ (0.0395 \times 10^{-6}) \cong$ 12 seconds.

The output coupling capacitor (10μfd) and the 1 megohm input impedance of the Ampex magnetic recorder have a time constant of 10 seconds (10×10^{-6}) (1×10^{6}). The preamplifier output is down 3 db at 0.03 cycles per second and is essentially flat to 5000. cycles per second.

The padding capacitors C4 through C6 (Co in preceding equations) are used to bring the total capacity across the line to 0.047 μfd. C4 and C5 are switched in when the 250 foot spare cable is used. Capacitor C6 appears in units No. 2 and 3 only and makes the total capacity of the compression mode units the same as that of the volume mode units. Capacitor C1 blocks the direct voltage on the grid of the preamplifier tube from the cable. Capacitor C2 blocks the direct cathode voltage from the recorder input which responds to direct current.

C. <u>Sequence Control Circuit</u>

This circuit controls the timing sequence of the entire remote controlled recording of blast pressures. It is triggered by two incoming 24 volt direct current signals prior to the blast. The heart of the unit is an Eagle Signal Corp., Multiflex Timer which programs the associated relays for warm-up, recorder motor starting, recording, calibration before and after blast, and final power shut off.

Certain precautionary features have been designed into the control circuit. For example, if the 115 volt power should fail momentarily the sequence operation will continue from the point of power failure and not reset to the original condition. Also, if any subsequent 24 volt direct current signal after the first two will have no effect on the sequence of operation. Thus, if at the time of the blast or later a false signal should arrive it will have no effect on the operation of the unit. It should be noted that the center section of the front panel is removable for servicing.

D. <u>1000 CPS Frequency Standard</u>

The 1000 cycle/second tuning fork frequency standard, manufactured by American Time Products, Inc., is used as a time standard, its output being recorded on channel 2 of the Ampex tape recorder. The output of the standard has been adjusted to approximately .06 volt R.M.S. and should require no adjustment. The temperature coefficient of frequency is one part per million/degree C. See appendix B for manufacturer's instruction book on this unit.

E. <u>Power Supply</u>

A Lambda Corporation Model 28 unit is the power supply in rack A for the preamplifier, calibration circuit, and 1000 cycle frequency standard. Its output has been adjusted to 200 volts ±1% to supply plate voltage and precision voltage Vs for the calibration circuit. If readjustment becomes necessary the volt-meter should be adjusted to 198 volts for Unit No. 1, 200 volts for Unit No. 2, and 202 volts for Unit No. 3. Appendix A is the instruction book supplied by the manufacturer on this power supply.

F. <u>Ampex Tape Recorder - Model S3141</u>

The Ampex 2 channel magnetic tape recorder with playback has a response which is flat from direct current to 5000 cycles per second within +1 - 3 db. A peak input of 1.41 volts is the maximum allowable without overloading the recorder. See Appendices C, D, and E for instruction books covering all components of the recorder.

G. Sola Constant Voltage Transformer, Model 30809

A 1000 V.A. voltage regulating transformer is supplied with each recorder to provide the necessary ±1% regulation.

III. Sequence of Operation

A. The first 24 volt direct current signal arrives at a minimum of minus seven minutes to allow all circuits to stabilize.

(1) Relay RY1, the 24 volt starting relay is energized for the duration of the signal which must be less than five seconds.

(2) Relay RY1 energizes lock-in relay RY2 which applies 115 volts to the power supply, recorder electronic parts, Hayden time delay relay, and to the clutch coil of the multiflex timer thus resetting it.

(3) After a delay of 5 seconds relay RY4 completes the circuit to lock in relay RY3 readying it for the second 24 volt control signal. The clutch coil was energized only for the duration of the first signal.

B. The second 24 volt direct current signal arrives at minus two minutes.

(1) RY1 is again energized applying power to both lock-in relays RY2 and RY3.

(2) Relay RY2 is already locked in but RY3 now closes applying power to the multiflex timer motor and the automatic operation begins.

C. Multiflex Operation

(1) Contacts 1A - 1B closed when the clutch coil was de-energized (1c).

(2) Contacts 2A - 2B close momentarily, starting the Ampex recorder motors by energizing the "start" circuit.*

(3) Contacts 3A-3B close momentarily, energizing the "record" circuit.

* The recorder can still be operated manually with its "start" and "record" buttons.

(4) Contacts 4A-4B close, energizing relay RY5, thus charging the calibration capacitor and shorting the input of the preamplifier to ground.

(5) Contacts 4A-4B open removing the short to ground and applying the calibration voltage to the preamplifier.

(6) Ampex recorder operates for 13 minutes.

(7) Contacts 5A-5B close. (Repeat d)

(8) Contacts 5A-5B open. (Repeat e)

(9) Contacts 2A-2B open, stopping the recorder motor.

(10) Contacts 3A-3B open.

(11) Contacts 6A-6B close, energizing the unlatching coils and opening RY2 and RY3, removing all 115 volt power.

IV. Manual Operation

(1) Connect the power cord to a 115 volt, 60 cycle power source and throw the main power switch S3. The pilot lamp L1 will light.

(2) Set the preamplifier sensitivity control to a value above the maximum pressure expected on that channel. Approximately 10% above maximum scale value can be tolerated on the recorder before overload takes place.

(3) Press the manual start button S1 once. Power will be applied to all circuits requiring preheating and to pilot lamp L2. The manual start button must be depressed for a period shorter than 5 seconds. A momentary contact is preferred. The 0-5 milliampere meter should read approximately 2.5.

(4) After a delay of at least 5 minutes, press the manual start button a second time. Power is now applied to the sequence timer which performs the following operations automatically.

(a) Starts the recorder motor.

(b) Begins the recording period.

(c) Calibrates the equipment (through to the magnetic tape).

(d) Provides an adjustable recording time.

(e) Recalibrates the equipment.

(f) Shuts off the equipment.

(5) At any time while the equipment is on, the reset button may be depressed causing the timer to reset and the entire equipment except lamp L1 to be shut off.

If a check on the operation of the control unit only is desired and no recording is contemplated, the 5-minute delay may be omitted.

V. Remote Operation

(1) Connect the power cord to a 115 volt, 60 cycle power source and throw the main power switch S3. Pilot lamp L1 will light.

(2) Set the preamplifier stage sensitivity control to a value above the maximum pressure expected on that channel. Approximately 10% above maximum scale value can be tolerated on the recorder before overload takes place.

(3) Check the value of calibrating voltage (200 volts) and preamplifier current (2.5 ma) by pressing manual start button. Push reset button to remove voltage from filaments.

(4) The operator may now leave the equipment as no further local adjustments are necessary.

(5) A 24 volt direct current signal applied to the control signal connector on the panel will cause power to be applied to all circuits requiring preheating. The duration of the 24 volt signal must be shorter than 5 seconds and a momentary pulse is preferred. (This signal should be applied at "minus seven minutes" or more for adequate warm-up).

(6) After a delay of not less than 5 minutes, the second 24 volt signal may be applied. The length of this signal is not critical nor will further pulses due to any cause have any effect on the equipment. This signal should be applied at "minus two minutes" to allow time for calibration.

Power is now applied to the sequence timer which performs the following operations automatically:

a. Starts the recorder motor.

b. Begins the recording period.

c. Calibrates the equipment.

d. Provides an adjustable recording time.

e. Recalibrates the equipment.

f. Shuts off the equipment.

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Sr. Research Associate

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Technical Manager

HORIZONS INCORPORATED
Cleveland, Ohio
March 5, 1953

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PART VI. DIAGRAMS, TABLES AND PHOTOGRAPHS

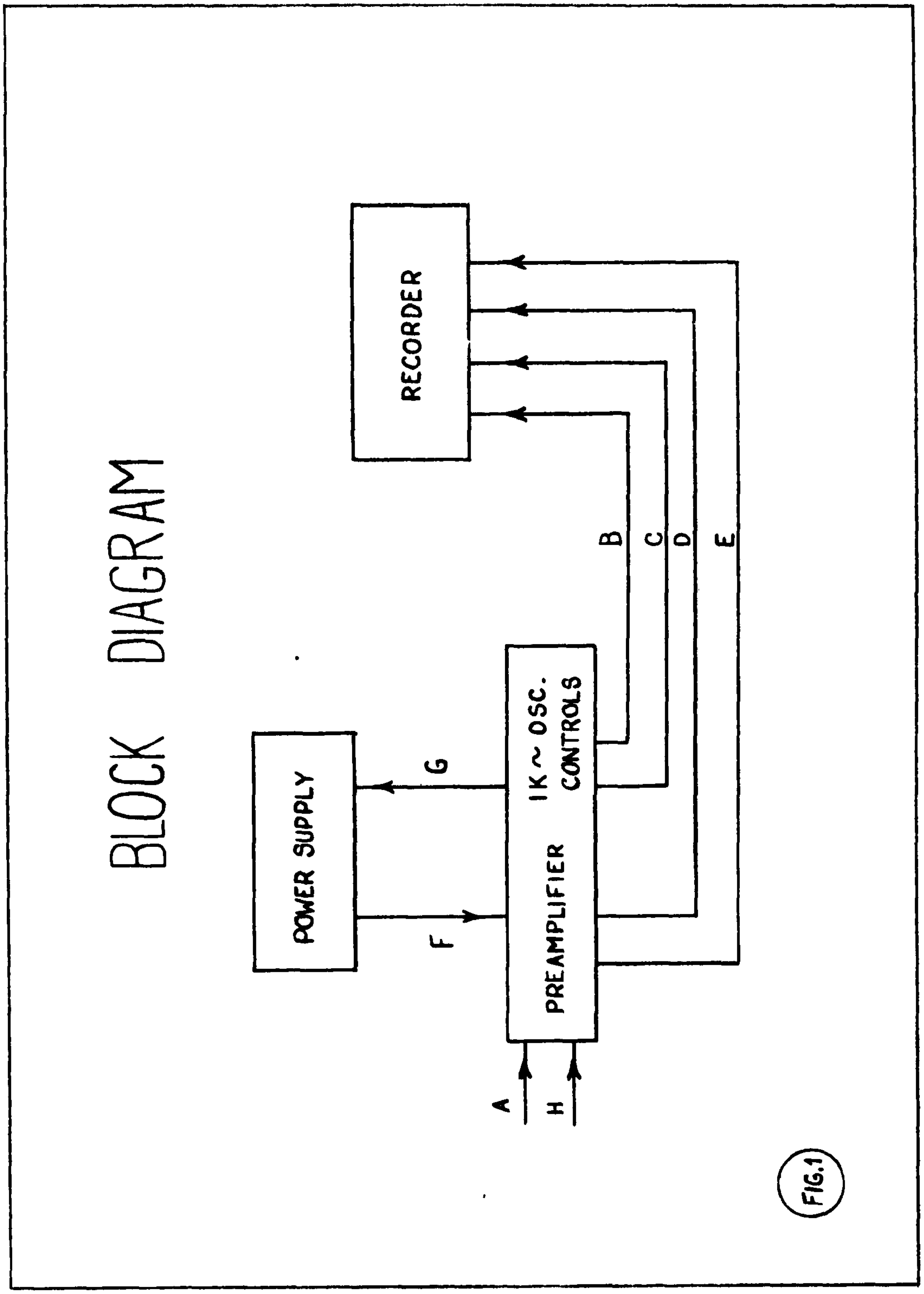


Figure 1. Block Diagram of Complete System

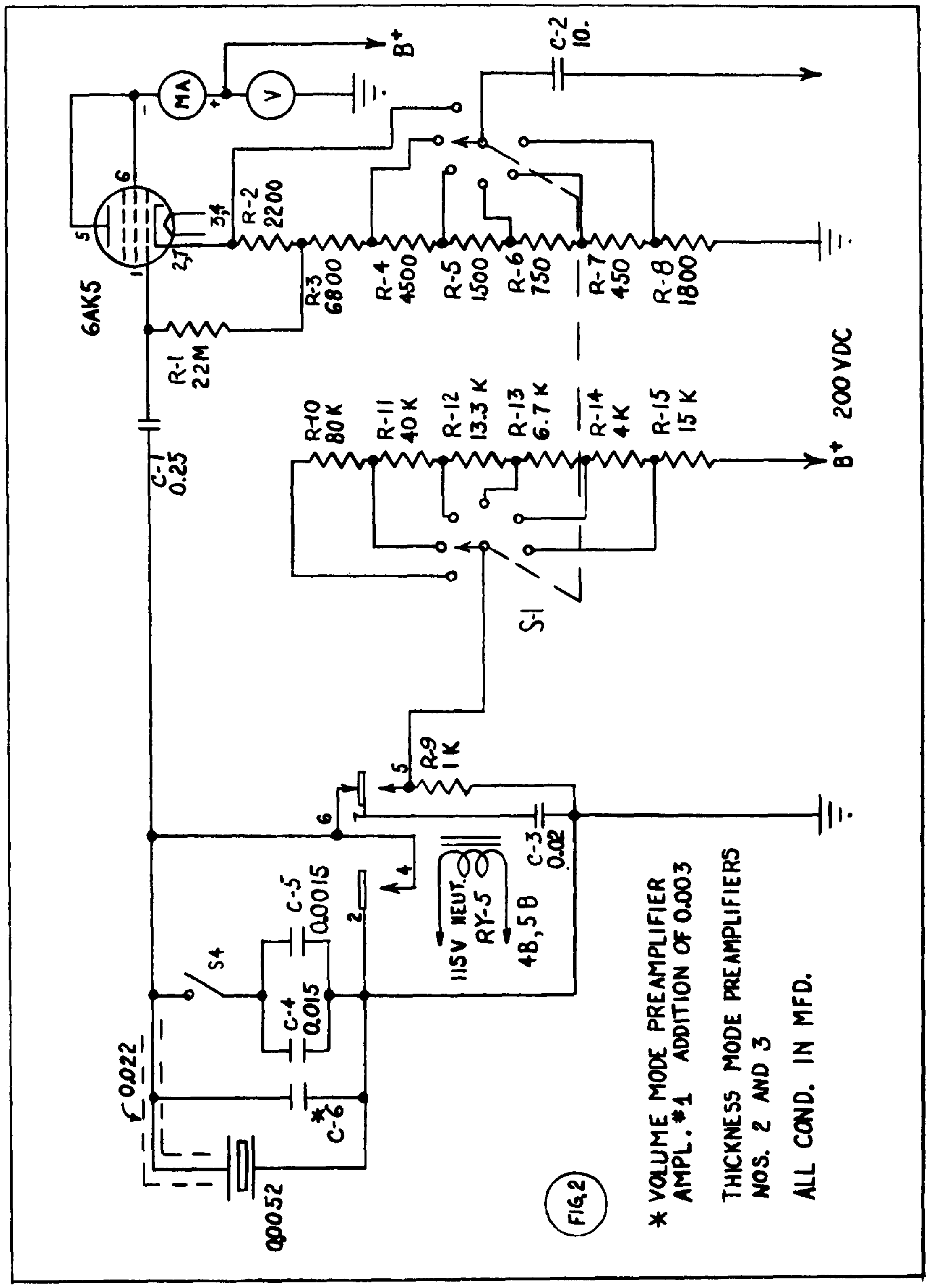


Figure 2. Schematic Diagram of Preamplifier

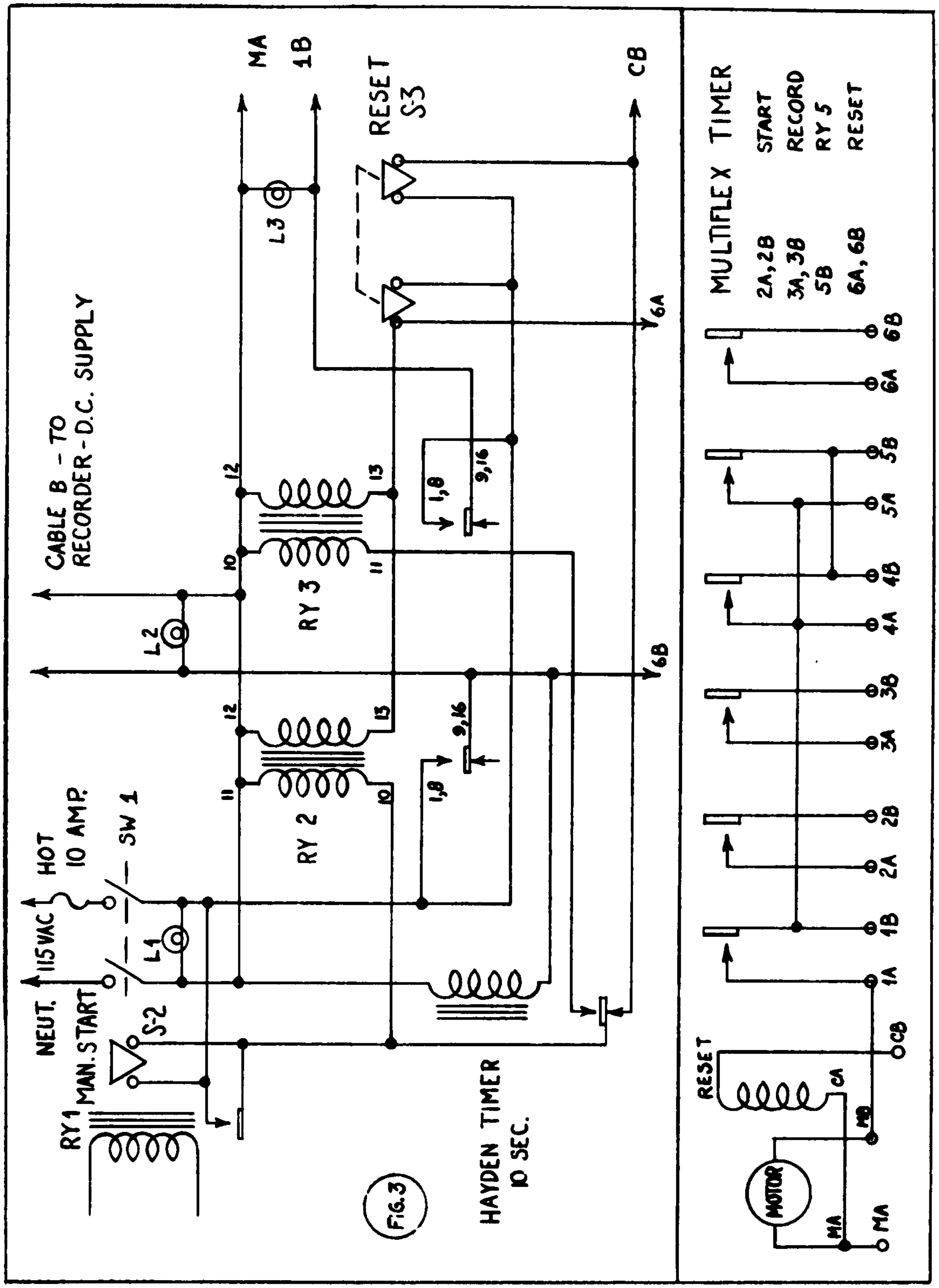


Figure 3. Schematic Diagram of Control Circuit

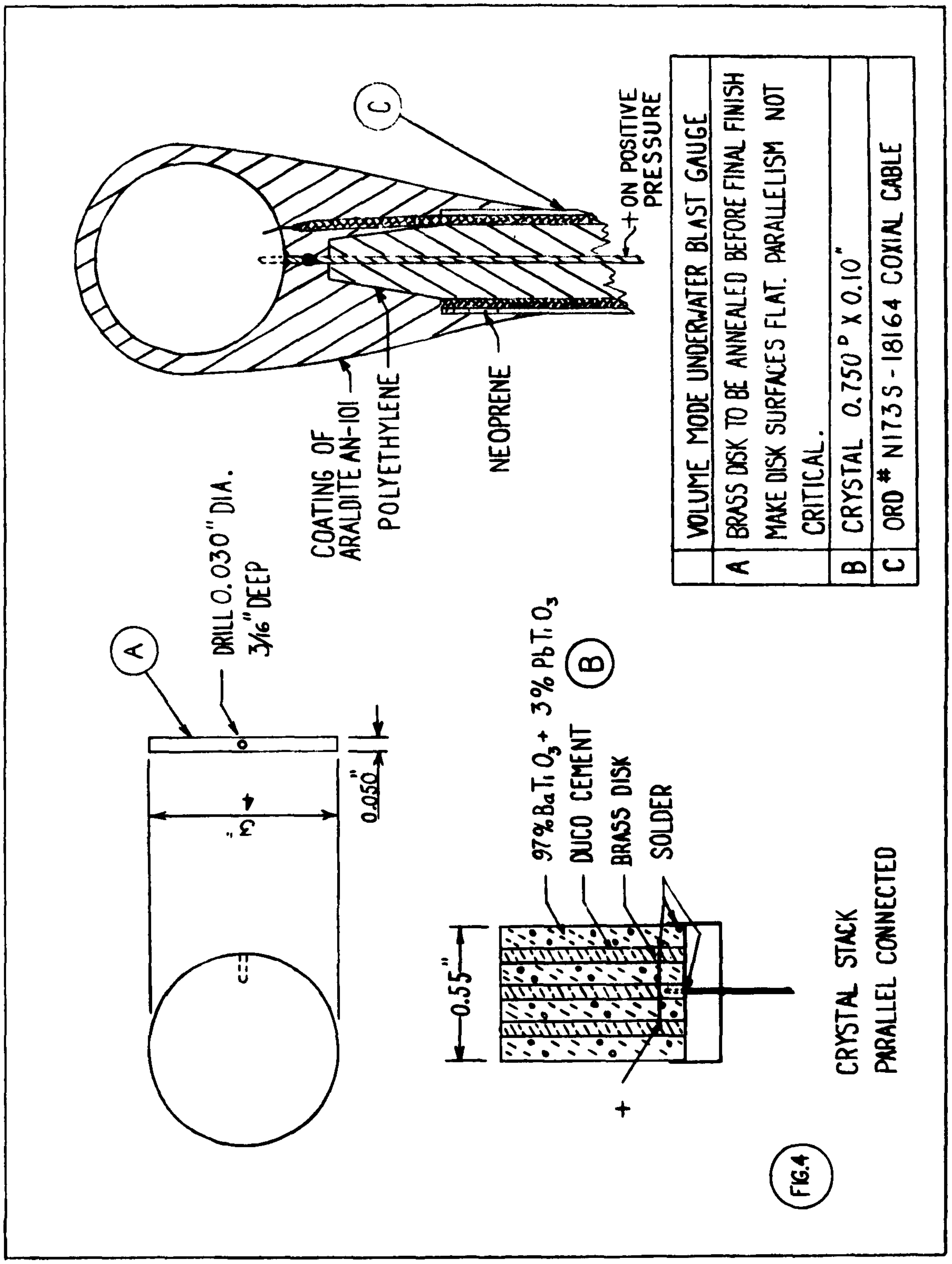


Figure 4. Volume Mode Gauge Drawing

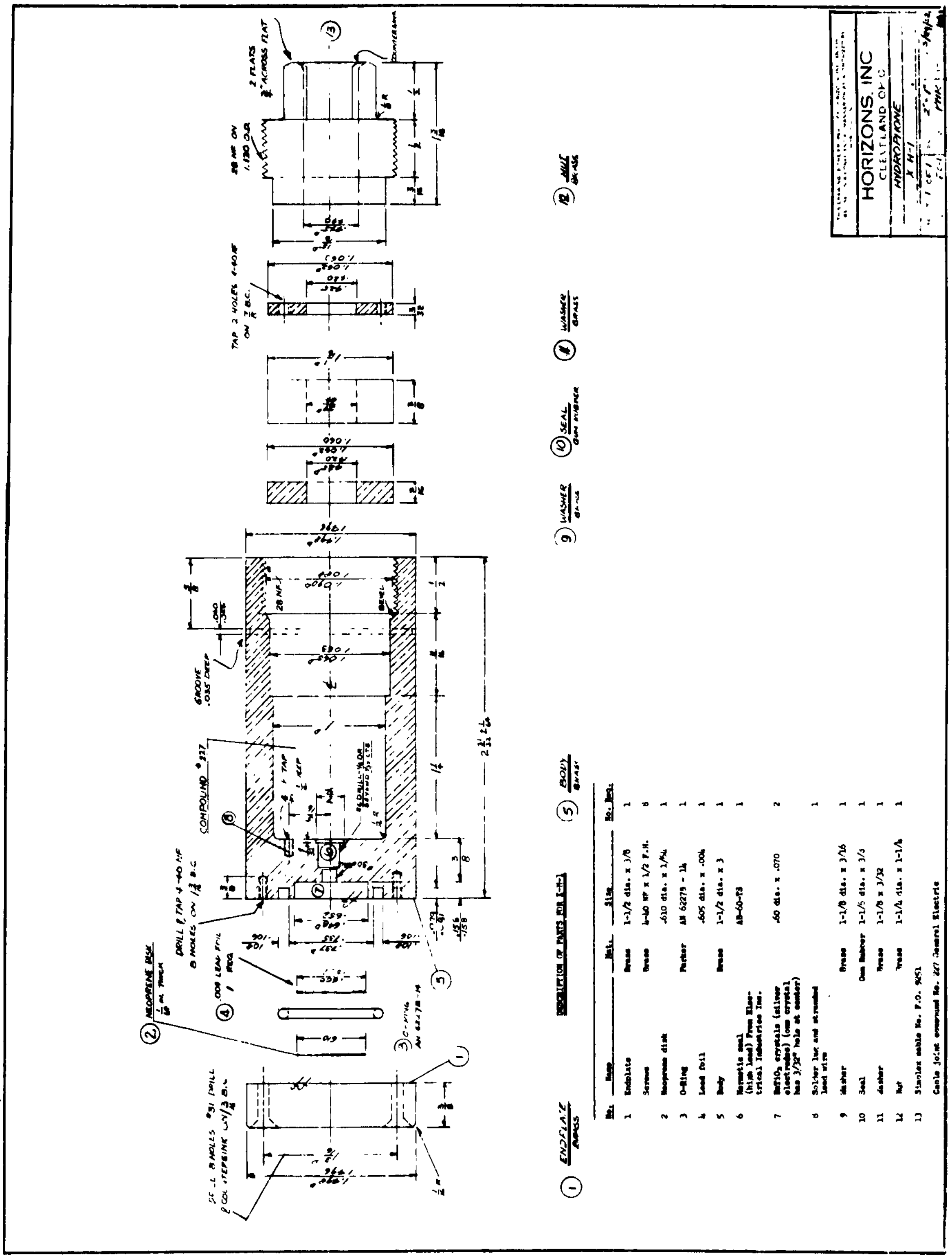


Figure 5. Thickness Mode Gauge Drawing

HORIZONS INCORPORATED

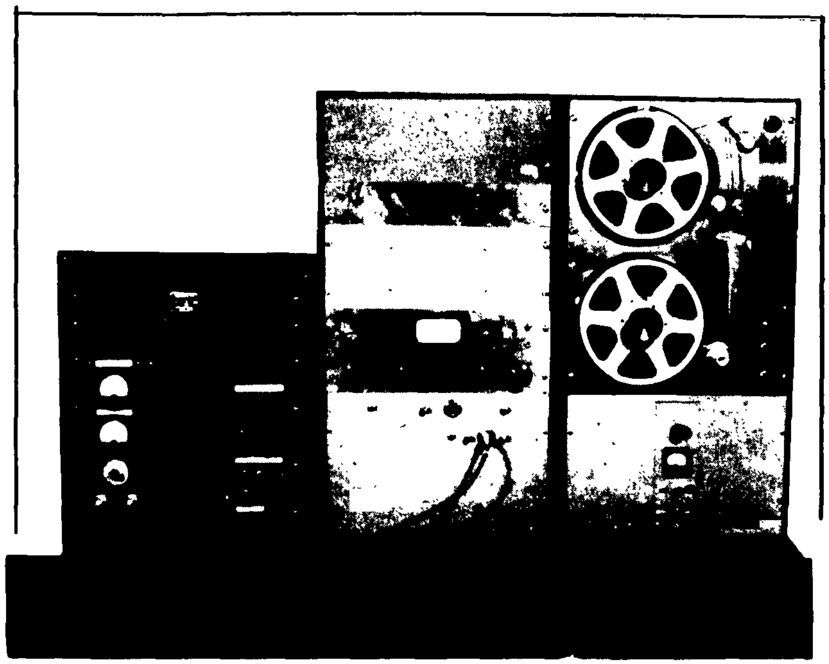


Figure 6. Front View of Complete System

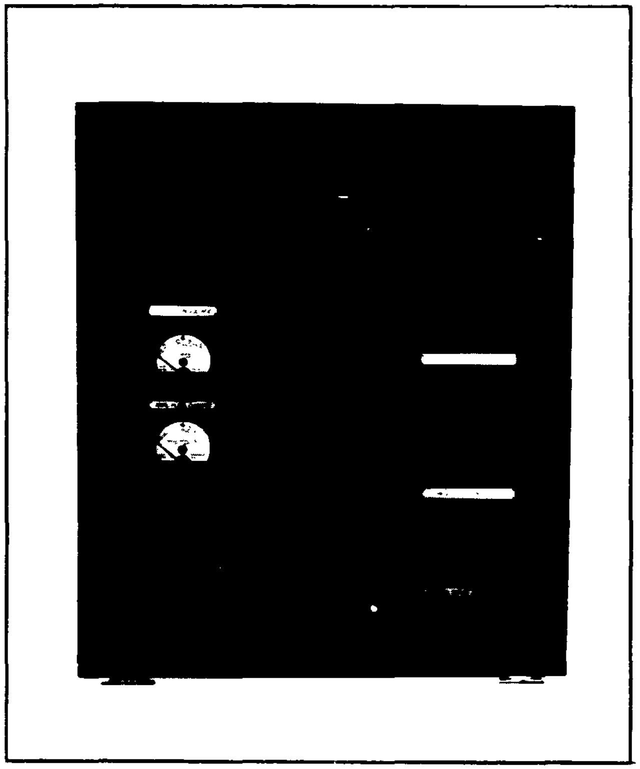


Figure 7. Front View of Control Chassis

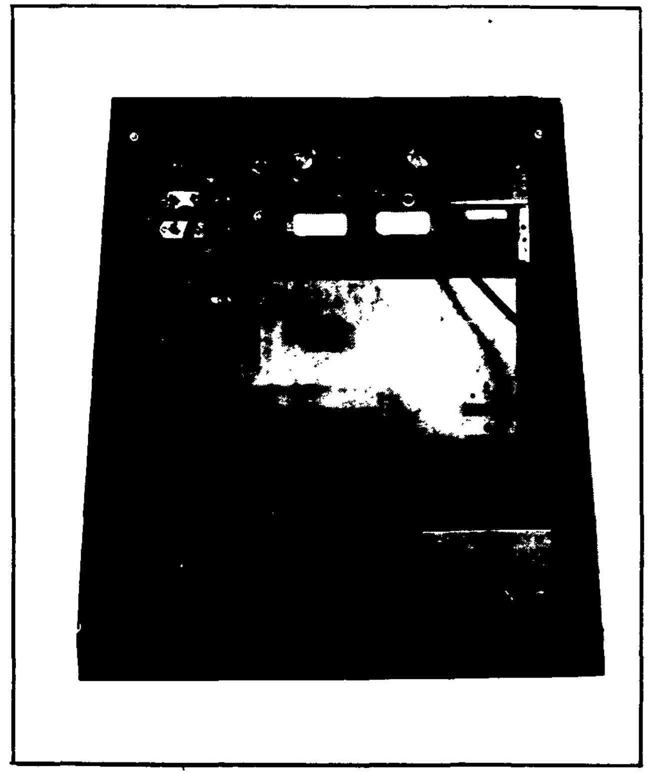


Figure 8. Rear View of Control Chassis

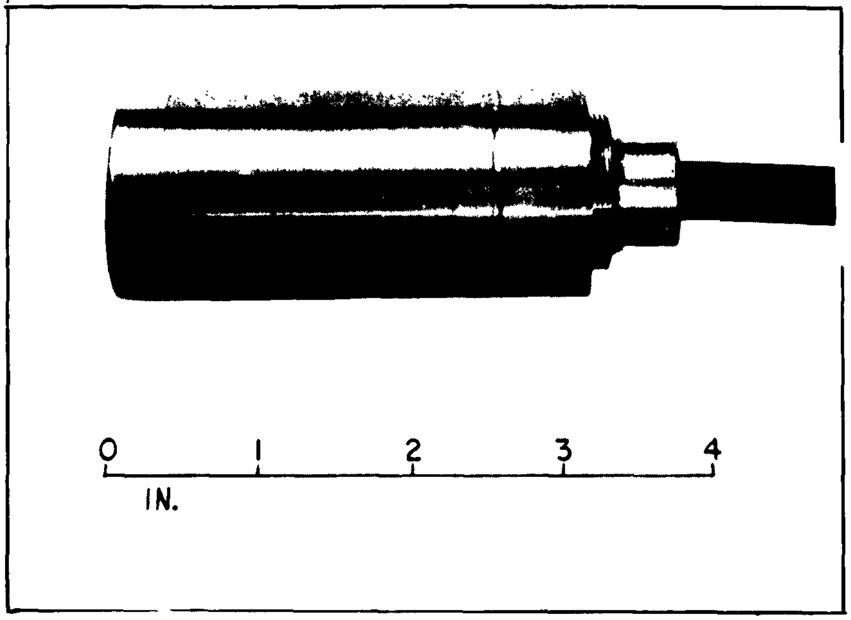


Figure 9. Thickness Mode Gauge

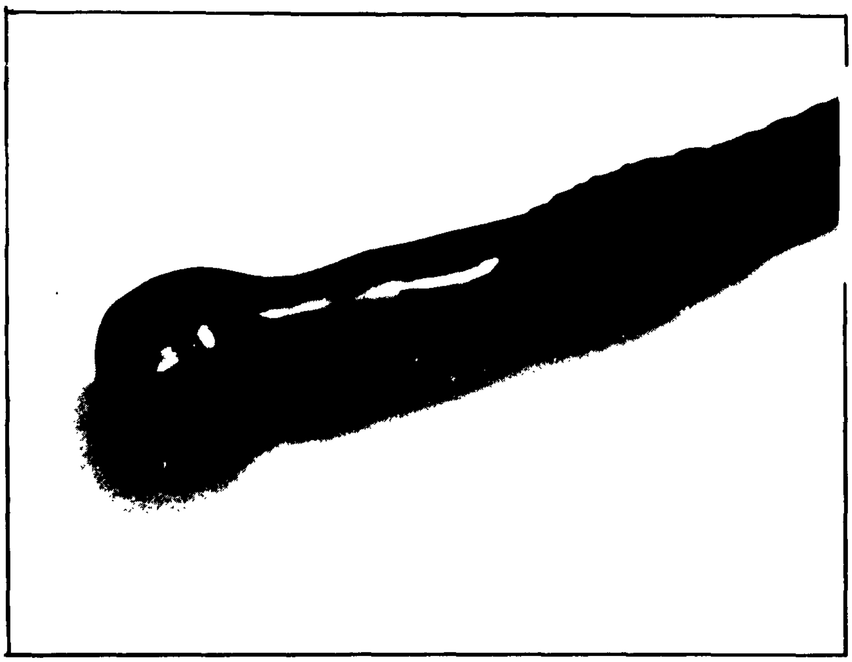


Figure 10. Volume Mode Gauge

Figure 11

PRESSURE RANGE SETTING	Vs	CsVs
300 psi	1.25	0.025×10^{-6}
600	2.5	0.05
1200	5.0	0.10
1800	7.5	0.15
2400	10.0	0.20
3000	12.5	0.25

Figure 12
GAUGE CHARACTERISTICS

GAUGE NO. and COMPOSITION	USED WITH RECORDER SERIAL NO.	ROOM T. GAUGE CAPACITY (No Cable) μμf	ROOM TEMP. CALIBRATION μμc/psi	0° CALIB. μμc/psi	MODULUS UTILIZED	CABLE LENGTH FEET
XH1 - 7 $BaTiO_3$+3%$PbTiO_3$	2	2520	215.	308	Thickness	1000
XH1-8 $BaTiO_3$+3%$PbTiO_3$	2	2500	192	----	"	250
XH1-11 $BaTiO_3$+5%$CaTiO_3$	2	2150	216	----	"	250
XH1-10 $BaTiO_2$+5%$CaTiO_3$	3	2150	215	272.	"	1000
XH1-12 $BaTiO_3$+5%$CaTiO_3$	3	2020	192	----	"	250
XH1-9 $BaTiO_3$+3%$PbTiO_3$	3	2650	225	----	"	250
XH1-13 Glass dummy	2	----	----	----	----	210
XH1-14 Glass dummy	3	----	----	----	----	250
V - 1 $BaTiO_3$+5%$CaTiO_3$	1	4000	264	200	Volume	1000
V - 2 $BaTiO_3$+3%$PbTiO_3$	1	5500	287	----	Volume	1000
V - 3 $BaTiO_3$+3%$PbTiO_3$	1	4980	231.	300	Volume	250
V - 5 Glass dummy	1	----	----	----	Volume	250

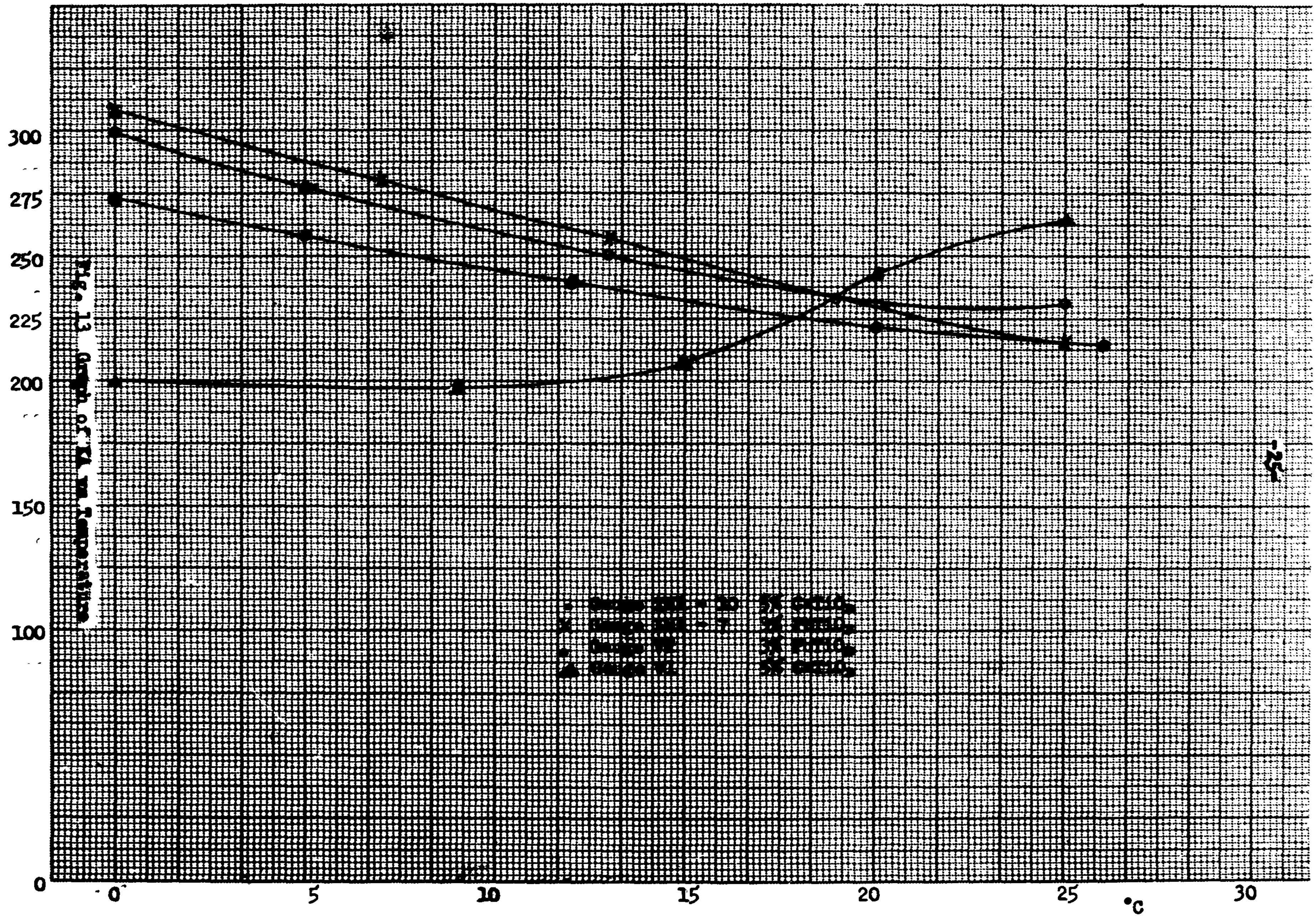
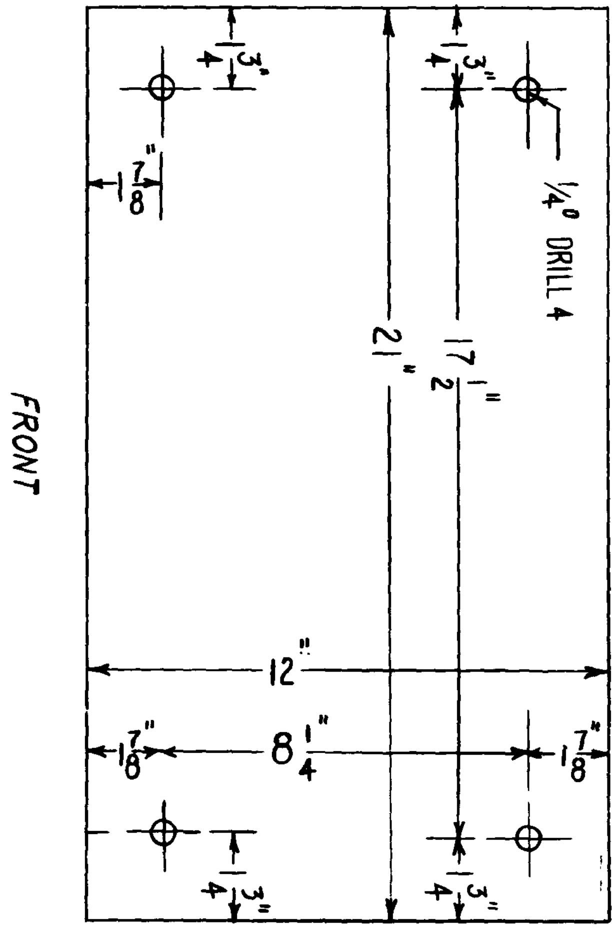
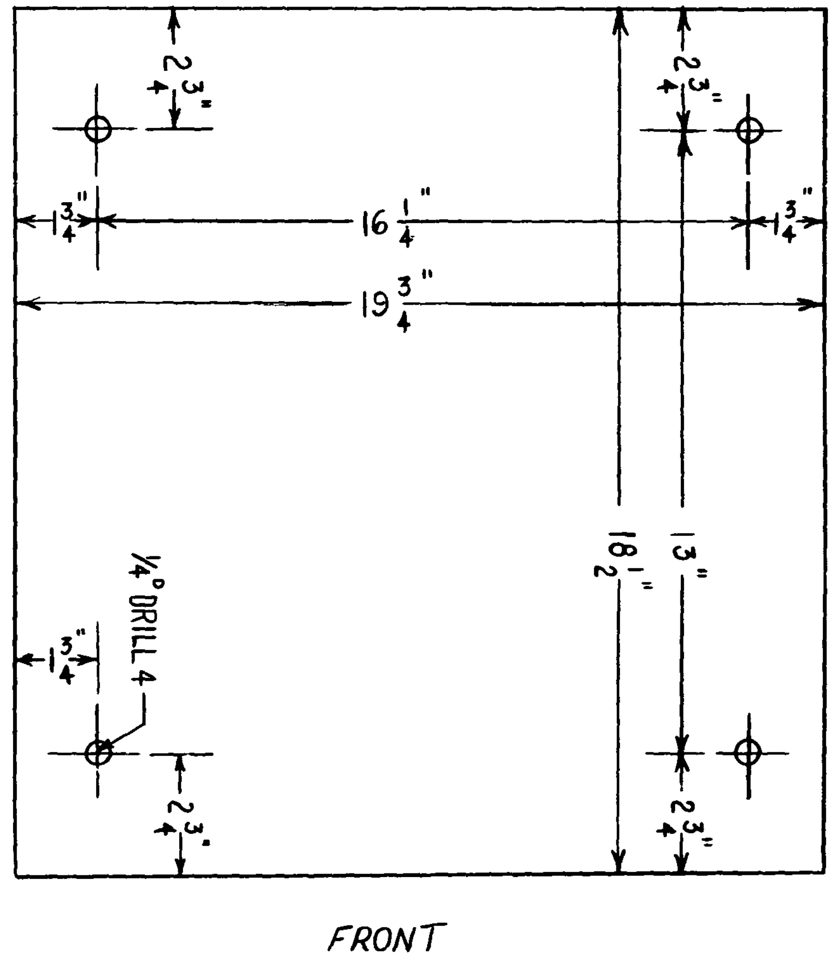


Fig. 13 Graph of KA vs Temperature





RECORDER BASE DIAGRAMS

DIMENSIONS ± 1/8 INCH

VII - PARTS LIST

		Mfg.
R1	22 megohm 1/2 watt, 10% tolerance	1
R2	2200. ohms, 1 watt, 1% " , Nobleloy	1
R3	6800. ohms, 1 " " " "	1
R4	4500. ohms " " " " "	1
R5	1500. " " " " " "	1
R6	750. " " " " " "	1
R7	450. " " " " " "	1
R8	1800. " " " " " "	1
R9	1000. " " " " " "	1
R10	80,000. " " " " " "	1
R11	40,000. " " " " " "	1
R12	13,333. " " " " " "	1
R13	6,666. " " " " " "	1
R14	40,000. " " " " " "	1
R15	15,000. " 5 watts " " "	1
C1	0.25 µfd. 400. volts, Polystyrene, 10% tolerance	2
C2	10. µfd. 400. volts, Stabelex "D"	3
C3	0.02 µfd. " " Polystyrene, 1% tolerance	2
C4	0.015 µfd. " " " 1% "	2
C5	0.0015 µfd. " " " 10% "	2
C6	0.003 µfd. " " " 10% "	2
RY1	Relay, 24 volt D.C. Coil. Type ASH-3D	4
RY2	" 115 volt A.C. Coil. Type BJUH-12A	4
RY3	" " " " " " " "	4
RY4	" " " " " " 5901-1	5
RY5	" " " " " " BJH-6A	4
V	Meter 0-250 volts, D.C. Type HS3	6

PARTS LIST (Continued)

	Mfg.
MA Meter, 0-5 milliamperes, D. C. Type HS3	6
S1 Rotary Switch, Type 176C	7
S2 Push button switch, Type 2001	7
S3 Push button switch, " 2001L	7
Multiflex Timer	8
Sola Constant Voltage Transformer Type No. 30809	9
Lamps, Type 6 watt	

PARTS MANUFACTURERS LIST

1. Continental Carbon Co.
2. John Fast
3. Industrial Condenser Corp.
4. Allied Control Co.
5. Hayden Mfg. Co.
6. Marion Electrical Instrument Co., Stark St. Gate, Manchester, N. H.
7. Mallory
8. Eagle Signal Corp.
9. Sola Electric Co.

PART VIII APPENDICES (Component Instruction Books)

APPENDIX A

LAMBDA MODEL 28 REGULATED POWER SUPPLY

INSTRUCTIONS

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLY

MODELS 25, 28

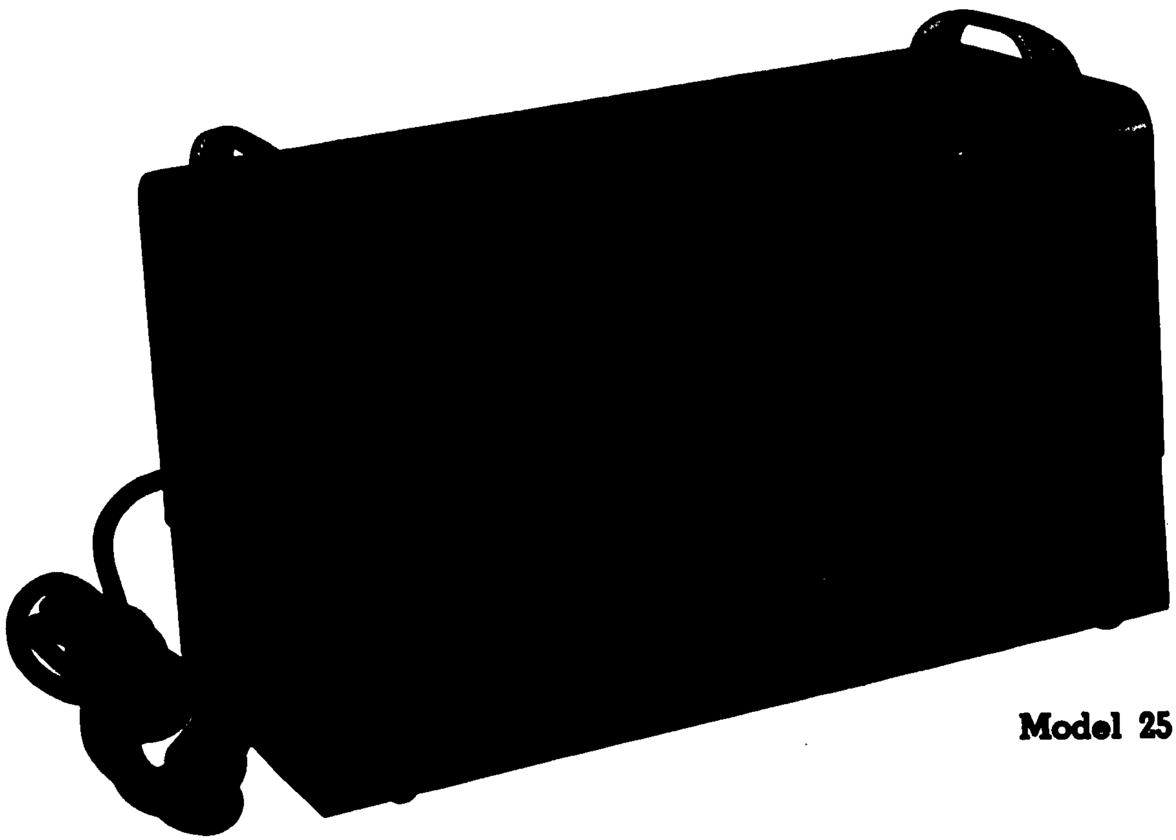
Manufactured By

LAMBDA ELECTRONICS CORP.

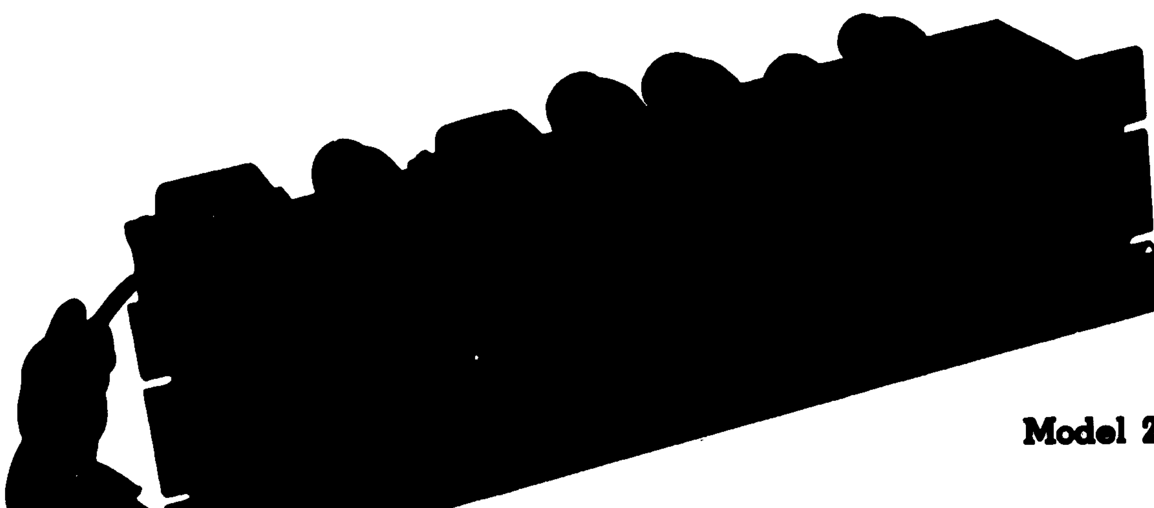
CORONA, NEW YORK

Model No. ....

Serial No. ....



Model 25



Model 28

INSTRUCTION MANUAL
for
Regulated Power Supply
Models 25, 28

I. General Description

1. General Description

The power supplies described herein are designed for use in industry, laboratory, radio station and school to supply power to electronic and other equipment. The DC output voltage is electronically regulated and is practically independent of external load (within limits) and normal line voltage fluctuations, and is also substantially free from hum and noise. Quality components, careful construction and conservative ratings are employed to insure long and dependable service.

To meet a variety of needs the power supplies are available in the following styles having identical electrical specifications:

Model 25 Compact and portable bench type. Functionally designed for maximum convenience and utility as a general purpose power supply.

Model 28 Compact unit for mounting in standard 19 inch racks. Designed for use with associated equipment in permanent and semi-permanent installations.

2. Electrical Characteristics of Models 25, 28

Input: 105-125 Volts AC, 50-60 cycles, 120 watts.

DC Output: Continuously variable from 200 to 325 Volts DC regulated from 0 to 100 ma max. Either positive or negative side of supply may be grounded.

AC Output: 6.3 Volts AC center-tapped at 3A unregulated.

DC Voltage Regulation: Output constant to better than 1% for loads from zero to full load and line voltage variations from 105 to 125 volts.

Internal Impedance: Approximately 10 ohms.

Noise and Ripple Output: Less than 10 millivolts rms for above ratings.

Tube Complement: 5V4G rectifier, 2-6Y6G series control tubes, 6SJ7 DC amplifier, OA3/VR-75 comparison voltage source.

3. Mechanical Specifications

Model 25 Cabinet Dimensions
Height: 8 inches
Width: 14 inches
Depth. 6 inches
Weight: 17 pounds
Finish: Grey ripple enamel.

Model 28 Standard 19" Rack Mounting
Panel Height: 5¼ inches
Panel Width: 19 inches
Depth behind Panel· 7½ inches
Weight. 17 pounds
Panel Finish: Black or gray (Munsell 4.5) ripple enamel.

II. Operating Instructions Models 25, 28

MODEL 25

1. Model 25 Front Panel Operating Controls and Terminals

a) The "AC ON" toggle switch is in the transformer primary circuit and controls power to the supply. The adjacent pilot light indicator having a green jewel is illuminated when the switch is in the ON position. The adjacent extractor type fuseholder marked "1.5A" is designed for a 1.5 ampere type 3AG fuse.

b) The "DC ON" toggle switch is in the transformer secondary center-tap circuit and permits the DC output to be turned off leaving the power supply in a "standby" condition. The adjacent pilot light indicator having a red jewel is illuminated when the switch is in the ON position. The adjacent fuseholder marked "0.125A" is designed for a 0.125 ampere type 3AG fuse.

c) The "DC OUTPUT VOLTAGE" control is a wirewound rheostat which permits the d-c output voltage to be set at any value between 200 and 325 volts d-c. The calibrated scale indicates the output voltage and is accurate to within 5%. For reasons of manufacturing and component tolerances it is necessary to leave a small portion at each end of the range of this control uncalibrated. When the control is set in these regions, the output voltage will be either slightly less than 200 volts or slightly greater than 325 volts d-c. The supply may be operated in this condition but loads drawing more than 70 ma are not recommended if regulation and hum-level ratings are to be maintained.

d) OUTPUT TERMINALS. The output terminals are sturdy, insulated "captive head" binding posts which can be used in a number of ways and are rugged enough to take a substantial amount of handling and abuse. They will accept "wrap-around" wire connections, "alligator" clips, banana plugs, spade lugs, and wire as large as #12 AWG for permanent feed-through clamping. The d-c output terminal pair and the 6.3 VAC output terminal pair are each spaced on ¾ inch centers so that they will accept standard double banana plugs.

DC OUTPUT CONNECTIONS. The DC output connections marked "200-325 VDC" supply the regulated DC output voltage. The positive connection is brought out through the red binding post. The negative connection is brought out through the black binding post. In most applications it is usual for the negative terminal to be at ground potential. In some cases it may be desired to place the positive terminal at ground potential. Still other application may require that neither positive nor negative be at ground potential. In such cases where either the positive or negative output connections are to be at ground potential, the appropriate terminal should be connected by means of a jumper wire to the binding post marked "GND." This latter post is connected to the power supply chassis.

AC OUTPUT CONNECTIONS. The AC output connections marked "6.3VAC 3A" supply unregulated voltage for vacuum tube heater circuits. The center-tap of this connection is brought out to the binding post marked "CT."

2. Placing Model 25 into Operation

a) Both "AC-ON" and "DC-ON" toggle switches should be in the OFF position.

b) Plug power cord into source of 115 volts AC, 50-60 cps.

c) Throw the left-hand toggle switch to the "AC-ON" position. The green pilot light should be illuminated. 6.3 Volts AC will be present at the terminals so marked. No output will be present at the DC output terminals. Allow the supply to warm up for a minute or so.

d) Set the "DC OUTPUT VOLTAGE" control to the desired voltage.

e) Throw the right-hand toggle switch to the "DC-ON" position. Regulated DC voltage will be present at the terminals so marked. The power supply is now in full operating condition.

f) If it is desired to turn off only the d-c output, use the d-c toggle switch, leaving the a-c toggle switch in the ON position. In this manner, the supply will be in a standby condition and ready for instant use.

NOTE: Should the supply be turned on by means of the "AC-ON" switch while the "DC-ON" switch is in the ON position, inherent protection is afforded by the circuit design to prevent the d-c output voltage from exceeding the voltage indicated by the "DC OUTPUT VOLTAGE" control.

3. Model 25 Fuse Protection

a) INPUT CIRCUIT. The 1.5 ampere 3AG fuse in the input circuit is mounted on the front panel and is marked "1.5A". Its principal function is to offer protection against overloads of the 6.3 VAC circuit or against short-circuits within the power supply itself.

b) D-C OUTPUT CIRCUIT. The 0.125A 3AG fuse in the d-c output section is mounted on the front panel and is marked "0.125A". Its principle function is to protect the regulator section, rectifier, power transformer and filter choke from severe overload and short-circuit conditions in the external circuit. This fuse will "blow" at approximately 140 ma. The fuse will also protect an external milliammeter if one is used with the supply.

A special note is in order with regard to the output circuit fuse. In the course of some laboratory experimental and developmental procedures, a large uncharged capacitor, e.g. 4 to 10 mf, is shunted across the d-c output connections while full d-c voltage is present. Since the capacitor is uncharged a relatively high transient current (practically equivalent to a short circuit current) will be demanded from the power supply with the resultant "blowing" of the fuse. In such cases one of the following procedures is suggested:

1) Throw d-c switch to OFF position. Connect external capacitor. Then throw d-c switch to ON position. This procedure results in a marked reduction in the peak transient current due to the fact that the supply itself requires a fraction of a second to build up its own output voltage.

Or 2) Replace the 0.125A fuse with a 0.125A "slo-blo" type. The "slo-blow" fuses permit a severe *temporary* overload without "blowing." They are relatively expensive and are not as commonly available as the fuses supplied with the unit.

Or 3) Replace the fuse with one of higher current-carrying capacity.

4. Model 25 Noise and Ripple Output

The noise and ripple output of the supply should be less than 10 millivolts rms at all voltages and load conditions within the specifications. This level will be present when the supply is regulating within the 1% specified. Measurement of this level may be made with an AC VTVM capable of reading 10mv rms.

It is recommended that either the positive or negative terminal be connected by a jumper wire to the "GND" terminal for minimum ripple output.

5. Model 25 Output Impedance

The output impedance of the supply for d-c is approximately 10 ohms. A 2 mfd oil-filled paper capacitor is in shunt with the d-c output circuit for two purposes: 1) to maintain this low value of output impedance at audio and at low and medium radio frequencies; 2) to provide a reservoir to supply transient currents of short duration having peak values greater than 100 ma.

An additional external capacitor shunted across the d-c output will provide even lower a-c output impedance and allow even higher peak transient currents to be drawn. For low impedance to high frequency RF currents, the common practice is to use a mica capacitor shunt close to the RF unit.

MODEL 28

1. Model 28 Operating Controls and Terminals

a) The a-c toggle switch, mounted on the front panel, is in the transformer primary circuit and controls power to the supply. The adjacent pilot light indicator having a red jewel is illuminated when the switch is in the ON position. The adjacent extractor type fuse-holder marked "1.5A" is designed for a 1.5 ampere type 3AG fuse.

b) The d-c output voltage control is a screw-slot adjusting potentiometer accessible at the rear of the unit adjacent to the output terminal strips. This control is uncalibrated and should be used in conjunction with an external voltmeter to set the output voltage at the desired value (within the specified limits of 200 to 325 VDC) For reasons of manufacturing and component tolerances it will be found possible to obtain output voltages of less than 200 volts and greater than 325 volts. When the control is set in the latter regions loads drawing more than 70 ma are not recommended if regulation and hum level ratings are to be maintained.

c) The regulated DC output connections are brought out to a terminal strip marked "DC plus" and "DC minus" at the rear of the unit. In most applications it is usual for the negative terminal to be at ground potential. In some cases it may be desired to place the positive terminal at ground potential. Still other applications may require that neither positive nor negative be at ground potential. In such cases where either the positive or negative output connections are to be at ground potential, the appropriate terminal should be connected by means of a jumper wire to the terminal marked with the ground symbol. This latter terminal is connected to the power supply chassis.

d) The AC output connections are brought out to a terminal strip marked "6.3 VAC 3A" at the rear of the unit. These terminals supply unregulated voltage for vacuum tube heater circuits. The center-tap of this connection is brought out to the terminal marked "CT"

2. Placing Model 28 into Operation

a) Plug power cord into source of 115 VAC, 50-60 cps.

b) Throw toggle switch to "AC-ON" position. The pilot light should be illuminated. Allow the supply to warm up for about a minute or so.

c) Set output voltage with an external voltmeter. The power supply is now in full operating condition.

3. Model 28 Fuse Protection

Because of the permanent or semi-permanent nature of installation and use of Model 28 only a primary fuse is provided. This fuse is of the 1.5 ampere 3AG type and is mounted on the front panel.

4. Model 28 Noise and Ripple Output

See Model 25 "Noise and Ripple Output" notes above.

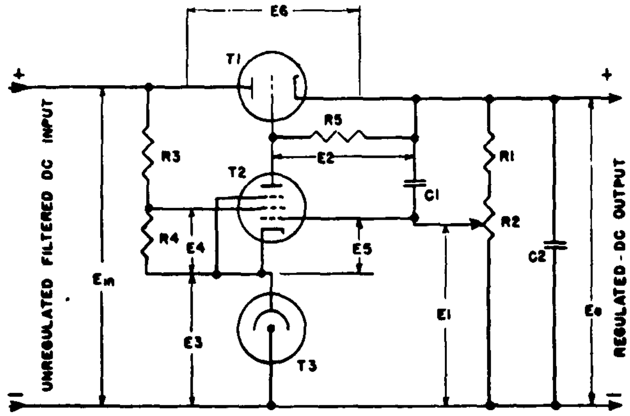
5. Model 28 Output Impedance

See Model 25 "Output Impedance" notes above.

III. Theory of Operation

Reference: Terman, Radio Engineering Handbook, P. 614.

The theory of operation of the series type electronically regulated power supply has been described in great detail in the literature. To review, reference is made to the simplified schematic diagram shown below:



SERIES TYPE ELECTRONIC VOLTAGE REGULATOR

This regulating system operates in such a way as to make the output voltage, Eo, substantially independent of the load connected across Eo, or of the d-c voltage Ein. This circuit operates as follows: Any fluctuation in output voltage, Eo, due to change in load, or Ein, produced by line voltage variation, will vary the potential E1. Hence the grid-cathode potential of T2 will change, since the action of T3, a gas-filled voltage regulator tube, is such that a practically constant voltage drop, E3, is maintained independent of current through T3. The change in grid-cathode potential of T2 is amplified by T2 and affects E2, the grid-cathode potential of T1 in such a manner as to produce a change in voltage drop, E6, through T1 that tends to compensate for the change in output voltage, Eo.

The steady state plate current through T2 determines E2 and therefore the voltage drop through T1. Hence the output voltage, Eo, (which the system attempts to maintain) is determined by the potential E1. Thus this output voltage Eo is determined by the setting of potentiometer R2.

When the screen grid voltage of T2 is obtained from a voltage divider, R3 and R4 across the unregulated supply voltage, Ein, additional compensation is obtained. Any fluctuation of Ein will vary the current through R4 and hence the screen-cathode potential, E4. This affects the voltage drop, E6, so as to compensate Eo for a change in Ein.

Since the output potential, Eo, tends to be independent of the load on the system, Eo acts as though it had a very low impedance source. If R4 is made a potentiometer and E4 is adjustable, it is possible to provide such compensation as to reduce the effective internal impedance of the regulator system to zero or even to a negative value, i. e., Eo will increase with an increase in load current. For maximum stability the 6SJ7 screen voltage potentiometer in the Model 25 and 28 regulated power supplies is set at the factory so that at an Eo of 270 volts there will be a voltage drop of 1 volt from no load to full load. With this adjustment Eo will not vary more than 1 volt with a line voltage fluctuation of 105-125 volts.

The internal impedance of the regulated supply is low from DC through audio frequencies and is a function of the response of T1, T2, T3 and their associated circuits.

A capacitor, C2, is shunted across the output to maintain the supply impedance at a low value for higher frequencies, and to serve as a reservoir for high peak transient currents. C1 increases the response of the regulator system to hum voltage and serves to reduce the ripple content of Eo.

IV. Maintenance
Models 25, 28

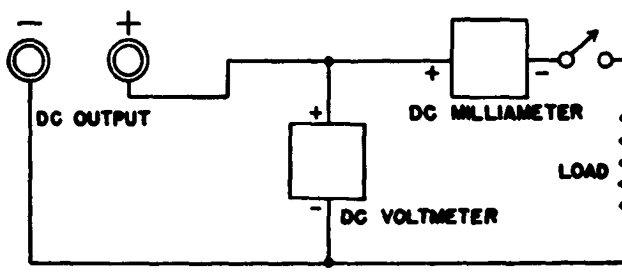
Under normal conditions no special maintenance of the Models 25 and 28 power supplies is required except for occasional tube replacement.

1. Models 25 and 28 Tube Replacement

The tubes are secured in their sockets by spring-type retaining clamps. The retaining clamps must be depressed into and held in a flattened position before removing tubes from their sockets.

Special attention is called to replacement of the 6SJ7 DC amplifier tube and the OA3/VR-75 voltage reference tube. Due to tube manufacturing tolerances, it may be necessary to check the operation of the supply when these tubes are changed if the power supply specifications are to be maintained. Checking and recalibration procedures are outlined in detail in paragraphs 2 and 3 below.

2. Model 25 Operational Check and Recalibration Procedures



RAPID CHECK SETUP

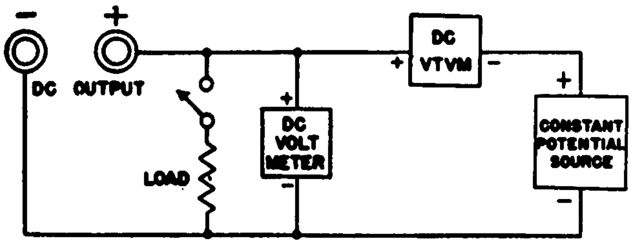
a) RAPID CHECK (see diagram). An approximate check of the power supply regulation and calibration may be made with a DC voltmeter having a voltage range at least to 300 volts (usually a 0-500 VDC meter or preferably a multi-range meter), a 0-100 ma DC milliameter (optional), and a load resistance capable of loading the supply to 100 ma and capable of dissipating the appropriate amount of heat, e. g., 2500 ohms 25 watts at an output voltage of 250 VDC.

Allow the supply to warm up for a few minutes. Adjust the "DC OUTPUT VOLTAGE" control so that the voltmeter reads 250 VDC. Connect the load resistor. The milliameter should read 100 ma. While carefuly observing the voltmeter, alternately connect and disconnect the load resistor. The voltage under load should not decrease more than approximately 2 volts from the no-load voltage. It may be difficult to accurately judge a 1 or 2 volt change but the meter needle should perceptibly move in the decreasing direction when the load is applied. If this condition is satisfied, the power supply regulation is proper.

If, under load, a decrease of more than 2 volts or a *rise* in voltage is noticed, adjustment of the internal controls is necessary. Remove the dust cover. A tube and control location diagram will be found on the inside of the dust cover. The "Screen Volt Adj." screw-slot potentiometer will be found near the filter choke. Adjust this potentiometer a little bit at a time and repeat the above regulation check each time until proper operation is obtained. Secure the potentiometer shaft in position with a drop of Duco or glyptal cement.

With the output voltmeter reading 250 volts, note the setting of the "DC OUTPUT VOLTAGE" control. If it does not read 250 volts, the following recalibration procedure is used.

The calibration of the "DC OUTPUT VOLTAGE" control should be made *after* the regulation adjustment has been completed. Turn the "DC OUTPUT VOLTAGE" knob to its extreme clockwise position. The knob pointer should be opposite the radial line on the scale indicating the limit of physical rotation. Reset this knob if necessary. Turn the knob so that the pointer is set to the center of the calibration dot at 250 volts. Adjust the "Range Set" screw-slot potentiometer (located near the power transformer) until the meter reads 250 VDC. Secure the potentiometer shaft with a drop of Duco or glyptal cement.



PRECISE CHECK SETUP

b) PRECISE REGULATION CHECK (see diagram above). For precise check of the power supply regulation it is necessary to have a means of measuring voltage changes of the order of 1%. The set-up suggested requires a suitable load to draw 100 ma from the supply; a monitoring voltmeter (optional); a constant potential source ,such as a set of 6 45-volt "B" batteries (270 VDC) or a regulated power supply (set at 250 VDC); and a high impedance voltmeter. It is suggested that this latter voltmeter be of the vacuum tube type to prevent meter burnout.

Allow the supply to warm up for a few minutes. Set the power supply to about 3 volts higher than the constant potential source, as indicated by a reading of plus 3 volts on the DC VTVM. Proceed with the regulation and calibration check as outlined in paragraph (a) above, setting the regulation at 1 volt decrease from no load to full load at either 250 or 270 volts depending on which is used in the above checking procedure.

c) ADJUSTING FOR CLOSER REGULATION. It should be noted that the regulation of the supply may be adjusted to near zero. The same adjusting procedure may be used as outlined in paragraph (b) above. When regulation near zero is desired and set, it is recommended that the range of output voltage over which the supply is to be used be kept small or better still the supply be used at the voltage at which the regulation adjustment was made, if stable operation is to be assured.

3. Model 28 Operational Check

The procedures outlined in paragraph 2 for Model 25 are in general applicable to the Model 28. The following differences should be noted:

a) The screen voltage adjustment potentiometer, marked "SCREEN ADJ" is of the screw-slot adjusting type and is located near the 5V4G rectifier tube.

b) The DC output voltage control potentiometer will be found next to the output terminal strips. The range of this potentiometer will be greater than the specified range of 200 to 325 VDC. It is recommended that the supply be used within the specified range.

c) No range setting control is provided.

4. Miscellaneous Maintenance Notes Models 25 and 28

a) A schematic diagram for Model 25 will be found on the inside surface of the chassis bottom plate.

b) A schematic diagram for Model 28 will be found on the inside surface of the top cover plate.

c) The pilot light indicator lamps on the front panel are of the 6-8 volt #47 bayonet type. They are accessible from the front panel by merely unscrewing the pilot light assembly jewel.

d) The fuse holders are of the finger-grip extractor type, permitting easy replacement of the fuses from the front.

5. Voltage Table Models 25, 28

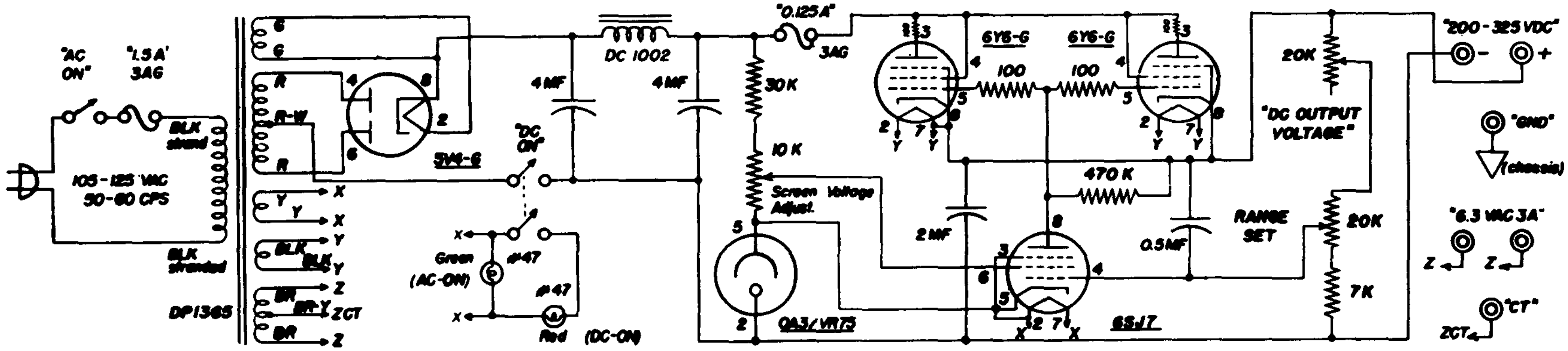
The following voltages are typical with the power supply operating with 115 VAC input, with an output of 250 VDC, and no load on the output. The measurements may be made with a voltmeter having a sensitivity of 1000 ohms per volt except where indicated otherwise. Voltages are measured between the indicated tube-pin and the negative output terminal, except for measurement of tube heater voltages.

Pin Number	5V4G	OA3/VR-75	6SJ7	6Y6G (Either)
1	—	—	0	—
2	535	0	77	250
3	—	—	77	530
4	425VAC	—	72	530
5	—	77	77	187 (b)
6	425VAC	—	80 (a)	187 (b)
7	—	—	77	250
8	535	—	187 (b)	250
2 & 7	5.0VAC (c)	—	6.3VAC	6.3VAC

a) *May vary from 50 to 125 volts*
b) *Measured with 20,000 ohms per volt meter*
c) *Measured between pins 2 & 8*

Safety Notice

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SEVERE SHOCK OR INJURY.

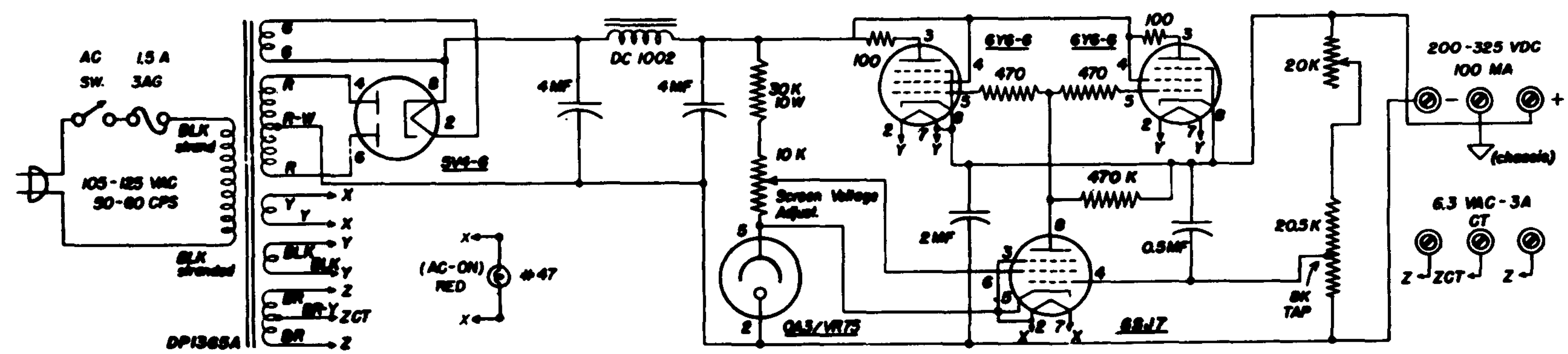


SCHEMATIC DIAGRAM

MODEL 25

LAMBDA ELECTRONICS CORP.
CORONA, NEW YORK

REGULATED POWER SUPPLY
BENCH MODEL



SCHEMATIC DIAGRAM

MODEL 28

LAMBDA ELECTRONICS CORP.
CORONA, NEW YORK

REGULATED POWER SUPPLY
RACK MODEL

NS-60-28B

W A R R A N T Y

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship; our obligation under this warranty being limited to repairing or replacing any instrument or part thereof, which shall, within one year after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS CORP.
103-02 Northern Boulevard
Corona, New York

APPENDIX B

AMERICAN TIME PRODUCTS, MODEL 20081-2S FREQUENCY STANDARD

INSTRUCTIONS

OPERATING

INSTRUCTIONS

AND SPECIFICATIONS

for

FREQUENCY STANDARD

TYPE — <u>2001-2A, 1000 series</u>

2001-2L

2001-2D

2001-2H

2001-2 — P

2001-2 — R

2001-2 — M

SERIAL NO. 3303

product of

American Time Products

Inc.

580 Fifth Avenue, New York 19, N. Y.

Maker of the

Watch Master

Printed in U. S. A.

FREQUENCY STANDARDS

TYPE 2001-2 SERIES

DESCRIPTION — The 2001 series frequency standards provide sources of frequencies from 40 to 20,000 cycles at a high order of accuracy. These units are compact and designed in a way to permit integrating them into basic equipment.

The small size is made possible through the use of a new, improved, miniature tuning fork. The low heater and B current drains permit, in the majority of applications, the use of the basic equipment power supply.

The fork itself is of bimetallic construction, making a close approach to a zero temperature coefficient possible. The drive and pickup system is electromagnetic. Driving force is applied to both tines, and pickup voltage is generated by motion of both tines. The magnetic assembly of coils and magnets for both the pickup and driving coils is located between the two fork tines, along the dynamic center of the fork. This insures maintenance of balance of the tines should the pickup and driving magnets be of slightly different strengths.

The whole assembly is housed in a hermetically sealed and partially evacuated housing. The fork is thus immune to barometric or altitude changes and also protected against adverse environmental conditions. The fork is shock mounted so that the whole unit does not require special mounting when used in mobile application.

The Q of the forks alone is approximately 30,000. The working Q is in excess of 5,000. Q checks are made on all forks to insure quality performance.

The electrical circuit is an amplifier consisting of one pentode followed by a pentode connected as a triode. The high input impedance of the pentode input tube combined with negative feedback through a voltage sensitive element maintains the fork amplitude and frequency constant regardless of supply voltage variations, change of tubes, or tube ageing.

Each completed unit is aged and checked periodically for proper performance prior to shipment. A phase control is provided for slight frequency adjustment.

CONSTRUCTION—The components and construction are in accordance with current government JAN specifications. (AN-e-19)

USES — Time keeping, facsimile systems, time bases, high speed cameras, chronographs, astronomical drives, viscosimeters, geo-physical instruments, fire control and navigation.

GENERAL SPECIFICATIONS

FREQUENCY — Any frequency as specified including fractional numbers from 40 to 20,000 cycles.

ACCURACY — 1 part in 100,000 (.001%).

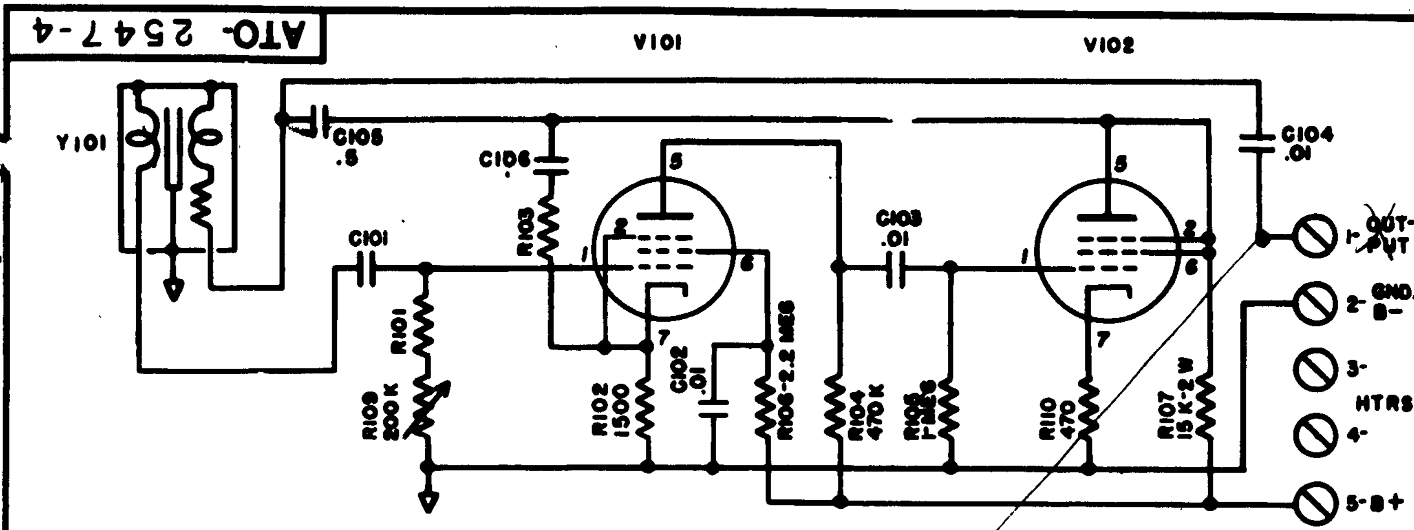
CALIBRATION—The frequency is set within 1 part in 1,000,000. A control is provided to adjust the frequency over a range of up to 100 parts in 1,000,000. A locking nut prevents unauthorized adjustments.

TEMPERATURE COEFFICIENT—Better than 1 part in 1,000,000 per centigrade degree from 0 to 60 degrees C. The temperature coefficient is measured for each unit. Accuracies for an overall temperature range for JAN applications are available.

POWER SUPPLY — 6, 12 or 24 volts A.C. or D.C. (specify), 100 to 325 volts D.C. at 5 to 10 M.A. Specify voltage available in above range. B voltage coefficient is better than 1 part per million per 25 volts from 100 to 325 volts. Units requiring 28 volts only are available on special order. 110 volts A.C. operation available by using P unit.

OUTPUT—Approximately 5 volts at 250,000 ohms minimum, approximate sine wave. Wave shape distortion is of the order of 10%.

TYPE 2001-2—This consists of a fork and amplifier circuit. The frequencies available are normally from 200 to 3000 cycles in standard designs. Frequencies above 3000 may be furnished on special order if the



TEMPERATURE/FREQUENCY COEFFICIENT BETTER THAN 1 PART/1,000,000/DEG. FROM 0 DEG. C TO 70 DEG. C.

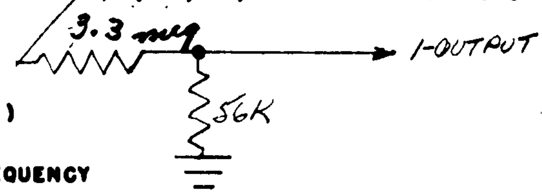
UNIT CALIBRATED WITH B VOLTAGE SHOWN BELOW

FORK VERTICAL WITHIN 5 DEGREES

OUTPUT VOLTAGE-5 TO 8 VOLTS (APPROX. SINE WAVE)

OUTPUT LOADING-GREATER THAN 250,000 OHMS

TURN RATE CONTROL CLOCKWISE TO DECREASE FREQUENCY

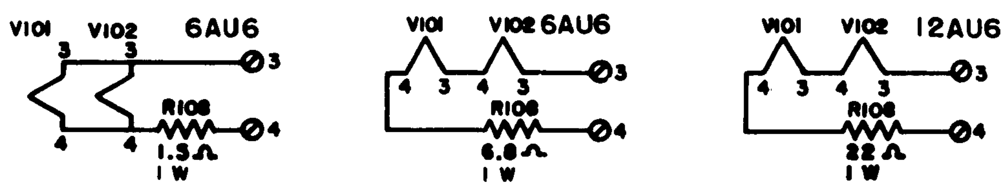


RANGE OF RATE CONTROL 101 PARTS PER MILLION

FORK FREQ 1000 CYCLES FORK NO. 30977 R103 33K OHMS
30K on #3371-72

C101 .002 MFD. R101 100K OHMS

B VOLTAGE 200 VOLTS



6 V. HTR SUPPLY ☑

12 V. HTR SUPPLY ☐ CHECK

24-28 V. HTR SUPPLY ☐

DATE 8-29-52 SER. 3385

CUSTOMER [illegible], INC.

W.O. 2729

REMARKS Build up time is approximately 3 minutes on 8 units of this frequency.

ASSOCIATED DRAWINGS—

FREQUENCY STANDARD

TYPE 2001-2 S

AMERICAN TIME PRODUCTS, INC.
580 FIFTH AVE., NEW YORK, N. Y.

APP'D	ENG.	DR.	DATE
J		FG	2-20-50

ATO- 2547-4

application warrants. The type 2001-2 is furnished on a plate 3¾" by 4½" suitable for mounting in a hole in a main chassis or on top of a chassis by using two metal channels furnished. There are two 6AU6 tubes used in this type. Outputs at distortions of 2% are available on this unit on special order. Specify 2001-2S.

TYPE 2001-2L—The frequencies available from this unit are 40 to 200 cycles. This unit consists of a Type 2001-2 unit plus a frequency divider unit of the multivibrator type using one tube. The frequency divider unit is the same size as the fork unit. There are two 6AU6 and one 12AU7 tubes used in this type. Counter type dividers are available if multi-vibrators are unsuitable.

TYPE 2001-2D—Counter type frequency divider. In applications where failure of the primary signal frequency must result in failure of output, the counter type divider is recommended. Four 12AT7, plus two 6AU6 tubes, are used.

The type 2001-2L and 2001-2D double unit is furnished with a channel mounting. The overall is 9"x3¾" and it can be mounted above or through a chassis.

TYPE 2001-2H—The frequencies available from this unit are 3,000 to 20,000 cycles. This unit consists of a Type 2001-2 unit plus a frequency multiplier unit using 2 tubes. The frequency multiplier unit is the same size as the fork unit. There are three 6AU6 and one 6J6 tubes used in this type. This double unit is furnished with a channel mounting similar to the 2001-2L above.

TYPE 2001-2M—This is a 2001-2 fork unit plus a 2 watt amplifier with an output of 2 watts at 100 to 150 volts (depending on load impedance) or 6 volts at approximately 1.5 watts or a combination of both with total loading of 2 watts. It requires a B voltage of 250 at 50 m.a. The Type 2001-2M uses two 6AU6 tubes in the fork unit and one 6AQ5 in the amplifier unit. This unit may be used in conjunction with the 2L, 2D and 2H units as well. Size of the amplifier unit only is 3¾" x 4½".

TYPE 2001-2P—This is a power supply which can furnish heater and plate voltage for the 2001 types listed above. A 6X4 tube is used. It operates on 115 volts, on frequencies from 50 to 500 cycles. Adding the designation P to the above numbers indicates that a power supply unit is wanted.

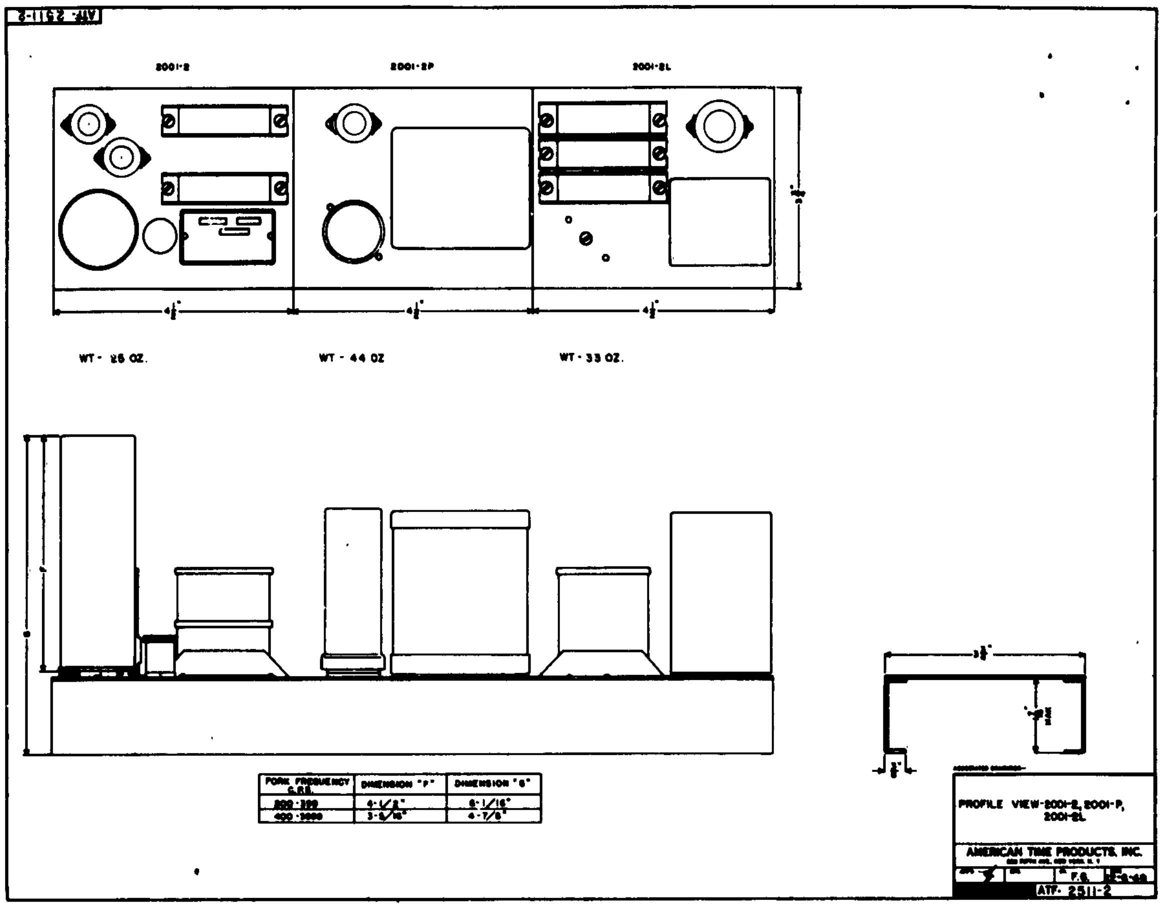
TYPE 2001-2R—This is an 8¾" x 19" black wrinkle standard rack panel with a shelf for mounting the above units. Adding the designation R indicates that a rack mounting is required.

INSTALLATION — The standards can be mounted either on or through a surface. Mounting holes and cutouts are shown on drawing 2035. When mounting through the surface of a chassis or panel the side channels are removed. The unit should be mounted so that the fork is approximately vertical. The fork unit should be located away from strong AC or DC magnetic fields. Connect the unit to the associated circuit. Shielded wiring for the output is not necessary except in the presence of very strong fields.

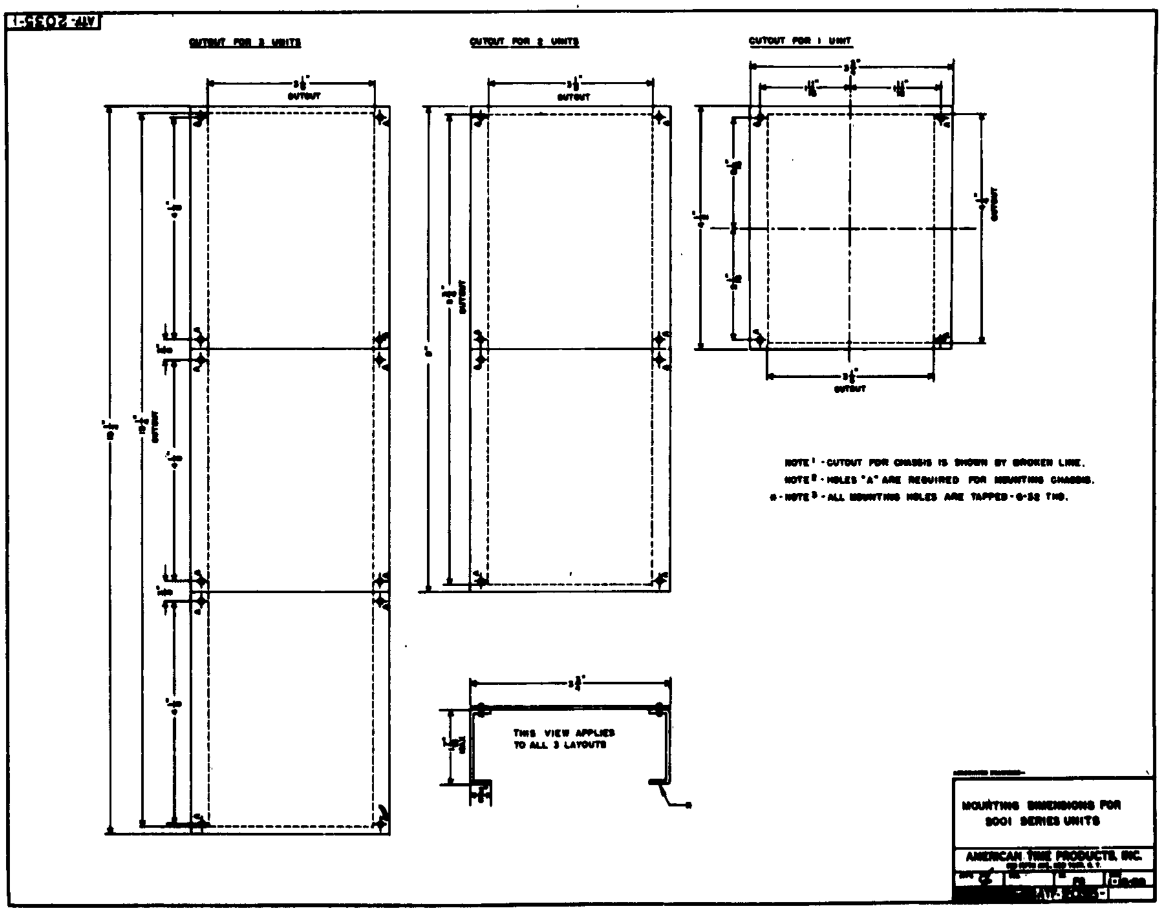
OPERATION — The output frequency is present approximately 50 seconds after the power is applied to the unit. In applications requiring the presence of frequency immediately after a switching operation, the unit should be left operating continuously and the output circuit switched.

FREQUENCY ADJUSTMENT—The unit, when shipped, is calibrated to within 1 part in a million of its nominal frequency. This calibration will normally remain to within 10 parts in a million. However, if it departs appreciably from a known standard to a degree intolerable for the application, the frequency can be readjusted. The control for this adjustment is on top of the panel which mounts the fork. The range of this control is given for each individual unit on the test sheet. Very approximately the change of rate is proportional to the range of the control as the amount of rotation is to 300 degrees. For instance, if the range of the control is 100 parts in a million and a 10 part in a million decrease in frequency is desired, a first approximation would be to turn the control clockwise perhaps one-half the indicated 30 degrees.

Parts per million as used above are more convenient in dealing with precise frequencies. Example, if a frequency of nominally 60 cycles is slow by 14 parts in a million, it has an actual frequency of 60-60 (.000014) or 59.99916 cycles. This is an error of close to 1 second in 24 hours.



FORK FREQUENCY C.P.S.	DIMENSION "F"	DIMENSION "G"
200 - 399	4-1/2"	6-1/16"
400 - 3000	3-5/16"	4-7/8"



APPENDIX C

AMPEX MODEL S3141 MAGNETIC TAPE RECORDER

INSTRUCTIONS

SPECIAL NOTE -

Due to the higher than normal grid impedance of V201 it is necessary to compensate the input circuit to keep the frequency response within specifications to 5000 cycles. The circuit has been compensated at the factory so that one volt RMS input will give the proper deviation. Any change in the setting of the input potentiometer will change the frequency response characteristics. Therefore, the signal to the recorder should be adjusted to one volt RMS external to the recorder.

Should the setting of this control, R211, be altered for any reason, the setting may be re-established by following the alignment procedure as given in Section V of this book.

S-3141 DUAL TRACK RECORDER

This machine, serial number ________, is a special type recorder designed for recording data from 0 to 5000 cycles per second. It is a dual track machine with the upper track for data recording and the lower track for data recording control signals. It consists of a Model 307 Top Plate (#1882) for 1/4 inch tape, a Model 306 Electronic Assembly (3870), a Model 403 Electronic Assembly (#3621), a Model 375 60 cycle amplifier (#841), a #2189 Control Track Generator, and the necessary interconnecting cables.

This Instruction Book is composed of figures and instructions from Apex standard instruction manuals. The mechanical assembly is explained in the front of the book, followed by the Model 306 data channel, and the Model 403 control channel. The standard Model 381 Speed lock instruction book is supplied under separate cover to explain the Model 375 amplifier and the #2189 control track generator.

The Model 307 Top Plate is designed for 15", 30" and 60" speeds. However, this machine should be operated at the 30" speed only (speed switch in low position with the bushing installed on the capstan). The fuses in this machine have been increased to accommodate the extra AC load. F801 and F802 have been changed to 8 amperes while F803 is a 5 ampere fuse. A special dual track head assembly has been incorporated with the upper (data) track color coded red.

The model 306 Electronic Assembly used on the upper (data) track has been modified with a one Megohm input potentiometer in the record amplifier. The operation and alignment are described in the second portion of this manual.

The Model 403 Electronic Assembly is used for the lower (control) track. The frequency range of this channel is 50 to 20,000 cycles at the 30 inch tape speed. The Signal to Noise ratio is better than 45 db below operating level. Since the Model 403 is an audio recorder, high frequency preemphasis is incorporated in the record circuit as shown in the 15"/Sec. curve of Fig. 7. Therefore, high frequency control signals should be recorded 10 to 15 db below operating level to avoid tape saturation. The output impedance of the 403 Electronics is 600 ohms, balanced or unbalanced. Three input impedances are available by changing the Input Transfer Switch:

Microphone level input strapped for 200 to 250 ohms.
Bridging for a balanced line 300,000 ohms.
Bridging for an unbalanced line 60,000 ohms.

The operation and alignment of the 403 are described in the rear portion of this book.

A special interconnecting cable (#4451) has been provided to supply power to the two Electronic Chassis.

SECTION II

INSTALLATION

1. Open packing case carefully and save it. In the event of possible shipping damage the case may be needed for return shipment.

2. Examine electronics chassis and see that any chassis that are shock mounted float freely on their rubber cushions.

3. If equipment is to be Rack mounted, install in the rack so that the head cables will reach the electronic unit without being extended in length. Do not lengthen the head cables for any reason whatsoever, because increased cable capacity will cause undesirable resonance with the heads.

4. Install all cables as shown in Fig. 12.

5. Release capstan drive motor shipping lock. This is the spring catch which holds the motor away from the rubber-tired flywheel. The retaining ring should be broken off and the lock removed from the motor bracket. Do not make any adjustments on the drive system at this time. No adjustments need be made unless damage has occurred during shipping. NOTE: Whenever recorder is transported, be sure to lock motor, or capstan tire may be damaged beyond repair.

6. Connect power cord to 115 V., 60 cycles A. C. only.

7. The capstan speed should be checked with the stick-on stroboscope provided. Before checking, let drive unit run for at least five minutes to warm up lubricant in the capstan assembly. If the lubricant is stiff, the additional drag will cause greater compression of the rubber tire and the capstan will therefore run slightly slow until warmed up. Place stroboscope on capstan shaft with sticky side down and view rotating shaft under 60 cycle light. If the speed is not correct the spokes will appear to rotate. Slight speed changes can be realized by change in capstan drive motor pressure. This adjustment is at spring D, Fig. 1 on the motor solenoid draw bar. If the adjustment is in the proper range, increasing pressure will slow the capstan, decreasing pressure will speed the capstan. Adjust for no rotation of the stroboscope spokes. (If drive motor pressure is too light, increasing pressure will speed the capstan. In this range the tire pressure is inadequate for stable operation, and the pressure should be increased until increase in pressure reduces capstan speed.)

8. Load the left hand reel holder with tape and thread as shown, in Fig. 5. Be sure the tape used has the oxide-coated side toward the rear of the machine; i.e., toward the head faces. Be sure to remove any adhesive that may have been used to seal the end. If this adhesive is not removed, the first layer may stick and cause the end to break off at the finish of rewind.

9. A reel hold-down or editing knob should be placed on each reel spindle. Editing knobs, catalog #1917, are furnished with console and portable recorders, while hold-down knobs, catalog #4402, are furnished with rack models.

The #4402 reel hold-down knob works in the following manner. A removable pin in the bottom surface of the knob engages a corresponding hole in the turntable. A collet grips the turntable shaft when the top of the knob is rotated. Two spring loaded balls hold the reel to the turntable. A pin in the side of the knob drives the reel. The knob should be positioned on the NARTB reels so that the removable pin engages one of the turntable holes and approximately two thirds of the ball is exposed above the reel. The knob should not be pushed down all the way, but should stick up above the turntable. Once the knob is positioned correctly, the NARTB reels may be removed without removing the knobs. When using the knob with the small RMA reels, unscrew the removable pin. The knob is used only to prevent the reel from falling off the turntable, since three pins in the turntable drive and center the reel. Lock the knob to the shaft, avoiding excess pressure on the reel which could distort the reel flanges.

The machine is now ready for operation. When shipped as a Model 307, it is factory adjusted for speeds of 30 inches per second and 60 inches per second unless ordered for 15"-30" operation. Model 306 machines are shipped for 15"-30" operation and should be operated at the 30 inch speed only. NO FURTHER ALIGNMENT SHOULD BE NECESSARY.

B. Mechanical:

After connecting the electrical circuits as previously described, set the "fast start-slow start" switch located on the connector panel underneath the top plate to the desired type of start. For the 60 inch per second tape speed, "slow start" must be used. Turn on Power Switch, see Fig. 5. This turns on the amplifiers and control circuits. On some multi-track machines a Power Distribution Panel is provided to feed AC Power to the Power Supplies and Mechanical Assembly. The Power Panel Master Switch must be turned on, as well as the Mechanical Assembly Power Switch. Thread tape as indicated in Fig. 5. When set for "fast start", the capstan drive will start when the tape is threaded, as the tapeup tension arm operates a switch which shuts the motors off when the tape runs out.

Pushing the Start button will now start the tape moving according to the mode selected on the Play, Rewind, Fast Forward control. In the Play position the tape will be reproduced at the output terminals. Pushing the Record button will permit an input to the machine to be recorded on the tape with almost simultaneous playback of the new program. A 1/2 second time interval should be observed between pressing the start button and pressing the record button to avoid switching transients magnetizing the record head. Pushing the Stop button will stop the machine and turn off the recording amplifier; therefore, one must always push the Start and Record buttons, in that order, to record. The mode selector switch allows transfer from Play to Rewind or Fast Forward without pushing the Start button when switching. This helps greatly in editing. However, when going from Rewind to Play, the machine shuts off and the Start button must be used to restart the tape motion.

SECTION III

OPERATION

C. Speed Change:

The model 307 is shipped to the customer either as a 15 inch-30 inch machine or as a 30 inch-60 inch machine, depending upon his preference. The Model 306 is shipped as a 15 inch-30 inch machine, and since the Model 306 electronic assembly is designed for 30 inch speed only, speed change is not required. In order to change from a 15"-30" to a 30"-60" in the field, or vice versa, four items must be changed.

1. Addition or removal of capstan bushing.
2. Adjustment of capstan idler pressure.
3. Changing of "slow-fast" start switch to the proper position.
4. Equalization of the playback amplifier.

TO CONVERT FROM 15"-30" TO 30"-60"

1. Remove the Allen cap screw from the capstan shaft. Attach capstan bushing adaptor. FOLLOW INSTRUCTIONS AND PRECAUTIONS CAREFULLY, as capstan adaptor must be handled very carefully to maintain wow-free performance. In order to have no speed variations, the runout of the capstan must be extremely low. Therefore, the capstan adaptor is a very close, precision fit. It must be treated carefully and kept scrupulously clean.

(a) Make sure capstan shaft and the inside of the adaptor are clean.

(b) Place adaptor over the capstan.

(c) Push adaptor down gently, being careful to keep it in alignment. Because of the precision fit, the adaptor will not go over the capstan if it is the slightest bit cocked.

(d) When the adaptor has been started on and is in good alignment, as evidenced by lack of wobble when the capstan is rotated, give the adaptor a rap with the palm of the hand, and it will seat properly. DO NOT TRY TO DRIVE ADAPTOR ON IF DIFFICULTY IS EXPERIENCED. If the adaptor is properly aligned with the capstan, it will go on readily. In case of difficulty, a slight smear of lubrication on the capstan shaft will help.

(e) Secure adaptor in place with the 10-32 Allen screw and wrench provided.

2. When changing from the small diameter capstan to the large one it is necessary to change the capstan idler pressure by the adjustment at point F in Fig. 1. Back off the adjusting nut until correct pressure is reached. One method for determining correct pressure is to feed a short length of tape into the capstan by hand while the machine is operating with the takeup tension arm secured in the running position. With the tape held motionless the pressure should be sufficient to physically deform or break the tape.

3. If the machine is to be operated at 60 inch per second change Switch S806 on Connector Panel underneath the top plate to the "slow start" position.

4. See Playback Equalization - SECTION V - B, Page 4 for the re-equalization procedure.

TO CONVERT FROM 30"-60" TO 15"-30"

1. Remove the Allen cap screw from the capstan bushing adaptor. In its place insert the capstan bushing extractor tool. Running this down with the wrench provided forces the capstan bushing adaptor off the capstan shaft. Wipe the capstan free of any lubrication. Insert the short Allen cap screw (found in the container with the extractor tool) in the capstan shaft. Replace the bushing, long cap screw, extractor tool and wrench in a safe place for future use.

2. When changing from the large diameter capstan to the small one it is necessary to change the capstan idler pressure by the adjustment at point F in Fig. 1. Tighten down the adjusting nut until the correct pressure is reached. One method for determining correct pressure is to feed a short length of tape into the capstan by hand while the machine is operating with the takeup tension arm secured in the running position. With the tape held motionless the pressure should be sufficient to physically deform or break the tape.

3. Change Switch S806 to the "fast start" position if fast start is desired.

4. See Playback Equalization - SECTION V - B, Page 4 for re-equalization procedure.

SECTION IV

OPERATING PRECAUTIONS AND MAINTENANCE

A. Mechanical Assemblies:

The drive system employs three motors. Two induction motors with solenoid operated brakes are used for takeup and rewind. These motors are shown in Fig. 7 and require no service attention! The torque of these two motors is adjusted at the factory by means of resistors R801. R802 and R803, and should be left alone unless shipping damage to the resistors has occurred. Both motors are adjusted for a tension of 5 to 6 ounces pull on the reel hub in Play. On top plates for 1/2 inch or 1 inch wide tape these tensions are increased to 10 to 16 ounces. R802 is adjusted for the maximum hold-back tension during Fast Forward and Rewind which will still allow the tape to accelerate when starting with a full reel .

The third motor is the synchronous motor used for capstan drive. This motor is mounted on a hinge which is moved by a solenoid to engage the motor and the capstan flywheel. The hinge is positioned by the Drive Motor Return Spring "B" when the solenoid is deenergized. A stronger return spring is required for rack mounted machines than for console or portable units. See Section VI Parts List.

When the machine is turned on and the tape threaded into position, the solenoid "C" pulls the motor into engagement with the capstan flywheel tire and drives it, The pressure between the motor and flywheel is adjustable at spring "D" and is adjusted to give synchronous speed as described in INSTALLATION.

The capstan shaft has a permanently lubricated ball bearing at the bottom end to take the flywheel load and to maintain a minimum of friction, see Fig. 2. The upper bearing on the shaft is a precision bronze sleeve bearing which permits absolutely true running of the capstan.

The mechanism of the capstan idler is operated by solenoid "E" in Fig. 1 and is returned by spring "A". Capstan idler pressure is set so that it will deform or break the tape if the tape is stopped with the hand while the machine is running. This pressure is adjusted at point "F" in Fig. 1.

The reel idler is shown in Fig. 1 at "G". This shaft has two single shielded ball bearings. Factory lubrication is for the life of the bearings. Should these bearings require servicing or replacement the complete reel idler assembly should be exchanged for a factory reconditioned unit. The extremely low pulley run-out of this assembly is achieved by a final finish cut being taken while running on its own bearings after final assembly. Under no circumstances should the shaft be removed from the assembly, since in all probability the relationship of parts will be lost. This may result in the introduction of the reel idler period into the measurable flutter and wow components of the machine.

The mechanical brakes on the rewind and takeup motors ordinarily require no adjustments. Should trouble occur which appears to be due to faulty braking, the tension may be adjusted. The only adjustment on the brakes is performed by adjusting tension at "H" in Fig. 1. If machine throws a loop of tape on stopping, the trailing reel brake tension is too low, or if it breaks the tape the tension is too high. However, unless tampered with, the adjustment should be permanent until such time as the brake bands wear out.

CLEANING: Daily attention should be given to the cleaning of the following:

(1) Capstan Shaft
(2) Head Faces
(3) Tape Guides

Clean all surfaces of the above with carbon tetrachloride applied with a soft cloth.

Weekly attention should be given to the cleaning of the capstan idler wheel. It should be cleaned with ethyl alcohol. Great care must be taken to see that oil does not reach the capstan idler tire. Oil will not only contribute to tape slippage but will also ruin the tire.

LUBRICATION: Every 3 months or 1000 hours.

1. Drive Motor: The drive motor uses a sleeve bearing and should be lubricated every three months or 1000 hours, whichever occurs first, with one of the following oils:

Gulf Oil & Refining Company . . . . Gulfcrest "A"

Standard Oil Co. of Indiana . . . . Stanoil #18 or #25

Sacony Vacuum Oil Co. . . . . Gargoyle D.T.E. Light

The motor should be lubricated with a pump-type oil can. To reach the upper bearing in the console model, use a flexible spout or else attach a piece of spaghetti to the end of the spout. In the portable model, the upper bearing is most conveniently reached by unbolting and lifting the top plate. The top plate should be tipped up by raising the righthand end, as viewed when facing the front of the machine. The plate need only be lifted a few inches to expose the bearing to be lubricated. CAUTION - DO NOT OVER-LUBRICATE SUCH THAT OIL MAY GET ON EXPOSED RUBBER SURFACES.

2. Capstan Idler: The capstan idler should be lubricated with a drop of S.A.E. 30 oil on all bearing surfaces. WARNING - under no condition should oil

be allowed to come in contact with the rubber surfaces of the capstan idler or the capstan flywheel.

3. Capstan: The upper bearing of the capstan should be lubricated with S.A.E. 30 motor oil every 3 months. To oil: Loosen set screw in dust cap surrounding the capstan shaft just below the tape contact point. Push the rubber idler wheel away from the shaft just enough to allow the cap to be removed. This exposes a felt washer which covers the oil hole. Remove this washer and oil through the larger of the two holes exposed. Fill until no more oil will enter! Replace as disassembled.

PRECAUTIONS:

REELS. In order for the brakes to work properly, the same size reel must always be placed on both turntables. In using the small RMA 5- or 7-inch reels, abnormal hold-back tensions will occur at the end of the reel due to the small hub diameter. This may cause trouble due to slippage at the capstan idler. If the small type reels are to be used exclusively, an additional 150 ohm, 50 watt resistor should be inserted in series with each of the resistors (R801 and R803), which are in series with the Rewind and Tapeup motors respectively. The machine will not meet specifications for flutter and wow when using the 5- or 7-inch RMA reels because of the discontinuity of the hubs on these reels.

BRAKES. In order to avoid the tightening action which occurs when brake bands become glazed, the brake bands have been treated with graphite. With the graphited brake bands, the proper tension as measured on the NAB reel hub in the unwinding or energizing direction is 14 oz. Should the brakes exhibit a tendency to tighten up or grab, they should be retreated with graphite. A mixture in the proportions of one level tablespoon of graphite to one 8 oz. cup of carbon tetrachloride can be applied to the felt of the brakebands with an oil can. After graphiting, the motors should be run 10 minutes with the brakes on to wear in the graphite. This may be accomplished by disconnecting the brake solenoids temporarily. On top plates for 1/2 inch and 1 inch wide tape, asbestos brake linings are used to increase the braking tensions. Graphite should not be used on these linings.

TAPE SLIPPAGE. The tape will slow down near the end of the program. if the capstan idler pressure is not great enough. This, of course, will become worse at the end of the reel where the hold-back tension is highest. The condition is further exaggerated if a small RMA type reel is used, in which case the hold-back tension is even higher.

Effective capstan idler driving force is reduced as the capstan idler gradually picks up the lubrication with which Minnesota Mining and Manufacturing Company type 111 tape is treated. This lubrication is quite important, as it reduces flutter and head wear, permits more uniform head contact and therefore less high frequency amplitude variation, and any tendency for the tape to "squeak". This "squeaking" sometimes occurs at the slow speed when using the small reels and is very objectionable. For this reason, the capstan idler should be cleaned with ethyl alcohol at least once each week.

To test for proper capstan idler pressure, hold the tape while the machine is running in the Play position. The idler pressure should be sufficient to deform or break the tape. The pressure can be increased by the adjustment at Point "F" in Fig. 1.

SPEED. If the machine has been subjected to severe cold the drive should be allowed to warm up for 5 minutes to reach stability. This is especially true at the high tape speed.

CAPSTAN MAGNETIZATION. The capstan may become magnetized by contact with a magnetized tool. Should this occur it may be demagnetized with an A.C. solenoid placed over the shaft and slowly pulled away.

DUMMY PLUGS. Two dummy plugs must be inserted into the appropriate sockets in the top plate for correct operation of the recorder. These plugs are catalog No. 567, 8 pin Jones plugs, with pins 1 and 2 jumpered and pins 7 and 8 jumpered.

1. One No. 567 must be plugged into receptacle J804S, labeled "Remote Control", located on the connector panel underneath the top plate. It is removed only when remote control is desired and the remote control cable must be plugged into the receptacle.
2. The other No. 567 must be plugged into receptacle J805S, labeled "Cable to Model 375 60 Cycle Amplifier", located on the connector panel underneath the top plate. When the Model 375 is used with the recorder, the input-output cable from the 375 is plugged into this receptacle. NOTE: The Model 300 and 301 do not incorporate the 60 cycle amplifier connector; therefore, the second dummy plug is not required. If the Model 375 is to be used with these models, it should be wired to the capstan motor terminal strip as explained in the Model 375 Instruction Book.

B. Head Assembly

The head housing, See Figure 5, is a die cast assembly which contains the two heads used in the recording process and a rotating idler wheel. The heads are respectively record, and playback as viewed from left to right when facing the machine.

On dual track machines two heads of multi-channel design are incorporated in place of the standard full track heads. One head is stacked above the other with the gaps in line. The cables associated with the upper track are color coded red.

The gate on the housing holds the playback and record shield covers and the tape-lifting fingers. The function of the tape-lifting fingers is to remove the tape from the heads when the gate is open during Rewind or Fast Forward operation. This reduces head wear considerably. The tape may leave a deposit on the heads if allowed to contact them at high speeds. Such a deposit will seriously impair the performance of the machine and should be guarded against by always opening the gate on Fast Forward and Rewind. If a deposit is left, it may be easily removed with carbon tetrachloride on a soft rag. Never use metal of any kind to touch the head surfaces. The gate should never be allowed to spring shut but should be closed gently.

HEAD MAGNETIZATION.

Occasionally the heads may become magnetized through an electrical fault in the amplifiers, improper use of the machine, or by the heads coming in contact with a magnetized object. This will result in an increase of noise level from 5 to 10 db. It is especially important that the heads be free of magnetization if you are to realize the dynamic range of type 111 tape. It should be remembered that any phenomena that tends to put an unbalanced pulse through the record head will magnetize it. Such pulses can appear in the form of signal or power line pulses. If the following precautions are observed, no difficulty should be experienced:

1. Do not remove any tube from the record amplifier while the machine is recording.
2. Do not connect or disconnect input leads or head leads while recording.
3. Do not depress the Record button until after depressing the Start button. In other words, allow the transient caused by switching the motors and solenoids to die out before the record head is connected. A one-half second pause is sufficient.
4. Do not saturate the record amplifier with an abnormally high input signal. Such a signal would be 10 db. greater than tape saturation and 30 db. greater than normal operating level.
5. Do not test continuity in the heads with an ohm meter.

HEAD DEMAGNETIZATION.

Should the heads become magnetized, they can be demagnetized with an AMPEX head demagnetizer (stock number B-704). In the event that time does not permit the owner of the machine to wait for delivery of a demagnetizer, he may make one as follows: Cut a piece of transformer lamination to a 1/4" x 2" size. Wrap the strip of metal with suitable insulating material and wind approximately 400 turns of No. 36 wire and attach a 4' length of 2 connector cord. Bend the iron strip into a "U" shape and bring the ends of the "U" to a spacing of 1/4". Connect to a 6 volt source of A.C., open the gate on the head housing and bring the ends of the "U" in contact with the 2 poles on the magnetized head. Remove the demagnetizer very slowly, allowing the A.C. field to die off gradually. Repeat this operation on record and playback heads only, as the erase head will demagnetize itself. In the event demagnetization is not effected, repeat the process several times.

MECHANICAL ASSEMBLY

Reference Number	Description	Ampex Catalog Number
A801	6-8 V. Panel Lamp - Bayonet Base	LA-5
A802	120 V. 6 Watt Lamp - Candelabra Screw	LA-6
A2001	120 V. 6 Watt Lamp - Candelabra Screw	LA-6
C501	5 MFD 330 V. AC Capacitor	CO-80
C601	3.75 MFD 330 V. AC Capacitor	CO-86
C701	3.75 MFD 330 V. AC Capacitor	CO-86
C801	.1 MFD 600 V. Tubular Condenser	CO-33
C802	.1 MFD 600 V. Tubular Condenser	CO-33
C803	.1 MFD 600 V. Tubular Condenser	CO-33
C804	.1 MFD 600 V. Tubular Condenser	CO-33
C805	80 MFD 150 V. Electrolytic Condenser	CO-105
C806	80 MFD 150 V. Electrolytic Condenser	CO-105
C807	.1 MFD 600 V. Tubular Condenser	CO-33
C808	.1 MFD 600 V. Tubular Condenser	CO-33
C809	.1 MFD 600 V. Tubular Condenser	CO-33
F801	5 Amp. 250 V. Fuse	FU-5
F802	5 Amp. 250 V. Fuse	FU-5
F803	2 Amp. 250 V. Fuse	FU-2
J801P	Chassis Connector	PL-27P
J802S	Chassis Connector	PL-68S
J804S	Chassis Connector	PL-54S
J805S	Chassis Connector	PL-54S
J806S	Chassis Connector - Utility Outlet	PL-141S
K801	3 Pole Double Throw DC Relay	RL-26
K802	3 Pole Double Throw DC relay	RL-26
K803	3 Pole Double Throw DC Relay	RL-26
R801	150 OHM 50 Watt Adjustable Resistor	RE-259
R802	500 OHM 50 Watt Adjustable Resistor	RE-221
R803	150 OHM 50 Watt Adjustable Resistor	RE-259
R804	10 OHM 5 Watt W. W. Resistor	RE-264
S501	Micro Switch	SW-2
S502	Dual DPDT Toggle Switch	SW-51
S503	Dual DPDT Toggle Switch	SW-51
S801	DPST Toggle Switch	SW-4
S802	6 Pole 3 Position Shorting Switch	SW-18
S803	Single Pole Pushbutton N. C. (Stop)	SW-35
S804	Single Pole Pushbutton N. O. (Record)	SW-34
S805	Double Pole Pushbutton N. O. (Start)	SW-12
S806	SPDT Toggle Switch	SW-28
S2001	Single Pole Pushbutton N. O. (Record)	SW-34
S2002	Double Pole Pushbutton N. O. (Start)	SW-12
S2003	Single Pole Pushbutton N. C. (Stop)	SW-35
SR801	Selenium Rectifier	SR-4

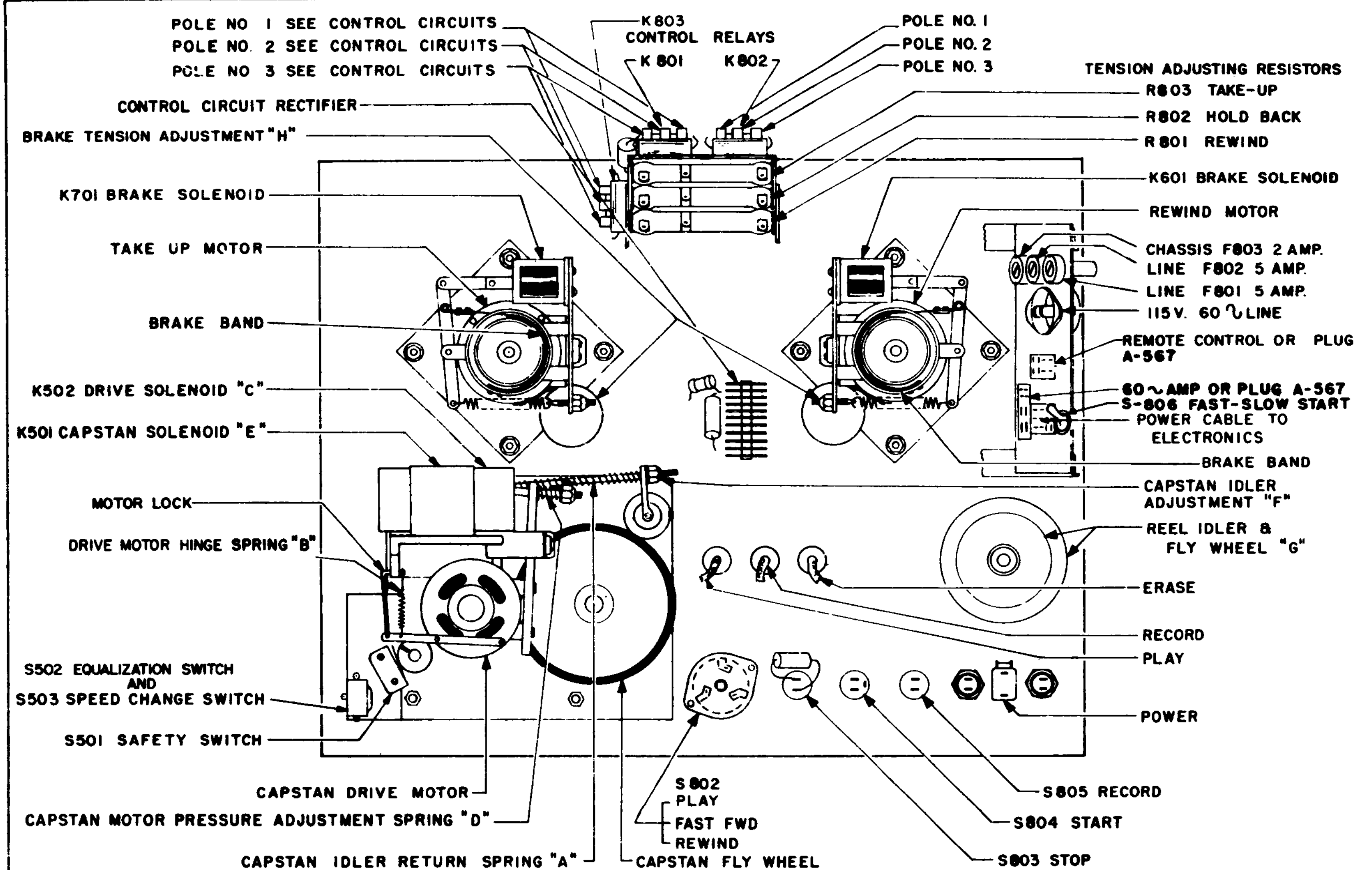
NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
	Top Plate Assembly (Complete)	1882
	Drive Assembly (Complete)	2327
	Capstan Assembly	1512
	Capstan Dust Cap	2326
	Capstan Felt Washer - Dust Seal	494
	Capstan Tru-Arc Retainer	RR-5-1
	Capstan Idler Assembly	500
	Capstan Idler Arm	372
	Capstan Idler Arm Bearing Housing	374
B501	Drive Motor Assembly - Complete with motor and pulley	1075
	Drive Motor Return Spring (Console & Portable)	1024
	Drive Motor Return Spring (Rack Mount only)	390
	Drive Motor Shield	1905
K502	Drive Solenoid - DC	670
	Felt Washer	PW-6-1/4-416-816
	Drive Motor Pressure Adjusting Spring	389
K501	Capstan Solenoid	670
	Felt Washer	PW-6-1/8-416-816
	Capstan Idler Return Spring	400
	Capstan Idler Adjusting Spring	676
	Tape Speed Switch Assembly (Including S501, S502, and S503)	364
	Takeup Assembly Complete	339
B701	Takeup Motor Assembly - Complete with motor, flange, brakedrum and turntable.	2458
	Brake Housing	317
	Brake Band Assembly	328
	Brake Band Leaf	720-1&2
K701	Brake Solenoid	337
	BrakeAdjusting Spring	322
	Turntable Pad	958
	Rewind Assembly Complete	338
B601	Rewind Motor Assembly - Complete with motor, flange, brakedrum and turntable.	2458
	Brake Housing	316
	Brake Band Assembly	328
	Brake Band Leaf	720-1&2
K601	Brake Solenoid	337
	Brake Adjusting Spring	322
	Turntable Pad	958
	Takeup Tension Arm Assembly	425
	Tape Guide	675
	Tape Guide Hook	355
	Takeup Tension Spring	422

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
	Reel Idler Assembly	1123
	Tape Guide	257
	Head Assembly - Model 307 Console	475-12
	Head Assembly - Model 307 Rack & Suitcase	475-13
	Head Assembly - Model 307-2 Console	3531-3
	Head Assembly - Model 307-2 Rack & Suitcase	3531-4
	Head Assembly - Model 306-1 Console & Rack	475-19
	Head Assembly - Model 306-1 Suitcase	475-20
	Head Assembly - Model 306-2 Console	3531-7
	Head Assembly - Model 306-2 Rack & Suitcase	3531-8
	Gate Pins	DR-2-3-10
	Gate Spring	438
	Reel	539
	Reel Knob - Editing (Console & Suitcase)	1917
	Reel Knob - Hold Down (Rack)	4402
	AC Power Cable	564
	Interconnecting Cable (Single Track) Console	563-2
	Interconnecting Cable (Single Track)Rack & Suitcase	563-1
	Interconnecting Cable (Dual Track) Console	3584-1
	Interconnecting Cable (Dual Track) Rack & Suitcase	3584
	Dummy Plug (Remote Control or 60 Cycle Amplifier)	567
	Record Pushbutton Guard	463
	Start and Stop Pushbutton Guards	361
	Speed Change Knob	KN-10
	Mode Selector Lever Knob	KN-2
	Fuse Holder	FE-1
	Pilot Lamp Base - Amber	DL-6
	Pilot Lamp Base - Red	DL-7
	Meter Control Panel Complete for Model 307	1884
	Cable Assembly - Record	2315
	Cable Assembly - Playback	2316
	Cable Assembly - Metering	2314
	Cable Assembly - Panel Lamp	625
	12 Bar - Strobosticker - to be used for checking speed at the lower speed (30" for 30"-60" machine and 15" for 15"-30" machine)	575
	Capstan Bushing Extractor Tool	TA-1514
	3/16" Hex Key	TO-1
	5/32" Hex Key	TO-2
	Head Demagnetizer	704
	30" Telemetering Standard Tape	1994
	Fan Assembly for Console Cabinet	2695
	Air Filter	AF-1

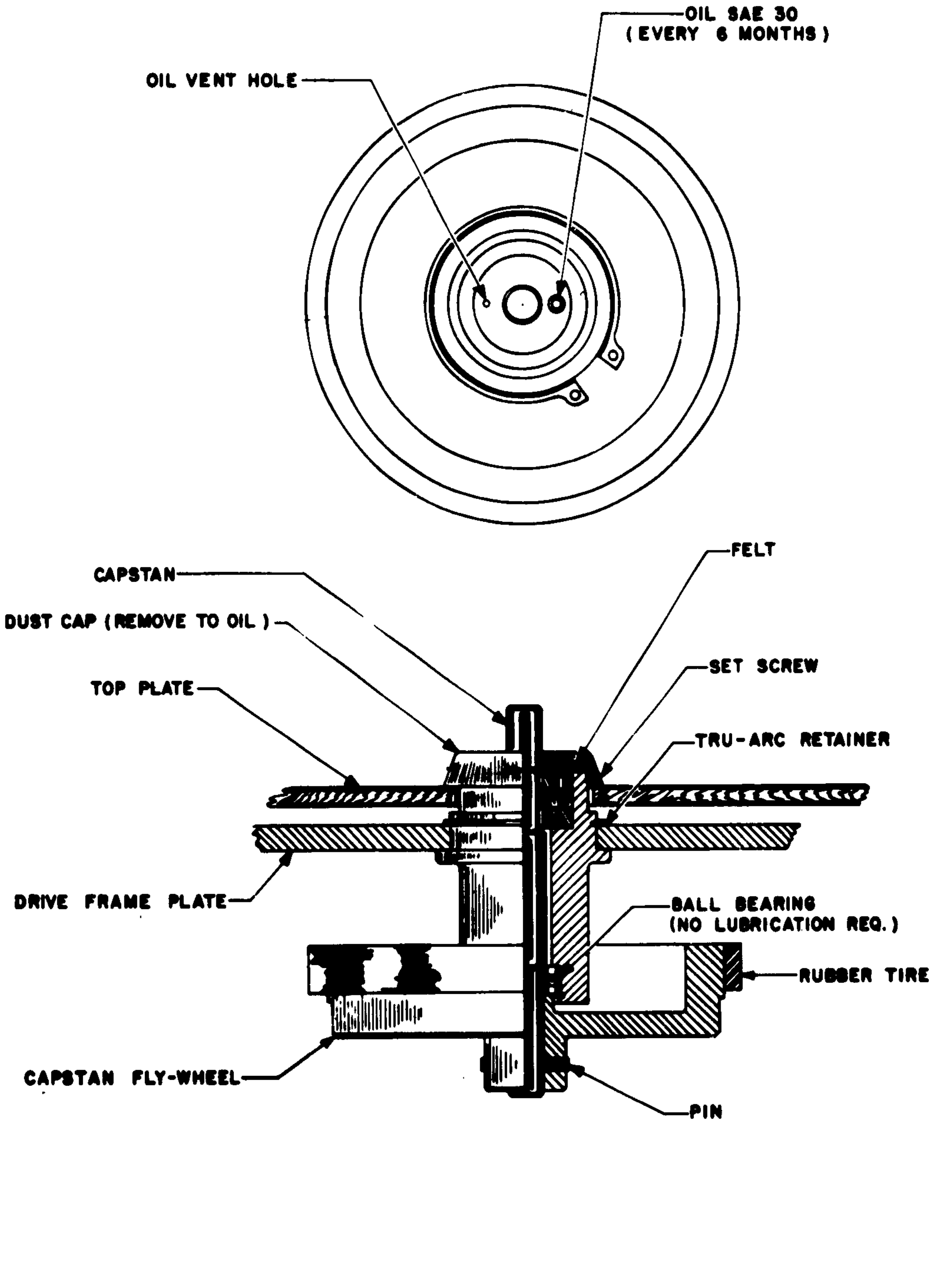
NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!



TOP PLATE ASSEMBLY (BOTTOM VIEW)
MODEL 307
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 1

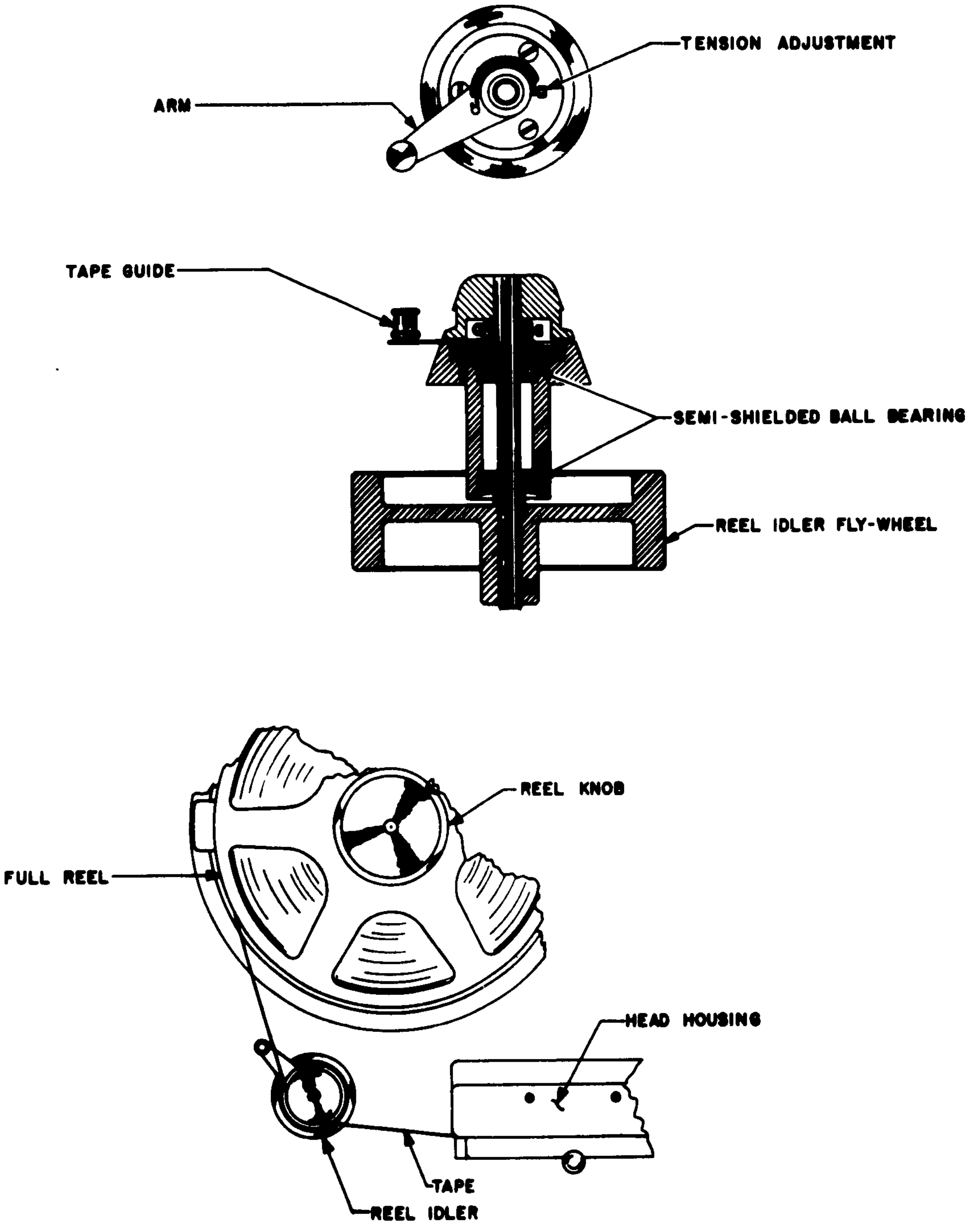
9-29-52



CAPSTAN ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 2

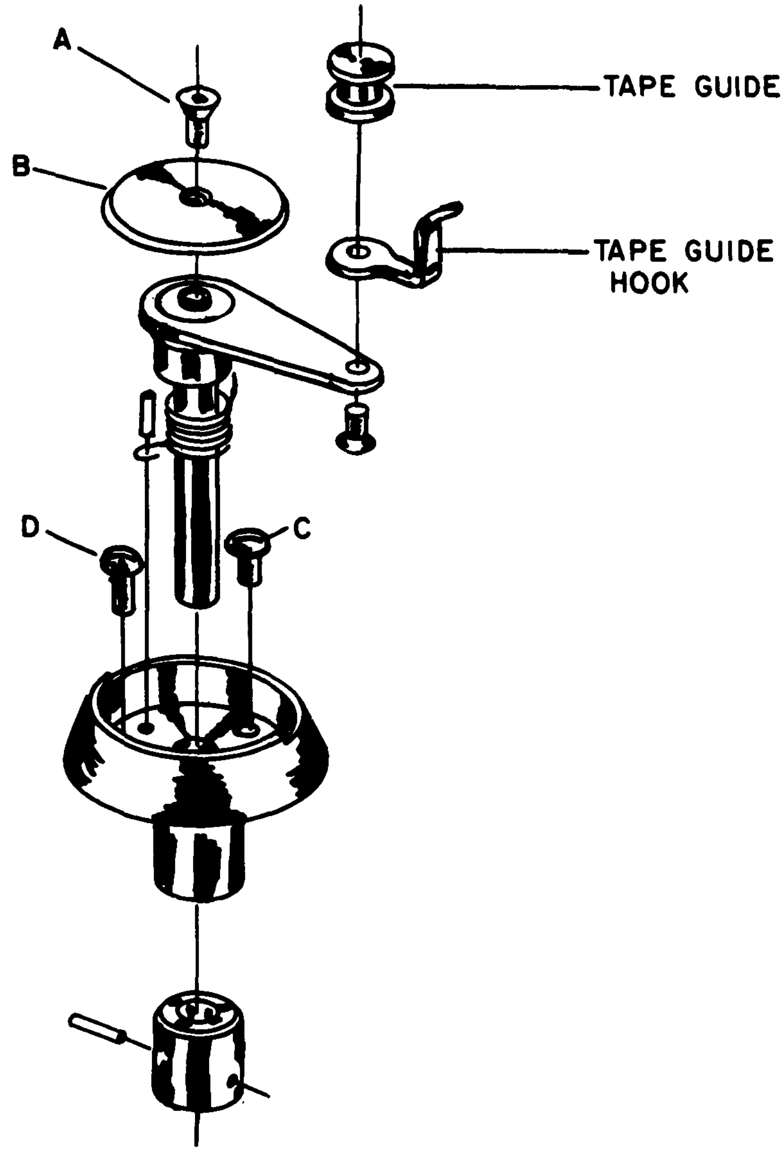
8-18-52



REEL IDLER ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 3

8-16-52



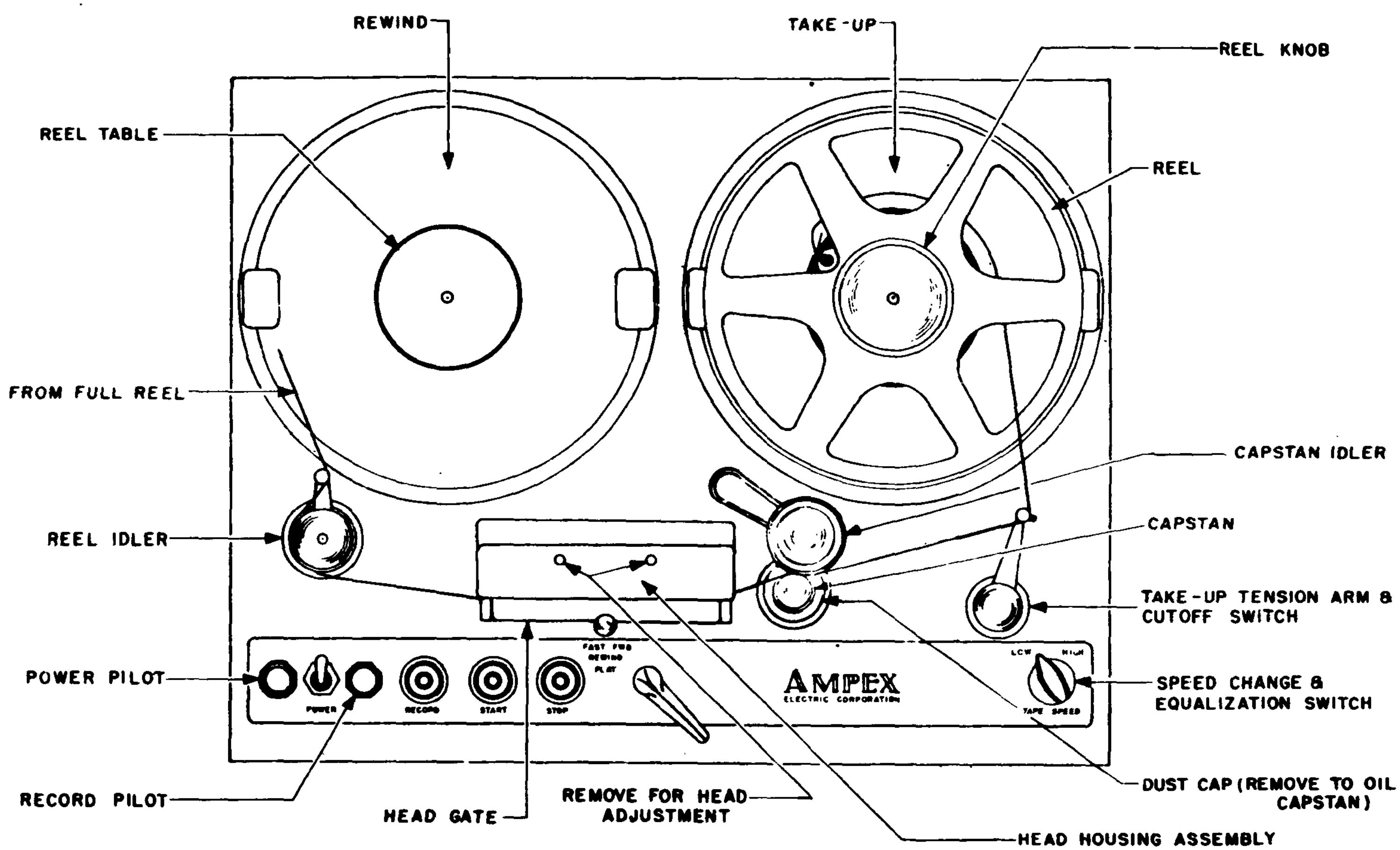
TO REMOVE ASSEMBLY FROM TOP PLATE REMOVE SCREW A, DISC B & SCREWS C & D. LIFT OUT.

DO NOT OIL ASSEMBLY

TAKE-UP TENSION ARM ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 4

B-5501 8-15-52



TOP PLATE ASSEMBLY (TOP VIEW)
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG 5

8-18-52

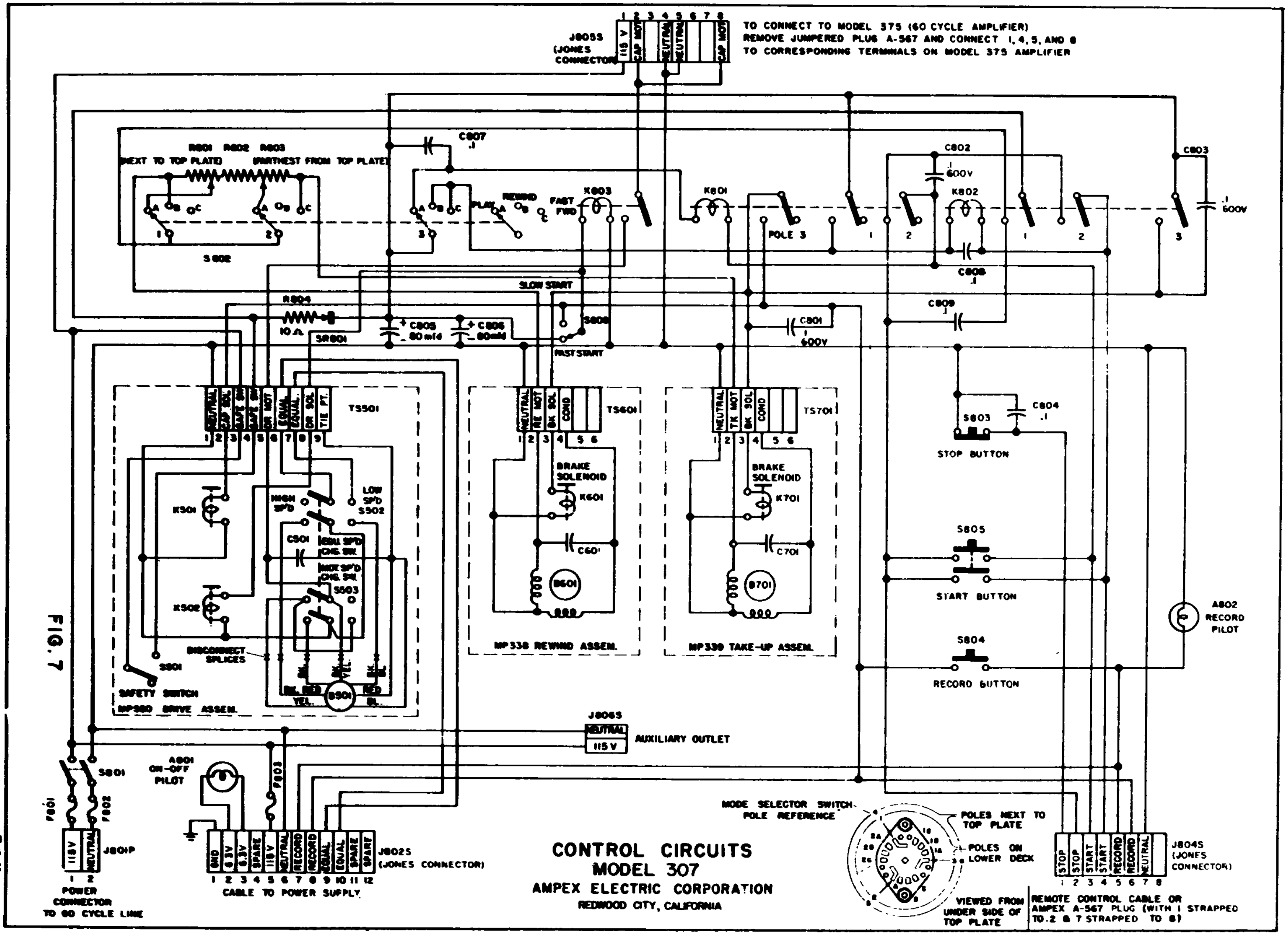
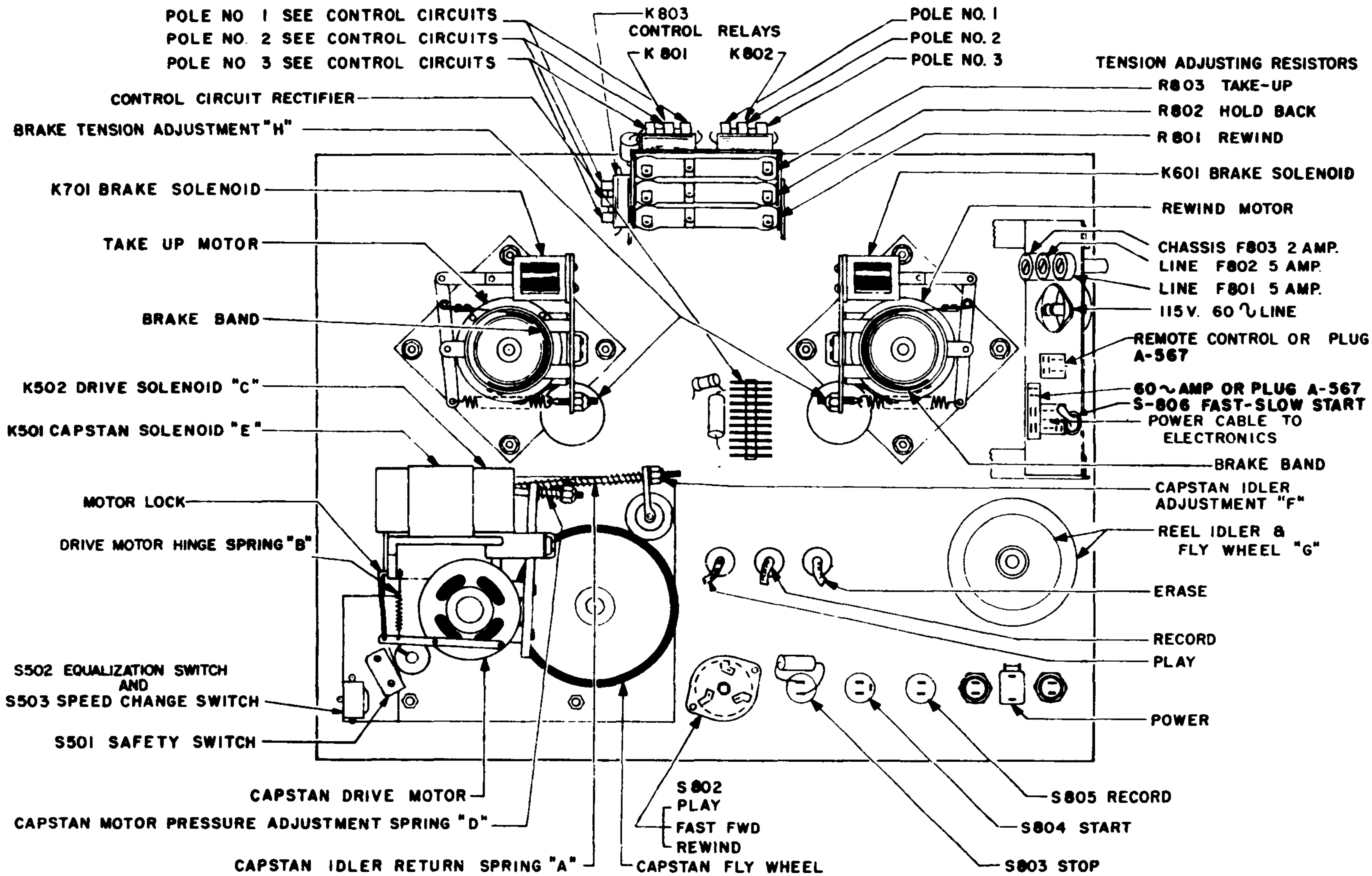

J805S (JONES CONNECTOR)
115 V
CAP MOT
NEUTRAL
NEUTRAL
CAP MOT
TO CONNECT TO MODEL 375 (60 CYCLE AMPLIFIER) REMOVE JUMPERED PLUG A-567 AND CONNECT 1, 4, 5, AND 8 TO CORRESPONDING TERMINALS ON MODEL 375 AMPLIFIER
R801 R802 R803
(NEXT TO TOP PLATE) (FARTHEST FROM TOP PLATE)
S802
C807 .1
PLAY
REWIND
FAST FWD
K803
K801
POLE 3
K802
C802 .1 600V
C808 .1
C803 .1 600V
R804 10 Ω
SR801
C805 80 mfd
C806 80 mfd
SLOW START
S808
FAST START
C801 .1 600V
C809 .1
TS501
NEUTRAL
CAP SOL
SAFE SW
SAFE SW
DR MOT
EQUAL.
EQUAL.
DR SOL
TIE PT.
K501
K502
HIGH SP'D
LOW SP'D
S502
C501
EQUAL SP'D CHG. SW.
MAX SP'D CHG. SW.
S503
DISCONNECT SPLICES
S501
SAFETY SWITCH
MP380 DRIVE ASSEM.
B501
TS601
NEUTRAL
RE MOT
BK SOL
COND
BRAKE SOLENOID
K601
C601
B601
MP338 REWIND ASSEM.
TS701
NEUTRAL
TK MOT
BK SOL
COND
BRAKE SOLENOID
K701
C701
B701
MP339 TAKE-UP ASSEM.
C804 .1
S803
STOP BUTTON
S805
START BUTTON
S804
RECORD BUTTON
A802 RECORD PILOT
J806S
NEUTRAL
115 V
AUXILIARY OUTLET
S801
F801
F802
J801P
115V
NEUTRAL
POWER CONNECTOR TO 60 CYCLE LINE
A801 ON-OFF PILOT
F803
J802S (JONES CONNECTOR)
GND
6.3V
6.3V
SPARE
115 V
NEUTRAL
RECORD
RECORD
EQUAL
EQUAL
SPARE
SPARE
CABLE TO POWER SUPPLY
CONTROL CIRCUITS
MODEL 307
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA
MODE SELECTOR SWITCH POLE REFERENCE
POLES NEXT TO TOP PLATE
POLES ON LOWER DECK
VIEWED FROM UNDER SIDE OF TOP PLATE
J804S (JONES CONNECTOR)
STOP
STOP
START
START
RECORD
RECORD
NEUTRAL
REMOTE CONTROL CABLE OR AMPEX A-567 PLUG (WITH 1 STRAPPED TO 2 & 7 STRAPPED TO 8)

FIG. 7

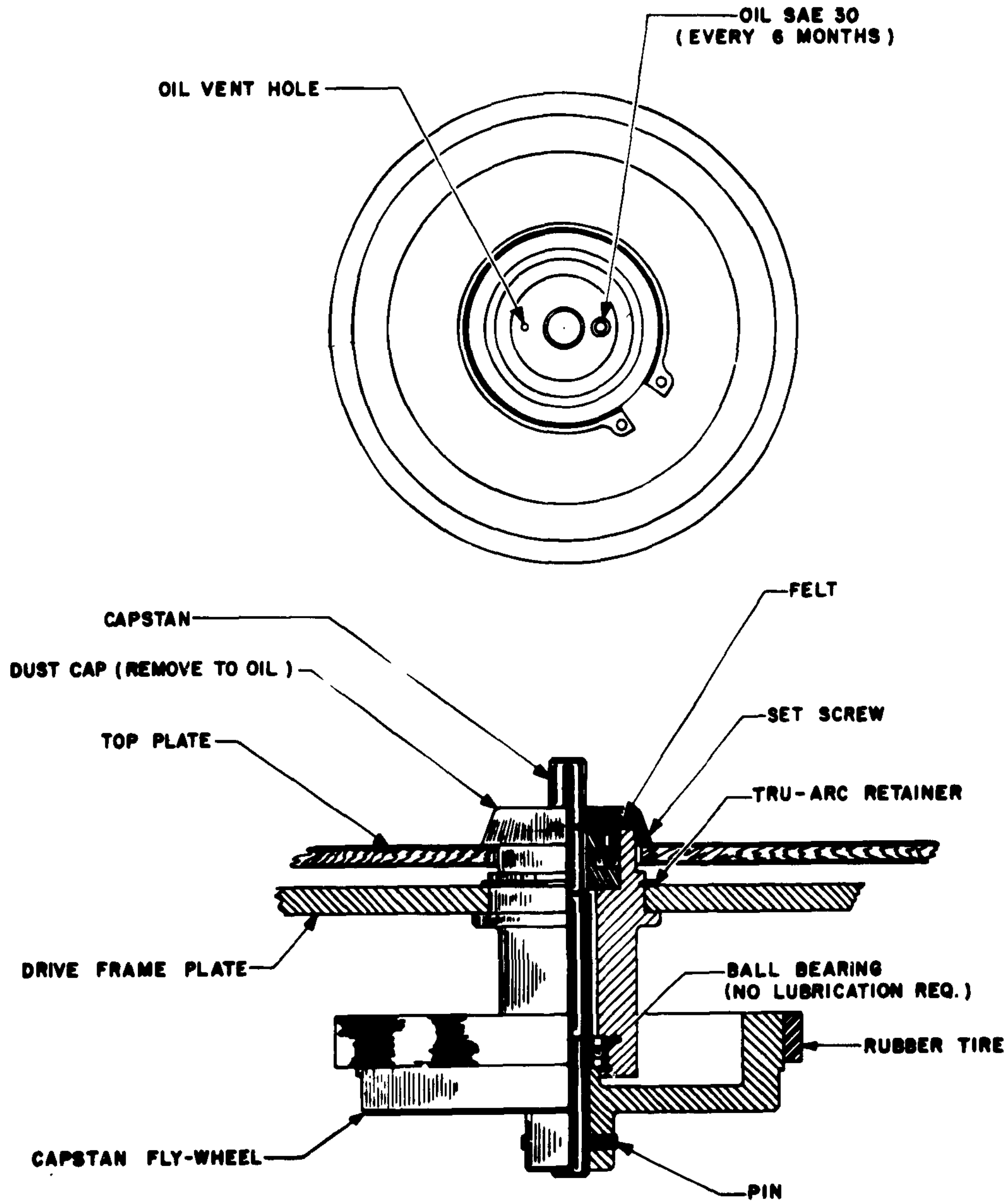
7-18-52



TOP PLATE ASSEMBLY (BOTTOM VIEW)
MODEL 307
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 1

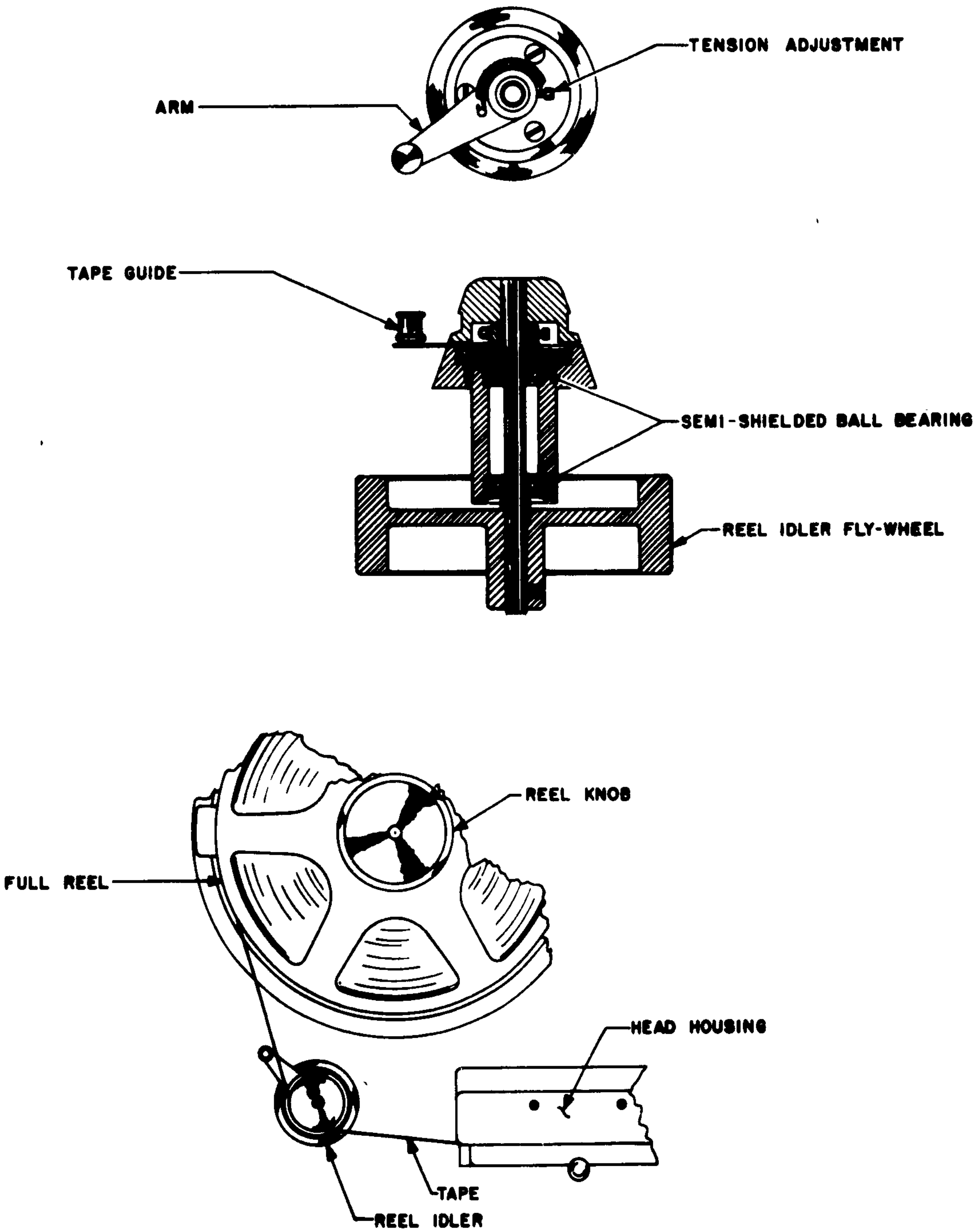
9-25-52



CAPSTAN ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 2

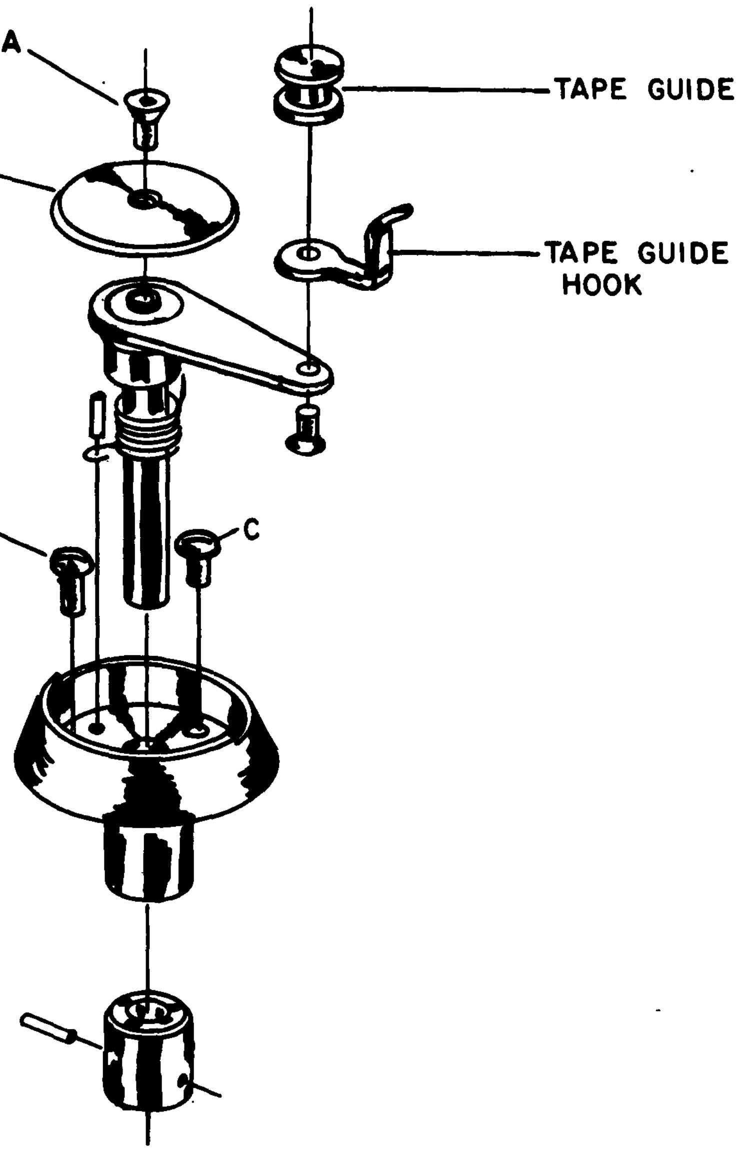
9-16-52



REEL IDLER ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 3

8-16-52



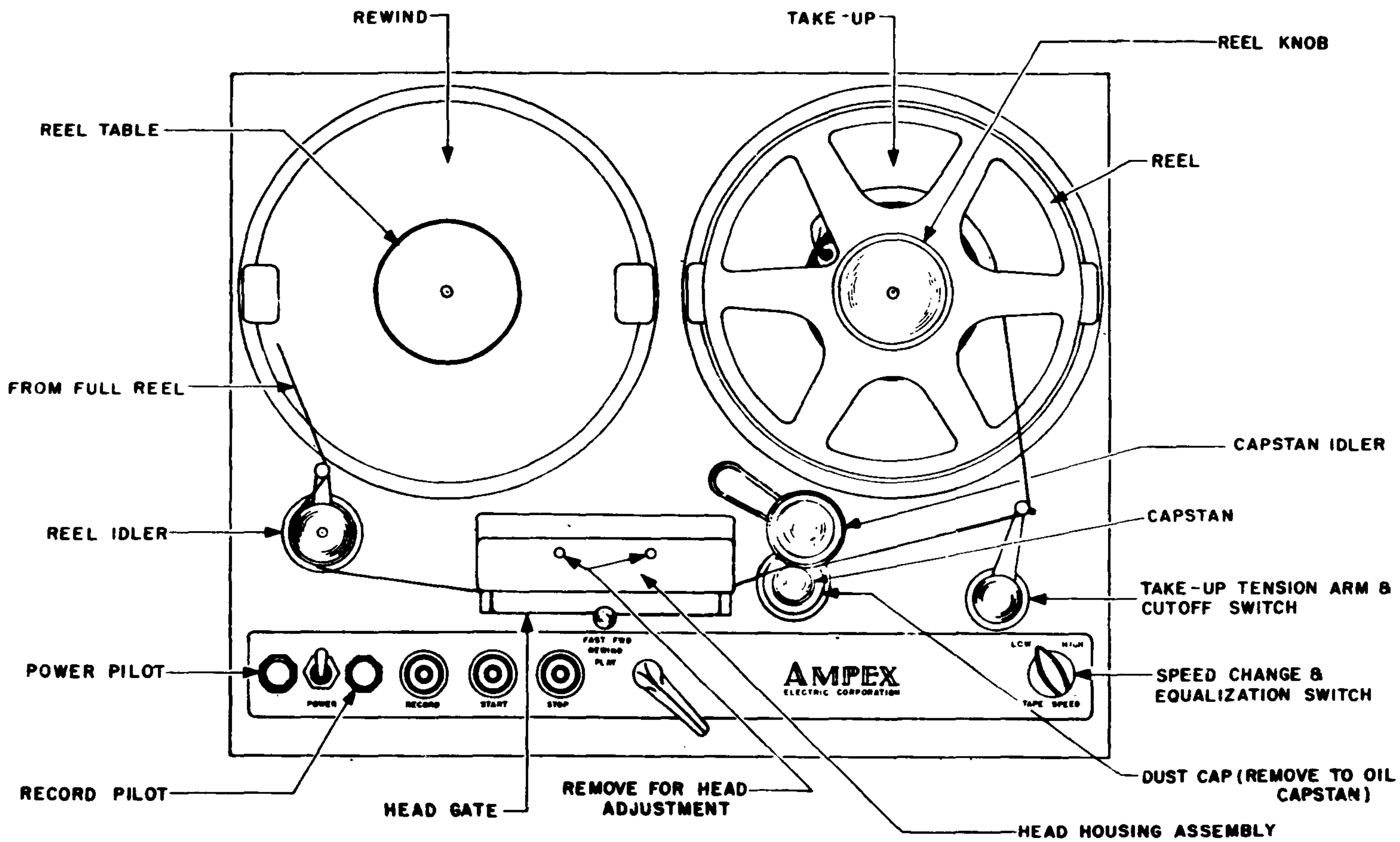
TO REMOVE ASSEMBLY FROM TOP PLATE REMOVE SCREW A, DISC B & SCREWS C & D. LIFT OUT.

DO NOT OIL ASSEMBLY

TAKE-UP TENSION ARM ASSEMBLY
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 4

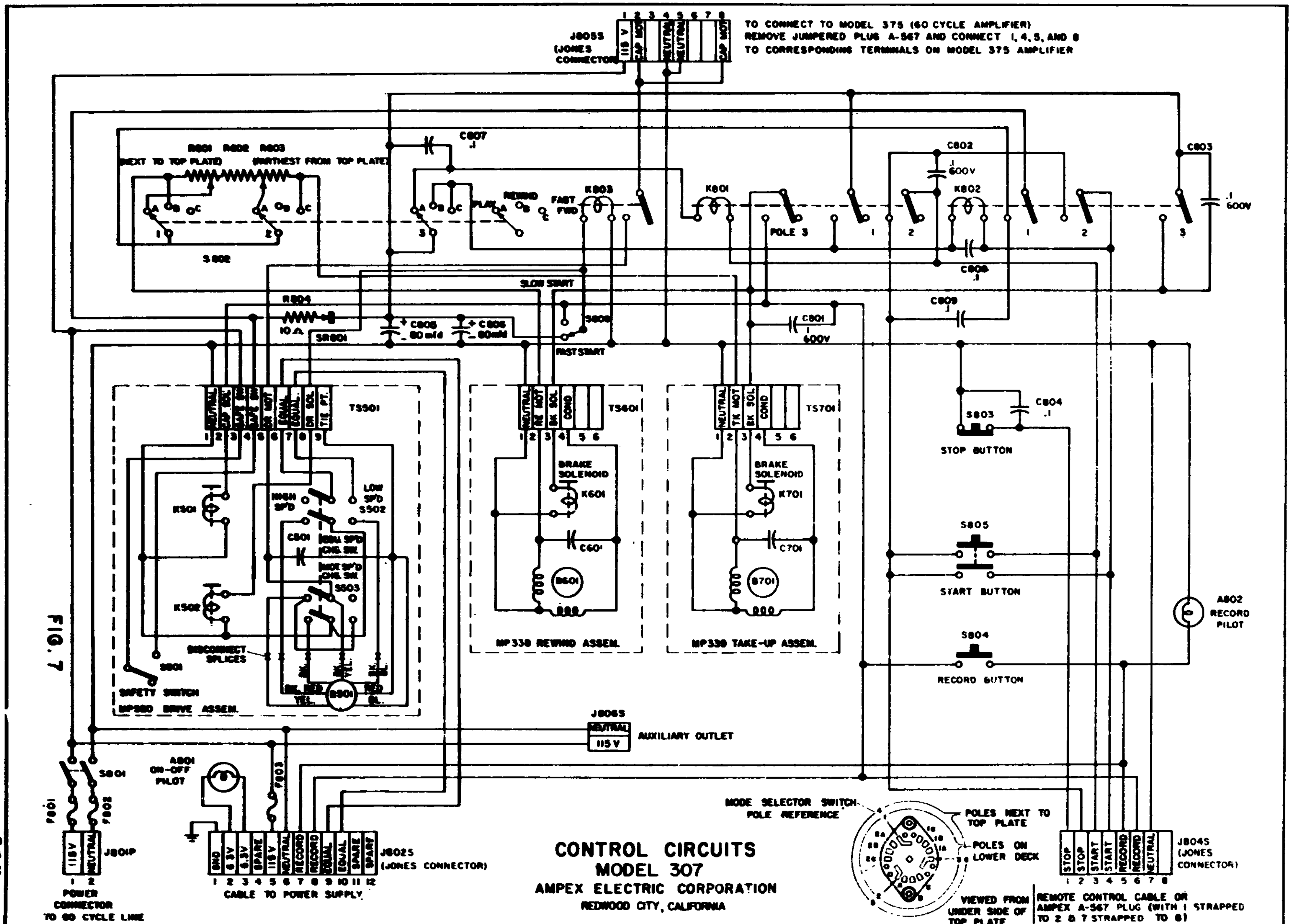
B-5501 8-15-52



TOP PLATE ASSEMBLY (TOP VIEW)
SERIES 300
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG 5

8-15-52



CONTROL CIRCUITS
MODEL 307
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 7

7-18-88

SECTION I

Specifications for Model 306-1 and 306-2

The Ampex Models 306-1 and 306-2 are FM tape recorders designed for data recording of frequencies between 0 and 5000 cycles. A Model 307 three speed Tape Transport is supplied with these recorders, although only 30 inch per second is used in the FM recording system. The Model 306-1 is a single channel unit while the 306-2 is a dual channel unit.

Tape Speed:

30 inch per second for FM recording with 15 inch per second and 60 inch per second available for other recording systems.

Frequency Response:

Plus 1/2 db 0 to 3000 cycles
Plus 1 -3 db to 5000 cycles

Signal to Noise Ratio

40 db below 100% modulation

Harmonic Distortion

2% RMS total harmonic distortion at 100% modulation

Modulator Record Amplifier

Input: 1 Volt RMS sine wave (1.4 Volts peak) at 100,000 ohm unbalanced for 100% modulation

Input Connector: Cannon XL-3-13

Controls: The carrier frequency adjustment is a locked screw driver control. The Level Adjustment is a locked screw driver control set to provide 100% modulation for 1 Volt RMS input. A phone jack is provided on the front of the rack panel for monitoring the carrier frequency.

Demodulator Playback Amplifier

Output: 1 Volt RMS sine wave (1.4 Volt peak) at 600 ohms unbalanced for a 100% modulated input.

Output Connector: Cannon XL-3-14

Controls: The clipping level control is a locked screw driver adjustment which varies the output voltage over a narrow range. It is factory set for 1 Volt RMS output at 100% modulation. The DC zero balance adjustment is a locked screw driver control. A test jack is provided at the input of the playback amplifier. A test cable is provided to attenuate the output of the record amplifier so it can be connected to the input of the playback amplifier. This arrangement allows system calibration and overall performance checks independent of the tape operation.

Starting Time:

Approximately 10 seconds for stable motion with slow start (60"/Sec.). With fast start (15" and 30") 1/10 second. The change from fast start to slow start is made by switch underneath the top plate. The fast start cannot be used at 60 inches per second.

Rewind Time: One minute for full 10-1/2 inch diameter reel.

Tape Transport Controls:

Start, Stop, and Record are relay controlled. The relays are operated by push buttons on the top plate. A receptacle is provided to allow connection of Start, Stop, and Record switches from a remoted location to operate these functions.

Complete Plug-In Head Assembly:

Double Mu-metal shield cans on playback head, equivalent shielding on record head, matching self-aligned covers on hinged gate. Drop-in tape threading.

Dimensions:

Mechanical unit on 24-1/2" panel for standard rack mounting; electronic unit on 12-1/4" panel for standard rack mounting.

Mounting:

Console, Portable Case, and Rack Mount.

SECTION III

OPERATION

A. Electrical:

Mechanical operation of the complete recorder is covered in Section III-B of this Instruction Book. CAUTION: Be certain that tape speed is set for 30 inches per second.

Adjust level of signal to be recorded to 1.0 volts RMS sine wave, or to 1.41 volts PEAK, and connect to input receptacle on electronics chassis.

Normally it is not necessary to pre-erase the tape. However, for highest signal-to-noise ratios, pre-erase the tape with a good tank eraser.

The Playback Level Control has been adjusted at the factory to give an output of 1.0 volts RMS sine wave into a 600 ohm load, with recordings made with a 1.0 volt RMS input.

SECTION V

ELECTRONIC ALIGNMENT

Alignment is the necessary adjustments required to have the Electronic Assembly of the tape recorder perform properly. It should not be necessary to align the recorder when it comes to you from the factory, since the procedures described on the following pages have been performed at the factory prior to shipment.

Alignment consists of the following steps:

I. Head Alignment (Not required on multi-track machines with three or more tracks)

II. Power Supply Voltage Adjustment

III. Record Circuit Alignment

IV. Playback Circuit Alignment

The following equipment is required for complete alignment.

1. AC Vacuum Tube Voltmeter such as Hewlett Packard 400 C.
2. Audio Oscillator with a range from 100 to 100,000 cycles such as Hewlett Packard 200 C.
3. DC Voltmeter
4. Frequency Meter or Counter, or Oscillescope.
5. Head Phones.
6. Standard Alignment Tape catalog #1994. This is a tape recorded at 30 inch per second containing a 40 KC tone for playback head alignment. The remaining tones are for use in aligning other types of tape recorders. The level of the 40 KC tone will slowly drop with continued usage, especially if the heads are magnetized. It is therefore recommended that the heads be demaggetized with an Ampex Head Demagnetizer #704 before playing the standard tape.

I Head Alignment

The high frequency response of the heads is dependent upon correct head alignment. Since 100% modulation produces frequency components up to 38KC the record and playback head azimuths must be correctly aligned for the proper operation of the machine.

The actual physical alignment of the record and playback heads consists of placing a 1/4 inch Spintite socket wrench on the left hand elastic stop nut and adjusting back and forth until the proper azimuth angle is determined.

To align the playback head, thread a standard alignment tape #1994 on the machine. Disconnect the playback head cable from the Electronic Assembly. Connect a Hewlett Packard 400 C Meter or equivalent across pins B and C of the head cable connector. Jumper pin B to the cable shield. Adjust the playback head azimuth for maximum output of the first tone on the tape (40 KC). The voice announcements on the standard tape can be heard by connecting headphones to the output of the voltmeter.

To adjust the record head azimuth with the playback head, tank erase a tape and thread on the machine. Leave the voltmeter connected to the playback head cable. Disconnect the record head cable and impress a 40 KC signal from an audio oscillator on the two contacts of the head cable connector. Adjust the record head azimuth for maximum playback output as read on the voltmeter.

II Power Supply Voltage

The Model 306 incorporates electronically regulated power supplies with adjustable output voltage. Both record and playback amplifiers obtain power from one power supply on the Model 306-1 and 306-2. On multi-track machines with three or more tracks separate power supplies are incorporated for record and playback. In either case, the locked screw driver control should be adjusted to produce and output voltage of 250 Volts. The regulators are designed to maintain this voltage throughout primary supply voltage limits of 105 to 130 Volts.

III Record Alignment

The basic element of the record amplifier is a free-running, positive-grid multivibrator, V202, the operating parameters of which are so chosen that the no-signal operating frequency, which will be referred to subsequently as the center frequency, is 27 kc. It is characteristic of this type of multivibrator that the repetition rate is very nearly a linear function of the positive grid-return potential with respect to the cathodes.

The grids of the multivibrator, or modulator, are returned to the plate of a dc amplifier, V201, which amplifies the input signal to the level required to produce the degree of frequency deviation necessary for adequate reproduced signal-to-noise ratio.

The variable Frequency Adjustment resistor, R213, is provided in the cathode return circuit of the dc amplifier to permit adjustment of the static plate current to the value required to cause the modulator center frequency to be exactly 27 kc.

A current regulator tube, V204, has been incorporated to provide essentially constant heater current for the dc amplifier tube, thereby minimizing center frequency drift resulting from heater supply voltage variations.

An isolation amplifier, comprising one half of V203, supplies current to the record head. The remaining half of V203 is connected as a cathode follower, which supplies power to an auxiliary test jack, J203, located on the front panel of the record amplifier.

The following procedure is recommended for proper adjustment of the record amplifier.

1. Turn on Power switch, located on the top plate. Make certain that the Mode Selector switch is in the Play position. Allow sufficient time for tube and component temperatures to stabilize.

2. Connect a Frequency Meter or Counter to Test Jack J203. If desired, comparison of the output with a signal of known frequency can be readily accomplished with an oscilloscope, using the Lissajous figure technique.

3. Remove the input cable from Input receptacle J201S.

4. Unlock and adjust the Frequency Adjust control, R313, to produce a center frequency of exactly 27 kc.

5. Connect a 1.41 volt direct current source to the input receptacle, J201S, making terminal 3 positive with respect to ground.

6. Unlock and adjust the Level control, R211, until the indicated modulator frequency is 16 kc., which corresponds to a deviation of approximately 40%.

The record amplifier will now be properly adjusted for recording under normal conditions. It is suggested that the center frequency be checked before recording data having very low frequency components.

IV <u>Playback Alignment</u>

The frequency-modulated signal recovered from the tape by the playback head is amplified by V301 and limited by V302 and V303 to a predetermined amplitude of approximately o.5 volt to minimize amplitude variation effects. The resultant signal is further amplified by V304 and again limited to an amplitude of 0.5 volt by V305 and V306. The squared wave is amplified by V307, after which it is limited by V308 and V309 to an amplitude determined by the Level Set control, R338. The limiting level at this point determines the amplitude of the recovered signal voltage delivered to the load, thus performing the function of a gain control in a conventional amplifier.

The fixed-amplitude square waves are differentiated and the pulses introduced into a phase inverter, V310, followed by the demodulator circuit, comprising diodes V311 and V312. The average component of the negative pulses appearing on the grid of V313 varies in proportion to the amplitude and rate of change of the recorded data signal.

The demodulated pulses are amplified by dc amplifier V313 and introduced into a low-pass filter through an inselating cathode follower, V314. The frequency response of the system is determined by the attenuation characteristics of the filter.

The output of the filter is coupled to the load terminals through a cathode follower, V315. Operating potentials of the cathode follower are so chosen that the cathode voltage, appearing on terminal 3 of J303P, is zero with respect to ground. The dc Zero Adjust control, R336, is provided on the panel to permit exact adjustment of this potential.

It is recommended that the following procedure be followed to properly adjust the Playback Amplifier:

1. Record a test tape on a properly aligned Record Machine. Feed a 200 cycle sinusoidal signal having an amplitude of 1 volt rms into the Record Amplifier. After making the test tape, transfer it to the Playback Machine.

2. Connect a 600 ohm load across the terminals of the output receptacle, J303P.

3. Connect a dc voltmeter across the load.

4. Connect an ac voltmeter across the load. A suitable blocking capacitor must be inserted in series with the instrument if it responds to a dc component.

5. After threading the tape, depress the Start button.

6. Adjust the Level Set control, R338, provided on the front panel, to produce an output voltage across the load of 1.0 volts rms.

7. Adjust the Zero Adjust control, R336, to the point which provides zero dc voltage across the load. If the Zero Adjust control does not accomplish this result approximately mid-way between adjustment limits, correction of the dc level may be effected by adjustment of the Bias Adjustment control, R330, located on the chassis.

8. Repeat steps 6 and 7; some degree of inter-action is a normal characteristic of the circuit.

It is possible to align the Playback Amplifier independent of the tape system. Connect the #4111 Test Cable from the Test Jack J203 of an aligned Record Amplifier to the Test Jack J302 of the Playback Amplifier. The Test Cable incorporates a 22k resistor in series with the center conductor to prevent overloading of the playback amplifier. Note: The playback head cable must be plugged into J301P, or pins B and C of J301P shorted together, for correct operation of the Test Cable. Repeat the steps described above while feeding the Record Amplifier with a 1 Volt RMS 200 cycle signal.

SECTION VI

RECORD AMPLIFIER STRIP

Single Channel Catalog #3670
Dual Channel Catalog #3671

Reference Number	Description	Ampex Catalog Number
C201	56 MMFD 500 V. Mica Condenser 5%	CO-227
C202	56 MMFD 500 V. Mica Condenser 5%	CO-227
C203	.01 MFD 400 V. Metalized Paper Condenser	CO-42
C204	8 MFD 350 V. Electrolytic Condenser	CO-215
C205	.1 MFD 400 V. Metalized Paper Condenser	CO-44
J201S	Connector Cannon XL-3-13	PL-58-S
J202P	Connector AN-3102-10S-4P	PL-61P
J203S	Phone Jack	JA-3
R201	150,000 Ohm 1 Watt Composition Resistor	RE-27
R202	10,000 ohm 1 Watt Composition Resistor	RE-453
R203	10,000 Ohm 1 Watt Composition Resistor	RE-453
R204	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R205	10,000 Ohm 2 Watt Composition Resistor	RE-168
R206	1 Megohm 1 Watt Composition Resistor 5%	RE-48
R207	1,800 Ohm 1/2 Watt Composition Resistor 5%	RE-477
R208	1,800 Ohm 1/2 Watt Composition Resistor 5%	RE-477
R209	1 Megohm 1 Watt Composition Resistor 5%	RE-48
R210	4,700 Ohm 1/2 Watt Composition Resistor	RE-352
R211	100,000 Ohm Carbon Potentiometer	RE-472
R212	820 Ohm 1/2 Watt Composition Resistor	RE-370
R213	1500 Ohm Potentiometer	RE-521
R214	1 Megohm 1/2 Watt Composition Resistor	RE-385
R215	470 Ohm 1/2 Watt Composition Resistor	RE-333
TS201	Terminal Strip with Marker	TS-7-7
V201	12AX7 Vacuum Tube	TU-29
V202	12AU7 Vacuum Tube	TU-28
V203	12AU7 Vacuum Tube	TU-28
V204	3V4 Vacuum Tube	TU-44

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

PLAYBACK AMPLIFIER STRIP CATALOG #3669

Reference Number	Description	Ampex Catalog Number
C-301	.0005 MFD 600 V. Paper Condenser	CO-231
C-302	.001 MFD 600 V. Paper Condenser	CO-216
C-303	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C-304	.005 MFD 600 V. Paper Condenser	CO-217
C-305	.25 MFD 400 V. Metalized Paper Condenser	CO-45
C-306	.005 MFD 600 V. Paper Condenser	CO-217
C-307	.5 MFD 400 V. Metalized Paper Condenser	CO-46
C-308	8 MFD 350 V. Electrolytic Condenser	CO-215
C-309	.00005 MFD 500 V. Mica Condenser 5%	CO-2
C-310	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C-311	.1 MFD 200 V. Metalized Paper Condenser	CO-97
C-312	.01 MFD 400 V. Metalized Paper Condenser	CO-42
C-313	10 MFD 25 V. Electrolytic Condenser	CO-198
C-314	.01 MFD 400 V. Metalized Paper Condenser	CO-42
C-315	10 MFD 25 V. Electrolytic Condenser	CO-198
C-316	.01 MFD 400 V. Metalized Paper Condenser	CO-42
C-317	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C-318	.0029 MFD 500 V. Mica Condenser - Bridged	CO-9
C-319	.0017 MFD 500 V. Mica Condenser - Bridged	CO-228
C-320	.0005 MFD 500 V. Mica Condenser - Bridged	CO-5
C-321	.000056 MFD 500 V. Mica Condenser - Bridged	CO-227
C-322	50 MFD 50 V. Electrolytic Condenser	CO-61
C-323	100 MFD 15 V. Electrolytic Condenser	CO-229
FI-301	5000 Cycle Low Pass Filter	3668
J-301P	Connector AN-3102A-10SL-3P	PL-59P
J-302S	Phone Jack	JA-2
J-303P	Connector Cannon XL-3-14	PL-4-P
L-301	.5 Henry Torroid	CH-41
NE-301	1/25 Watt Neon Bulb NE-2	LA-4
R-301	100,000 Ohm 1 Watt Composition Resistor	RE-26
R-302	240,000 Ohm 1 Watt Composition Resistor 5%	RE-475
R-303	27,000 Ohm 1 Watt Composition Resistor 5%	RE-19
R-304	47,000 Ohm 1 Watt Composition Resistor 5%	RE-22
R-305	330,000 Ohm 1 Watt Composition Resistor 5%	RE-30
R-306	4,700 Ohm 1 Watt Composition Resistor 5%	RE-11
R-307	47,000 Ohm 1 Watt Composition Resistor	RE-22
R-308	330,000 Ohm 1 Watt Composition Resistor	RE-30
R-309	2,200 Ohm 1 Watt Composition Resistor	RE-7
R-310	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-311	4,700 Ohm 1 Watt Composition Resistor	RE-11
R-312	10,000 Ohm 1/2 Watt Composition Resistor	RE-453
R-313	39,000 Ohm 2 Watt Composition Resistor	RE-174
R-314	100,000 Ohm 1/2 Watt Composition Resistor-Bridged	RE-549
R-315	47,000 Ohm 1/2 Watt Composition Resistor-Bridged	RE-486

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

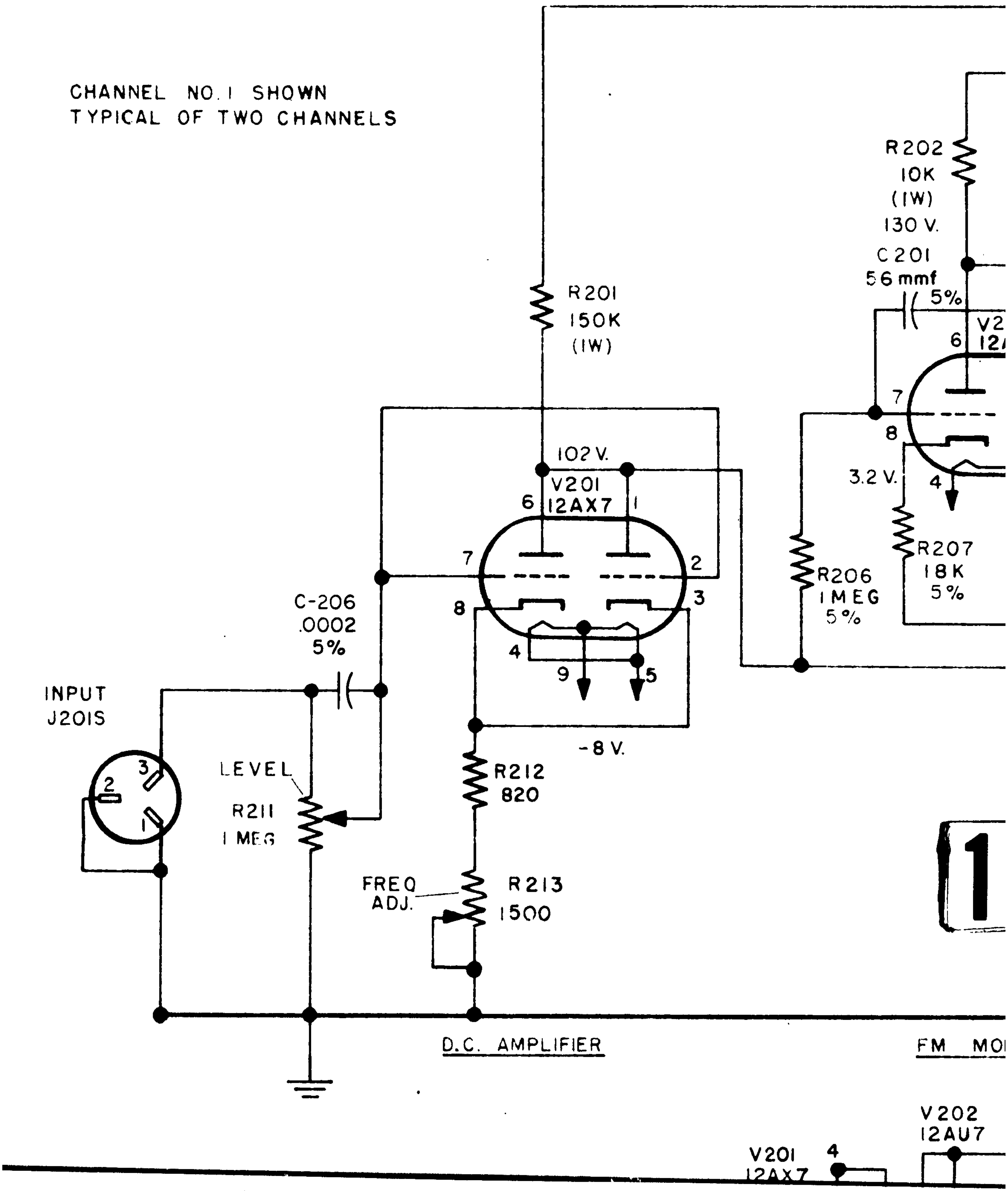
Reference Number	Description	Ampex Catalog Number
R-316	470,000 Ohm 1/2 Watt Composition Resistor-Bridged	RE-422
R-317	1 Megohm 1/2 Watt Composition Resistor	RE-385
R-318	47 Ohm 1/2 Watt Composition Resistor	RE-341
R-319	330,000 Ohm 1/2 Watt Composition Resistor	RE-427
R-320	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-321	330,000 Ohm 1/2 Watt Composition Resistor	RE-427
R-322	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-323	330,000 Ohm 1/2 Watt Composition Resistor	RE-427
R-324	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-325	6,800 Ohm 1/2 Watt Composition Resistor	RE-452
R-326	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-327	4,700 Ohm 1 Watt Composition Resistor	RE-11
R-328	10,000 Ohm 1/2 Watt Composition Resistor	RE-453
R-329	100,000 Ohm 1/2 Watt Composition Resistor	RE-300
R-330	500 Ohm Carbon Potentiometer	RE-473
R-331	15,000 Ohm 1 Watt Composition Resistor	RE-16
R-332	4,700 Ohm 1/2 Watt Composition Resistor 5%	RE-487
R-333	1.5 Megohm 1/2 Watt Composition Resistor 5%	RE-494
R-334	10,000 Ohm 5 Watt Wirewound Resistor	RE-262
R-335	390,000 Ohm 1/2 Watt Composition Resistor	RE-495
R-336	250,000 Ohm Carbon Potentiometer	RE-491
R-337	82,000 Ohm 1 Watt Composition Resistor	RE-25
R-338	10,000 Ohm Carbon Potentiometer	RE-474
R-339	220 Ohm 1/2 Watt Composition Resistor	RE-338
R-340	39 Ohm 2 Watt Composition Resistor	RE-19
R-341	82,000 Ohm 1 Watt Composition Resistor	RE-25
R-342	1,000 Ohm 1/2 Watt Composition Resistor	RE-448
R-341	27,000 Ohm 1 Watt Composition Resistor	RE-19
V-301	6CB6 Vacuum Tube	TU-43
V-302	IN34A Crystal Diode	TU-18
V-303	IN34A Crystal Diode	TU-18
V-304	6CB6 Vacuum Tube	TU-43
V-305	IN34A Crystal Diode	TU-18
V-306	IN34A Crystal Diode	TU-18
V-307	6CB6 Vacuum Tube	TU-43
V-308	IN34A Crystal Diode	TU-18
V-309	IN34A Crystal Diode	TU-18
V-310	6C4 Vacuum Tube	TU-26
V-311	IN34A crystal Diode	TU-18
V-312	IN34A Crystal Diode	TU-18
V-313	6AU6 Vacuum Tube	TU-33
V-314	6C4 Vacuum Tube	TU-26
V-315	12AT7 Vacuum Tube	TU-44
V-316	7H4 Vacuum Tube	TU-45

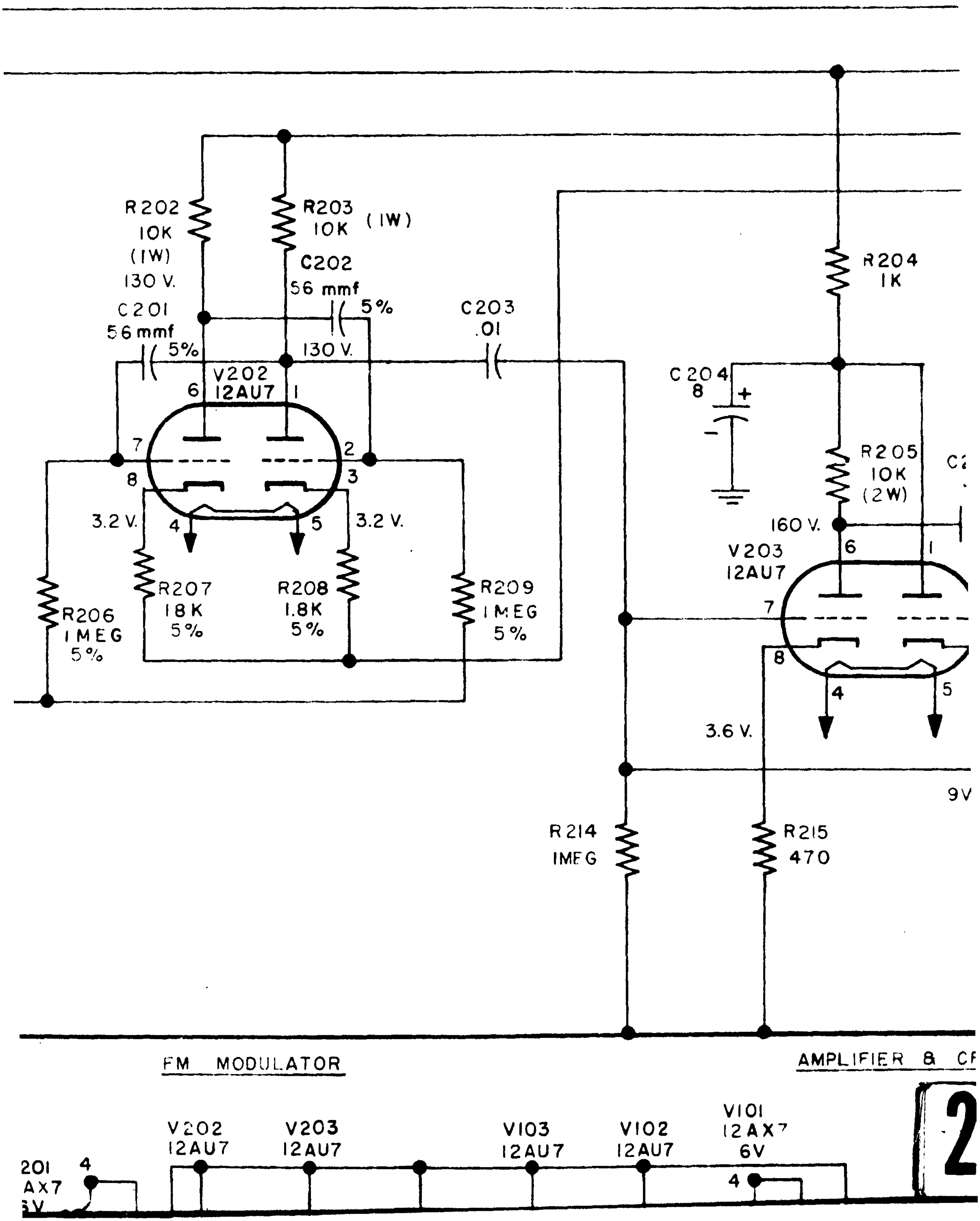
NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

POWER SUPPLY CATALOG #3846

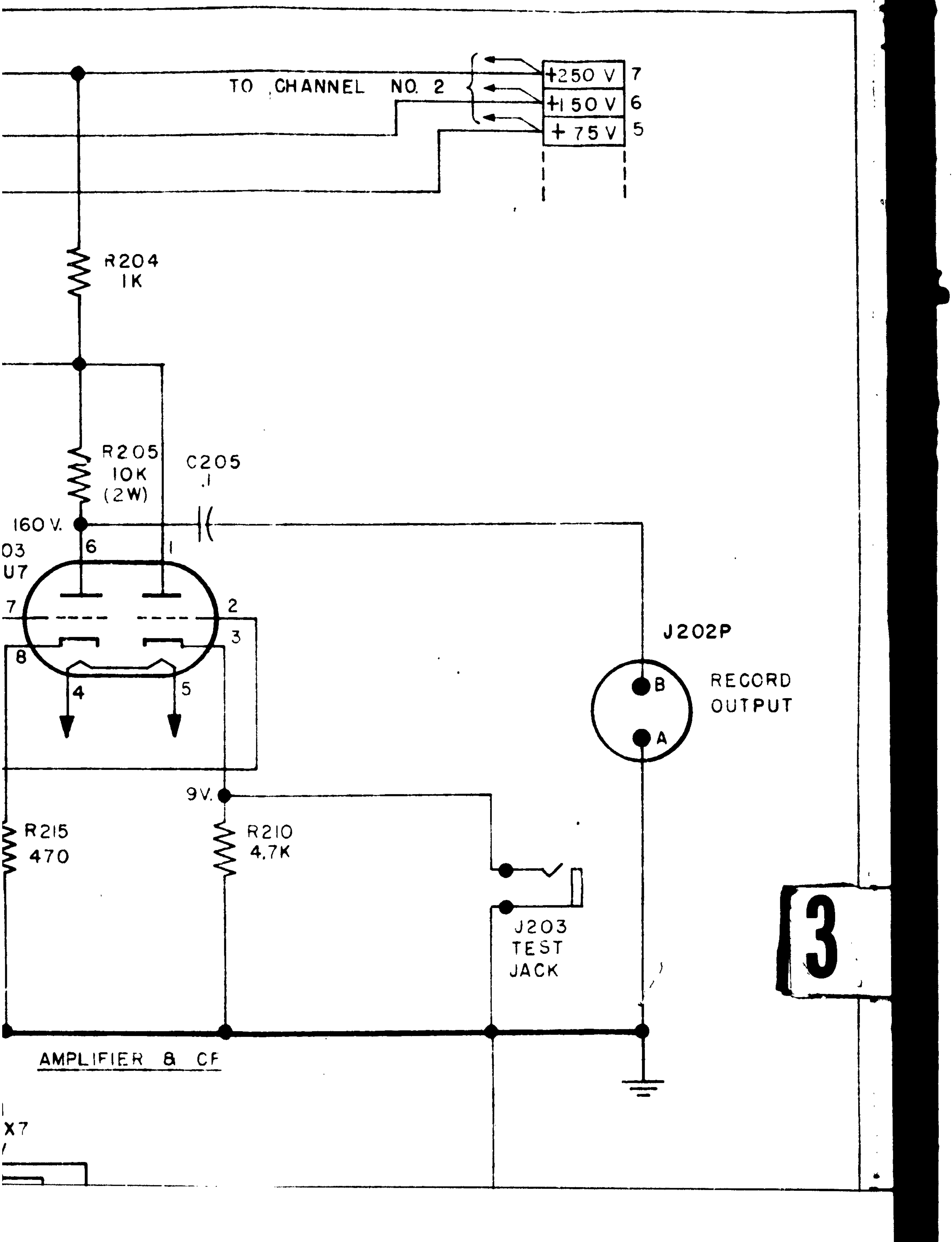
Reference Number	Description	Ampex Catalog Number
C-401	1. MFD 600 V. Oil Filled Condenser	CO-48
C-402	4 x 20 MFD 450 V. Electrolytic Condenser	CO-126
C-403	10 MFD 600 V. Oil Filled Condenser	CO-50
C-404	.1 MFD 600 V. Paper Condenser	CO-33
C-405	.25 MFD 600 V. Paper Condenser	CO-35
C-406	20 MFD 450 V. Electrolytic Tubular Condenser	CO-57
C-407	.1 MFD 600 V. Paper Condenser	CO-33
C-408	.1 MFD 600 V. Paper Condenser	CO-33
C-409	.1 MFD 600 V. Paper Condenser	CO-33
C-410	.05 MFD 600 V. Paper Condenser	CO-32
K-401	3 PDT Relay 115 V. D.C.	RL-26
L-401	12 Henry Filter Choke	3479
L-402	15 Henry Filter Choke	CH-33
R-401	39 Ohm 1 Watt Composition Resistor	RE-497
R-402	39 Ohm 1 Watt Composition Resistor	RE-497
R-403	2,700 Ohm 1/2 Watt Composition Resistor	RE-375
R-404	2,700 Ohm 1/2 Watt Composition Resistor	RE-375
R-405	1 Megohm 1/2 Watt Composition Resistor	RE-385
R-406	15,000 Ohm 10 Watt Wirewound Resistor	RE-16
R-407	10,000 Ohm 2 Watt Composition Resistor	RE-168
R-408	100,000 Ohm 1 Watt Composition Resistor	RE-26
R-409	25,000 Ohm Potentiometer	RE-481
R-410	33,000 Ohm 1 Watt Composition Resistor	RE-20
R-411	100,000 Ohm 1 Watt Composition Resistor	RE-26
R-412	15,000 Ohm 1 Watt Composition Resistor	RE-16
R-413	3,500 Ohm 10 Watt Wirewound Resistor	RE-326
R-414	10,000 Ohm 25 Watt Wirewound Resistor	RE-122
T-401	Power Transformer	TR-39
TS-401	Terminal Strip	TS-1-8
V-401	5U4G Vacuum Tube	TU-1
V-402	6X5 Vacuum Tube	TU-19
V-403	6AS7 Vacuum Tube	TU-17
V-404	6AC7 Vacuum Tube	TU-4
V-405	VR75/OA3 Vacuum Tube	TU-21
V-406	VR75/OA3 Vacuum Tube	TU-21
V-407	VR75/OA3 Vacuum Tube	TU-21
V-408	VR150/OD3 Vacuum Tube	TU-2

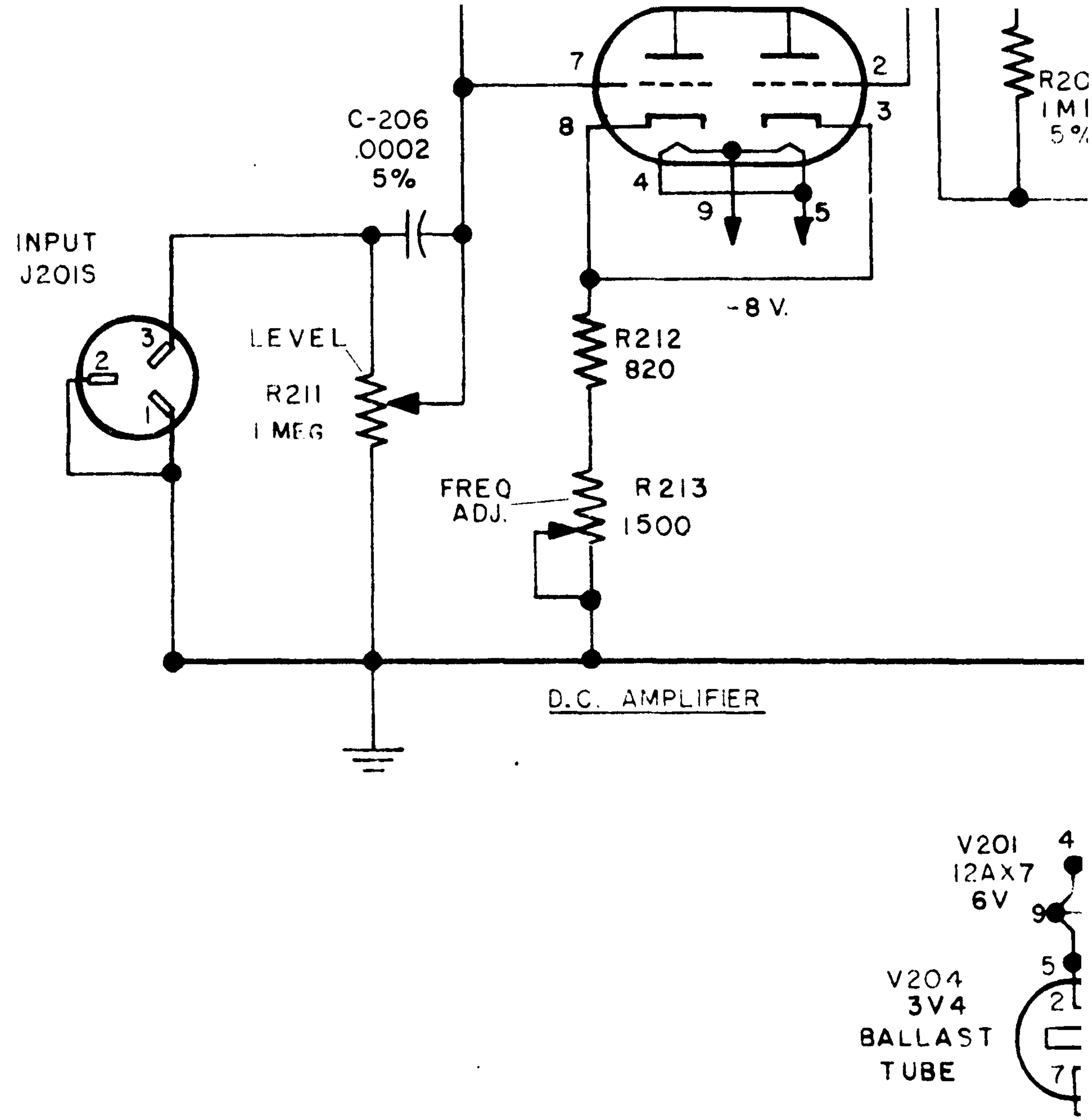
NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!


CHANNEL NO.1 SHOWN
TYPICAL OF TWO CHANNELS
R202
10K
(1W)
130 V.
C201
56 mmf
5%
R201
150K
(1W)
102 V.
V201
12AX7
-8 V.
R206
1 MEG
5%
3.2 V.
R207
18 K
5%
C-206
.0002
5%
INPUT
J201S
LEVEL
R211
1 MEG
R212
820
FREQ
ADJ.
R213
1500
D.C. AMPLIFIER
FM MO
V202
12AU7
V201
12AX7



R202
10K
(1W)
130 V.
R203
10K
(1W)
C202
56 mmf
5%
C201
56 mmf
5%
130 V.
C203
.01
V202
12AU7
3.2 V.
3.2 V.
R206
1 MEG
5%
R207
18K
5%
R208
1.8K
5%
R209
1 MEG
5%
R204
1K
C204
8
R205
10K
(2W)
160 V.
V203
12AU7
3.6 V.
9V
R214
1MEG
R215
470
FM MODULATOR
AMPLIFIER & C
V202
12AU7
V203
12AU7
V103
12AU7
V102
12AU7
V101
12AX7
6V
201
AX7
2


TO CHANNEL NO. 2
+250 V 7
+150 V 6
+75 V 5
R204
1K
R205
10K
(2W)
C205
.1
160 V.
03
U7
J202P
B
A
RECORD
OUTPUT
9V.
R215
470
R210
4.7K
J203
TEST
JACK
AMPLIFIER & CF
X7
3

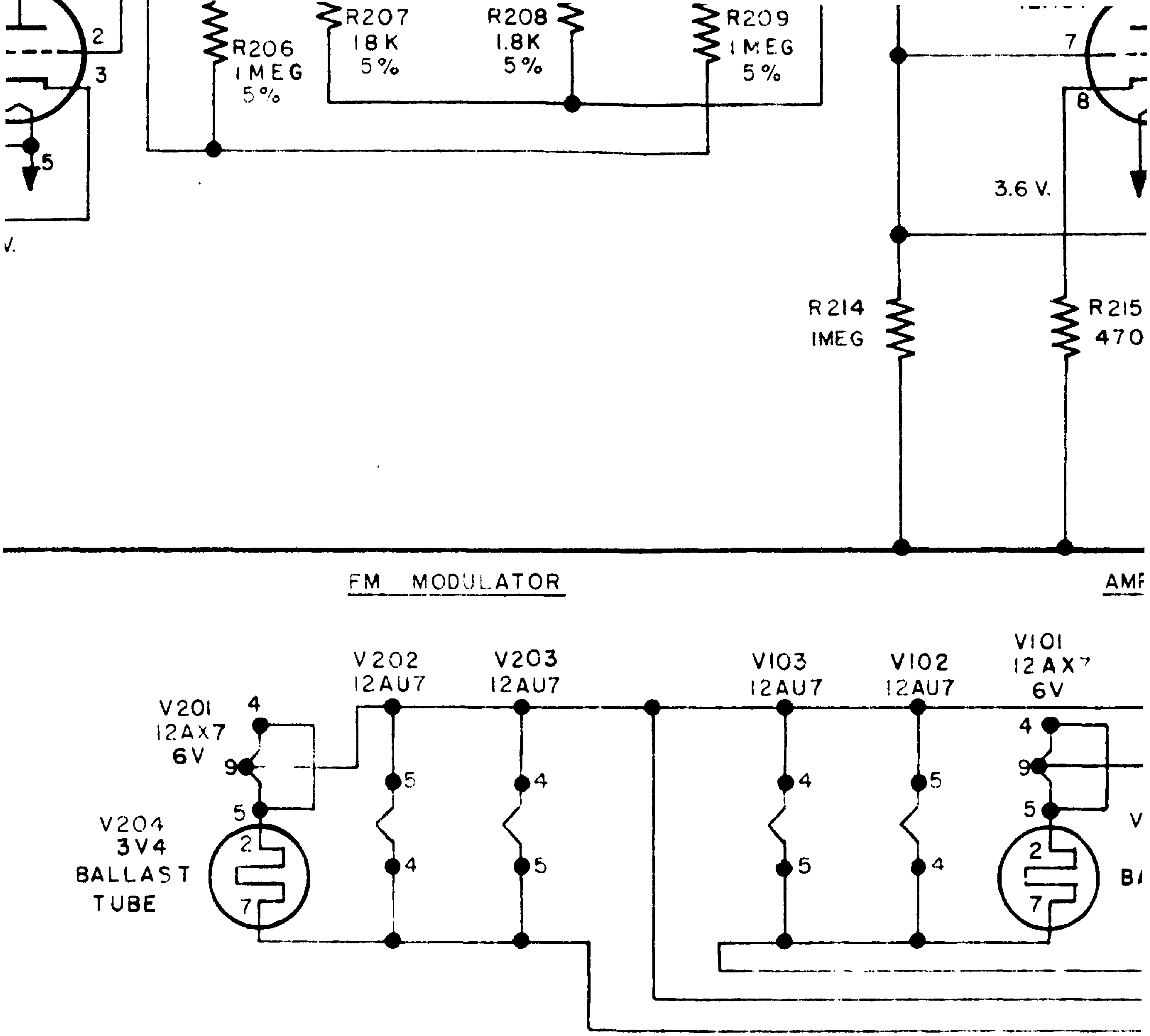


NOTE

1. ALL RESISTANCES MEASURED IN OHMS AND ALL RESISTORS RATED 1/2 WATT UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITIES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3. SCHEMATIC REF. NOS. SHOWN ARE FOR CHANNEL NO. 1 SCHEMATIC REF. NOS. FOR CHANNEL NO. 2 ARE 100 SERIES.
4. ALL VOLTAGES MEASURED WITH 20,000 OHMS/VOLT METER WITH RATED PLATE SUPPLY VOLTAGES AND NO INPUT VOLTAGE.

FIG. 6

4

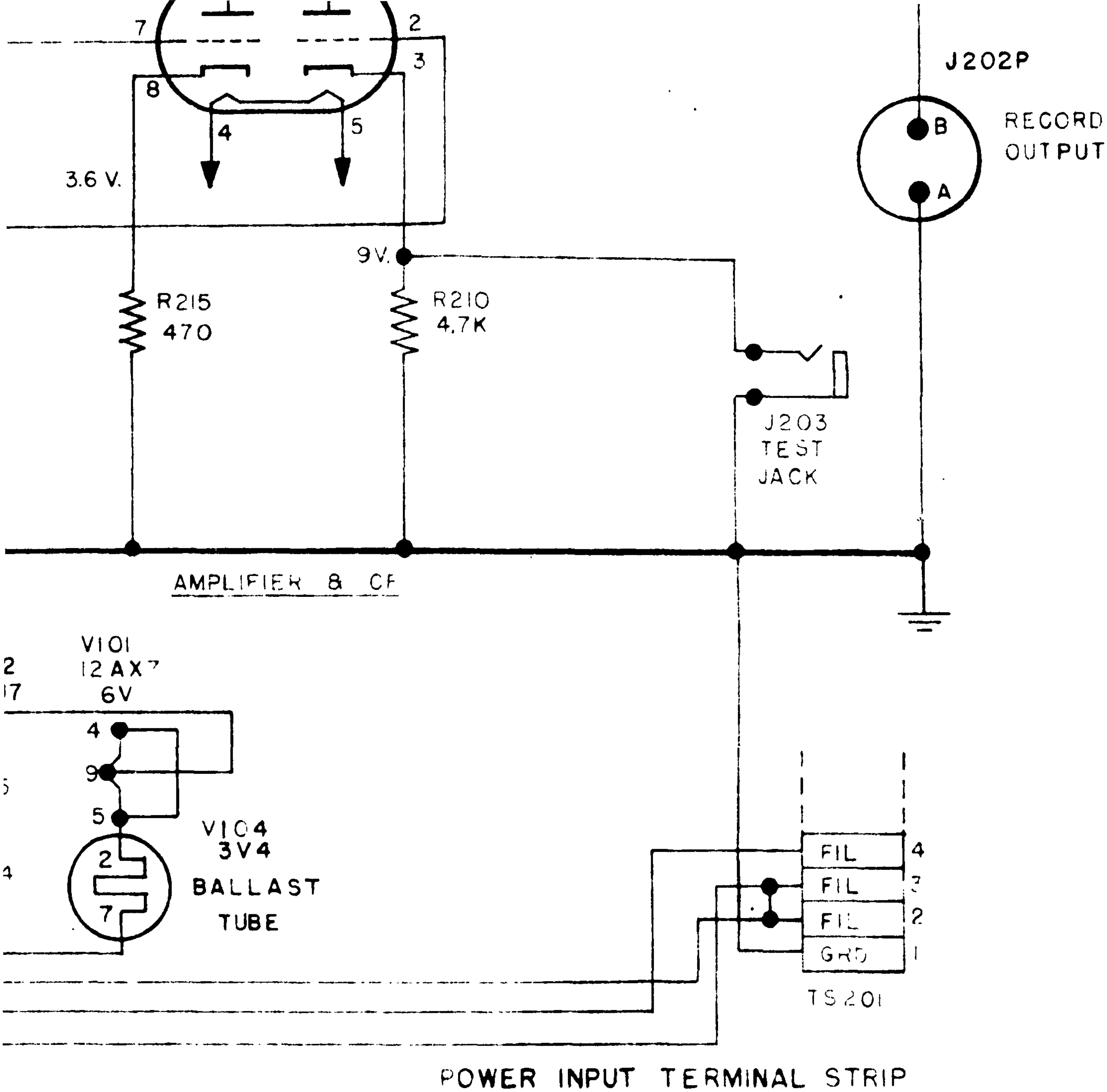


FILAMENT CONNECTIONS
2 CHANNELS SHOWN

SERIES.
METER WITH
.TAGE.

RECORD CHANNEL
MODEL S-3107
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

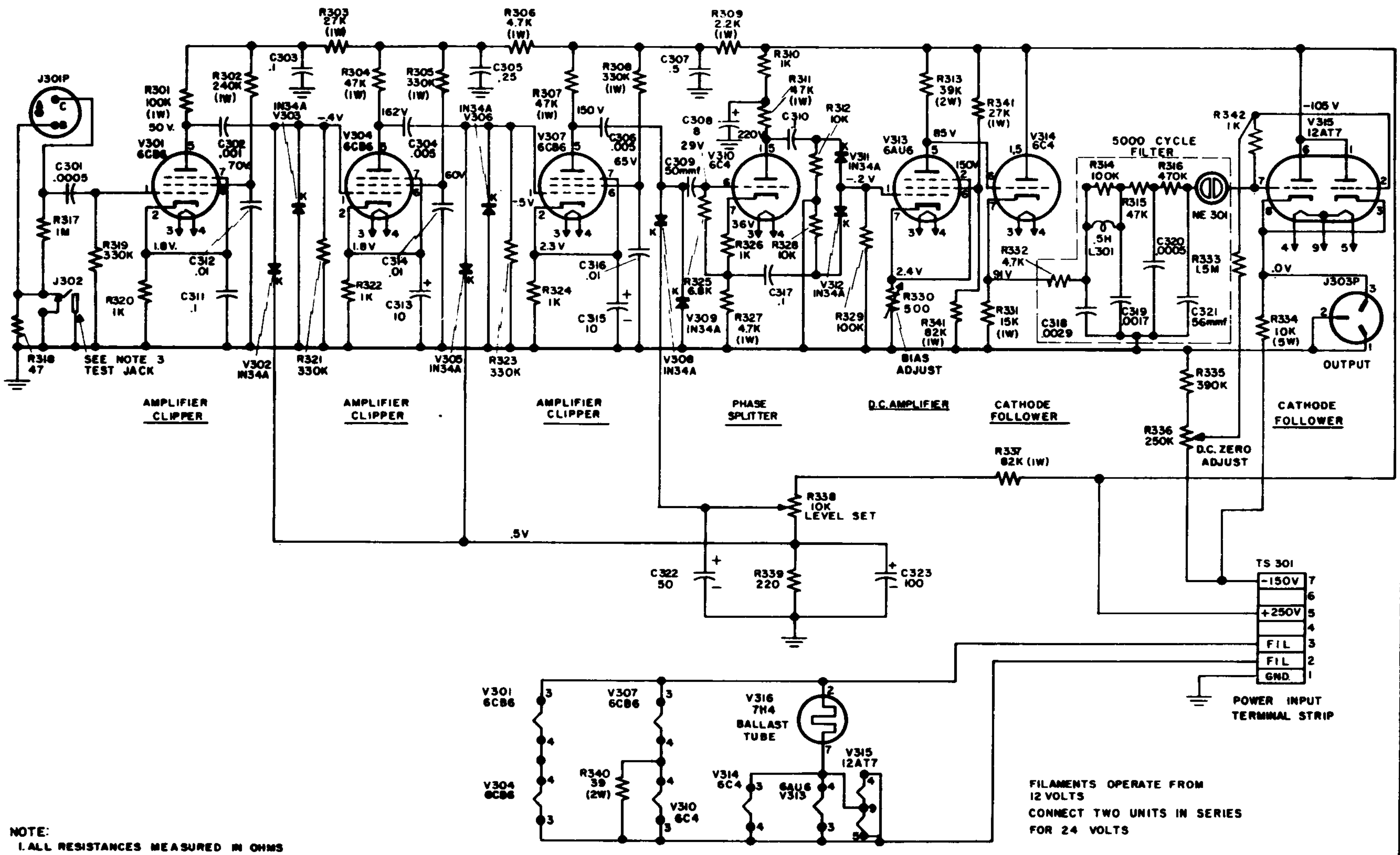
5



FOR 12 VOLT FILAMENT OPERATION, JUMPER 2 TO 3 AS SHOWN AND USE 3 AND 4

FOR 24 VOLT FILAMENT OPERATION, USE 2 AND 3 AND REMOVE JUMPER.

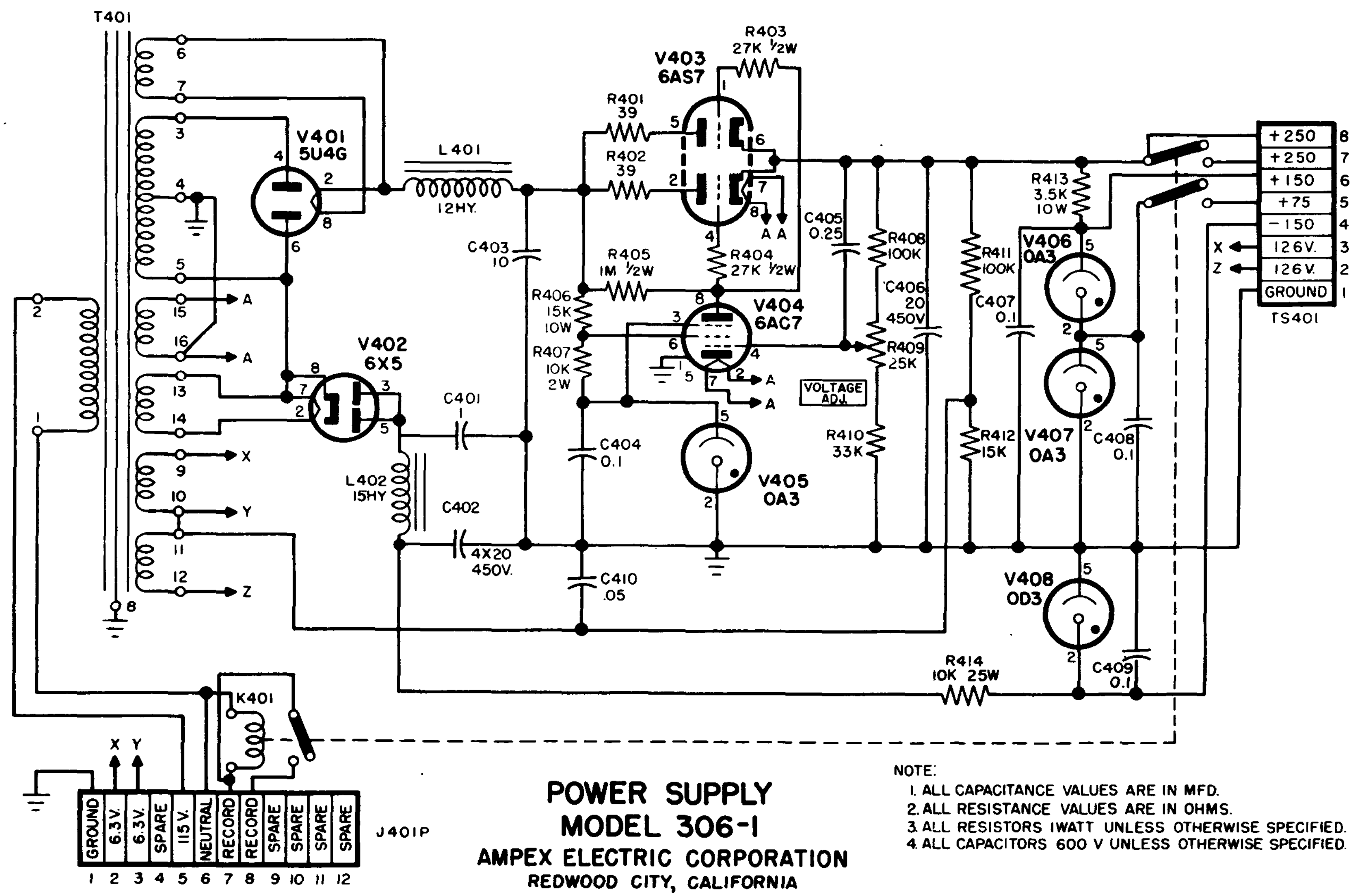
ON



NOTE:
1. ALL RESISTANCES MEASURED IN OHMS AND ALL RESISTORS RATED 1/2 WATT UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITIES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3. PATCH CORD MUST HAVE 22K SERIES RESISTOR
4. ALL VOLTAGES MEASURED WITH 20,000 OHMS/VOLT METER WITH 250V D.C. B+ SUPPLY AND UNMODULATED CARRIER FED TO J 301P

FIG. 8

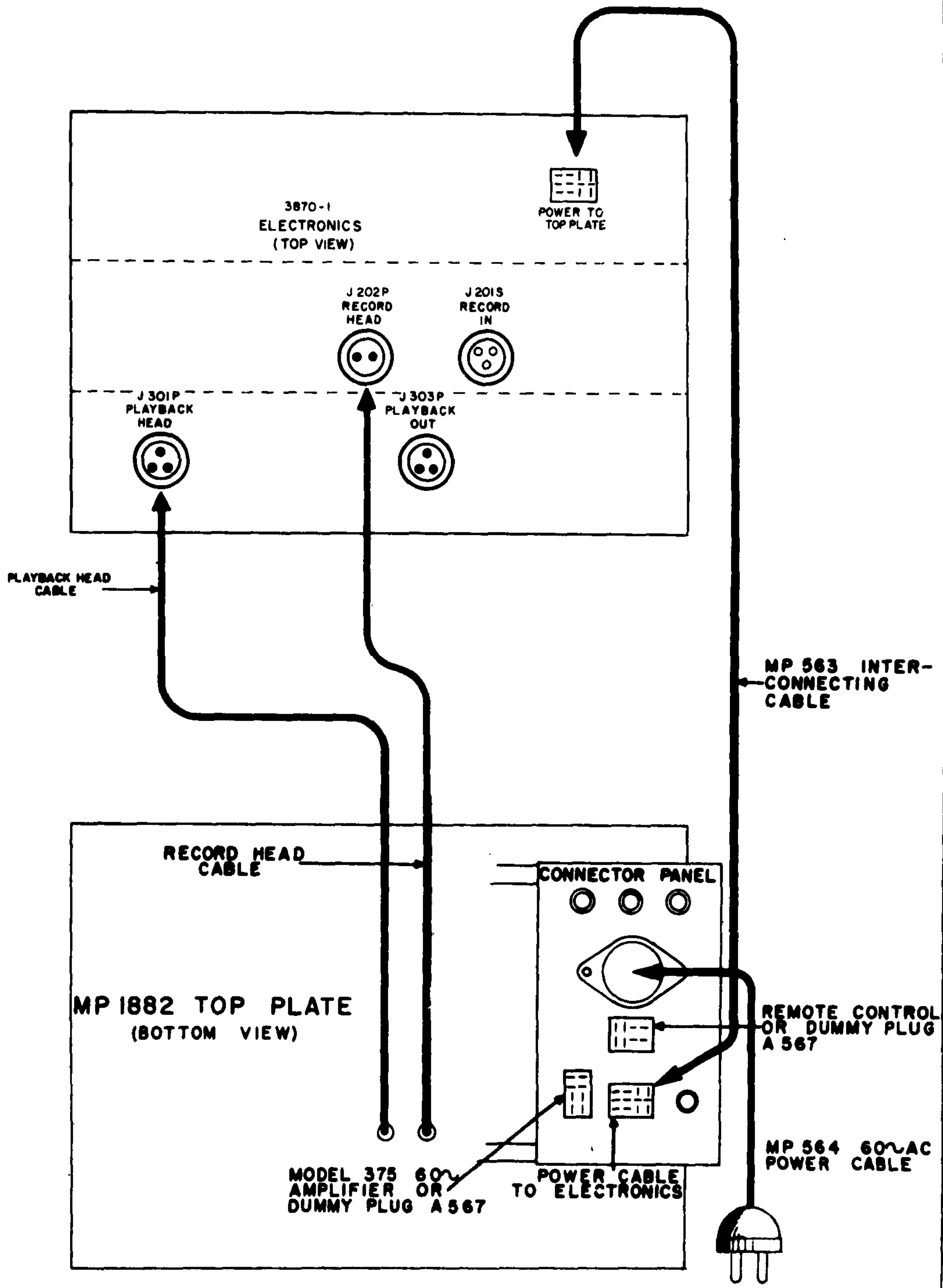
PLAYBACK CHANNEL
MODEL 306
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA



POWER SUPPLY
MODEL 306-1
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

NOTE:
1. ALL CAPACITANCE VALUES ARE IN MFD.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL RESISTORS 1WATT UNLESS OTHERWISE SPECIFIED.
4. ALL CAPACITORS 600 V UNLESS OTHERWISE SPECIFIED.

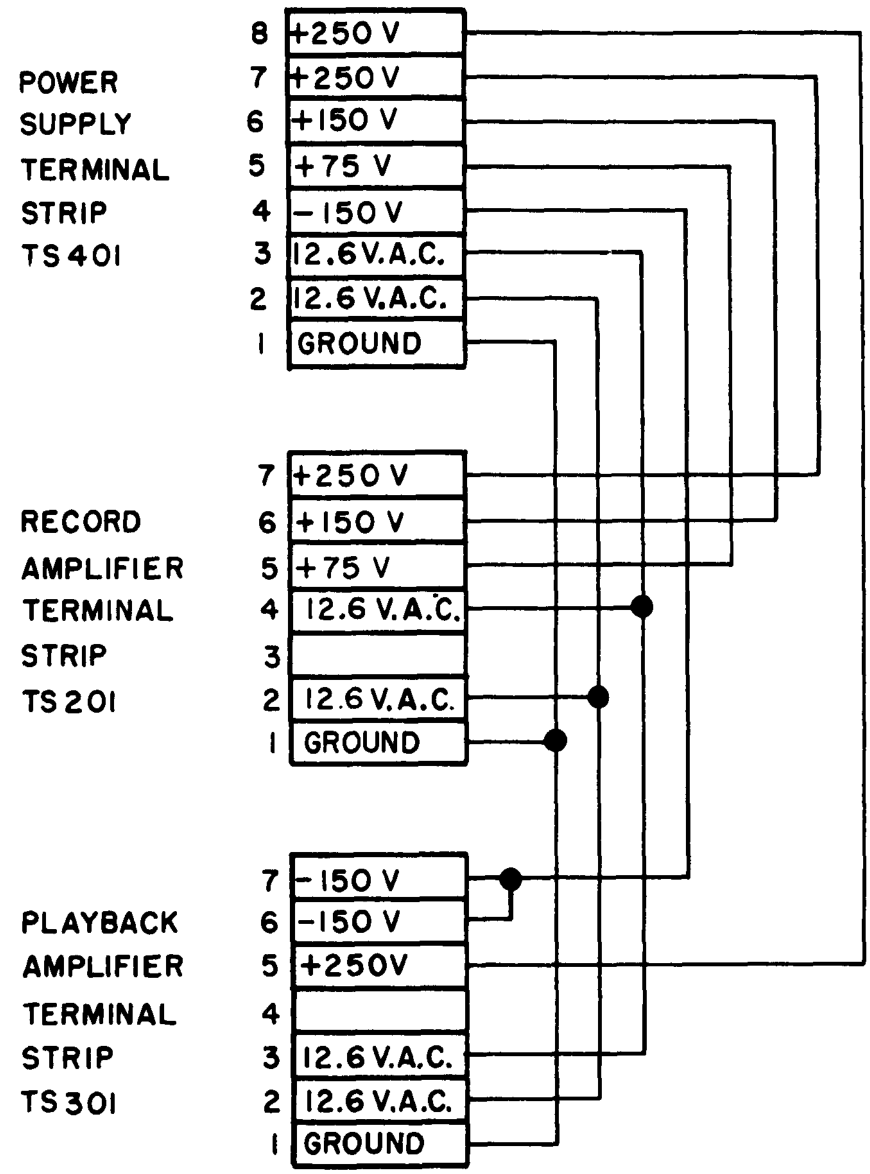
FIG. 9



INTER UNIT CONNECTION DIAGRAM
MODEL 306-1
AMPEX ELECTRIC CORP.
REDWOOD CITY, CALIF.

FIG. 12

ED-3891



INTER-CONNECTING CABLE
#3870 ELECTRONIC ASSEMBLY
MODEL 306

AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 13

EC 3922 10-1-52

III. ELECTRONICS ASSEMBLY:

The Electronic Assembly of the Models 402 & 403 Recorders consists of a Record Amplifier, a Playback Amplifier and an Erase and Bias Oscillator on one chassis and a Power Supply on a separate chassis.

The Record Amplifier is a four stage, high gain amplifier that feeds the Record Head through the Noise Balance Circuit and Record Relay (K401). The Record Relay is energized by the Record Button (S403) through contacts of the Start Relay (K505) in the energized position and contacts of the Fast Forward Relay (K506) and the Rewind Relay (K507) in de-energized positions. Therefore the Record mode of operation can only be realized when the tape is traveling at the Play speeds. Whenever the Fast Forward, Rewind or Stop Buttons are depressed, the Record Relay will be de-energized. Three input impedances can be selected by the Input Transfer Switch (S401); low impedance microphone, balanced bridge and unbalanced bridge. The Record Amplifier also provides separate high frequency pre-emphasis for each speed. This change in equalization is made by the Equalization Speed Switch (S402) located on the front panel. The Record Gain Control (R409) is located on the front panel.

The Playback Amplifier is a three stage amplifier which provides a plus 4 VU 600 ohm output at the Line Out Connector (J404P). The playback equalization is the same for both speeds and is adjusted to a standard curve (Figure 6) by R432, located on the top of the Electronics Chassis. The playback gain is controlled by R437 also located on the front panel. An output termination is provided by the Line Out Termination Switch (S404).

Monitoring is provided by a VU Meter and a Phone Jack connected to the Playback Amplifier output. The Meter and Output Switch (S405) provides four monitoring checks: Playback Level, Record Level, Bias Current, Erase Current. In the Erase position the VU Meter is connected across the 7 ohm resistor (R448) to read erase current. In the Bias position the meter is connected across the adjustable 500 ohm resistor (R450) to read bias current. In both the Record and Playback Level positions the meter is connected across the Playback Amplifier output. In the Playback position the Playback Amplifier functions normally and the output of the tape is monitored. In the Record position the last two stages of the Playback Amplifier are disconnected from the first stage and bridged across the Record Amplifier before pre-emphasis through the Record Level Meter Calibration Control (R413). The Calibration Control is adjusted so that the desired record level will be effected on the tape.

The Erase and Bias oscillator provides the 100 KC erase and bias frequency. It feeds the erase head through the Erase Trimmer (C435) and the record head through the Record Bias Control (R449) located on the top plate of the Electronics Chassis. The Power Supply provides the 6.3 Volt AC heater power, the 12.6 Volt DC heater power through a full wave selenium rectifier (SR601) and the plate supply through the 5Y3G Full Wave Rectifier (V601).

down the Stop and Fast Forward or the Stop and Rewind Buttons. Now press the Start Button and control the tape speed with this button. CAUTION: Avoid this operation at high speeds, as it will result in tape breakage if the wrong combination of buttons should be pushed. When the tape is traveling at high speed in the Rewind or Fast Forward mode, the tape will break if the Stop and Start Buttons are pressed in rapid sequence. This is caused because sufficient time is not allowed for the brakes to stop the tape before the Capstan Idler locks the tape to the Capstan.

VII. PLAYBACK:

To play back a previously recorded tape, turn the Meter and Output Switch, (S405), to the extreme left position designated PLAYBACK. Then start the tape in motion as indicated under PLAY. A Playback Level Control has been provided on the front panel to adjust the tape level to plus 4 VU output.

VIII. RECORD:

To record a new program on previously recorded tape, or on blank tape, turn the Meter and Output Switch (S405) to the second position from the left which is designated RECORD-LEVEL. Turn the Record Level Control, (R409) clockwise until the level reads 0 (zero) on the VU Meter on the most intense program peaks. The program can be audibly monitored through either the Phone Jack (J403S), or the Line Out Connector (J404P) before the tape is in motion. (For correct meter calibration it is important that the Line Out be properly terminated either external to the machine or by use of the Line Output Termination Switch, (S404). This direct monitor feature allows the program to be set up through the machine without actually recording during the set up period.

When the program level is properly set, start the tape in motion as indicated under PLAY. Then push the Record Button, (S403). (It is desirable that a delay of at least 1/2 second occur before the Record Button is depressed, as the surge from operating the Start Button may magnetize the record head, thereby increasing the noise level on the tape.) The Record Indicator, (NE401), next to the Record Button will now glow and the machine is recording.

It is desirable to check the record bias and erase currents occasionally. In order to do this, re-position the Meter and Output Switch (S405), to the positions designated BIAS and ERASE, respectively. The erase is not critical and should read approximately zero on the meter scale. The bias should read between -1/2 and +1/2 on the VU scale. The bias is somewhat critical and must be kept within the indicated range in order to record the higher frequencies at 7 1/2 inch tape speed.

The bias is adjusted by means of the Bias Control, (R449) located on top of the electronic chassis. The meter calibration for bias measurement can be checked as indicated in Section VI.

An actual comparison of the recording with the direct program can be made both audibly and on the VU Meter by moving the Meter and Output Switch, (S405), to the extreme left position for playback monitor, and then to the second from the left position for monitor of the unrecorded program. The Playback Level Control must be adjusted for the same output as that obtained from the record monitor position. Care must be taken not to record at the wrong level on the tape which is possible if the Meter and Output Switch is left in the playback position with the Playback Level Control arbitrarily set.

When the program being recorded is finished, press the Stop Button. The Tape Transport will stop and the Record Relay will drop out, making the record circuits inactive. The record circuits will remain inactive until the Record Button is again depressed while the tape is moving in the Play mode.

NOTE:

Because of the extremely wide frequency range of the VU Meter, some pickup of the erase and bias frequency will be experienced while monitoring the record or playback level while recording. The pickup of this oscillator frequency (approximately 100 KC) if read on the VU Meter will be at least 20 db below the program level. This does not interfere in any way with the performance of the machine.

SECTION VI

ELECTRONIC ALIGNMENT

Alignment is the necessary adjustments required to have the Electronic Assembly of the tape recorder perform properly. A machine "out of alignment" may be characterized by poor frequency response, high noise, low output, or high distortion. It should not be necessary to align the recorder when it comes to you from the factory. The procedures described on the following pages have been performed at the factory prior to shipment. No further adjustments should be necessary except as required by routine maintenance where the machine will not perform as indicated under Specification Section I when checked according to Section II-VIII.

Alignment consists of the following steps:

I. Head Alignment

II. Playback Circuit Alignment

III. Record Circuit Alignment
   1. Bias Adjustment
   2. Noise Balance
   3. Record Equalization
      A. 7 1/2 inch per second
      B. 15 inch per second
   4. Erase Adjustment
   5. Record Level Meter Calibration

A standard tape is available for alignment purposes and contains the following frequency run recorded at 15 inches per second, 10 db below 15 inch operating level. IMPORTANT. Before playing the standard tape demagnetize the heads with the AMPEX Head Demagnetizer, catalog #704. Magnetized heads will cause a partial erasure of the high frequencies on the standard tape.

1 kc for level adjustment
15 kc for playback azimuth alignment
50 cycles

100 "	8000 cycles
200 "	9000 "
400 "	10000 "
800 "	11000 "
1600 "	12000 "
3200 "	14000 "
6400 "	15000 "

I. HEAD ALIGNMENT:

The high frequency response of the recorder depends on the correct head alignment. If tapes are to be interchangeable from one machine to another the heads of all machines must have the same azimuth setting. This is accomplished by using a Standard Tape (Catalog #1993), for aligning the heads of all machines. Head alignment is independent of tape speed; however, it is recommended that the heads be aligned at 15 inches per second since the standard tape is recorded at this speed.

Remove the top cover from the Head Housing by removing the two screws from the top and pulling cover gently back and up. Looking at the Head Housing from the front the three heads from left to right are: Erase, Record, and Playback.

The azimuth angle of the erase head is not adjustable.

The Record and Playback Heads should be aligned only after reading and fully understanding the procedure under PLAYBACK AND RECORD CIRCUIT ALIGNMENT.

The actual physical alignment of the Record and Playback Heads consists of placing a 1/4" spintite socket wrench on the left hand elastic stop nut in each head and adjusting back and forth until the proper azimuth angle is arrived at.

First adjust the Playback Head azimuth by playing the standard tape at 15 inches per second and adjusting the stop nut for the maximum output of the 15 kc tone (second tone that appears on the standard tape).

The Record Head azimuth is then aligned with the Playback Head by recording a 15,000 cycle signal from an audio oscillator on a blank tape and adjusting the record stop nut for maximum playback output.

II. ALIGNMENT OF PLAYBACK CIRCUIT: Refer to Figure 1.

1. Position the Electronic Assembly so that adjustments can be made on the controls located on the top of the chassis.

2. Set the Tape Speed Switch (S502) and Equalization Speed Switch (S402) to 15 inches per second.

3. Set the Meter and Output Switch (S405) to the PLAYBACK-LEVEL position.

4. Terminate the line output either by means of the Line Out Termination Switch (S404) or by external termination of 600 ohms.

5. Connect an amplifier and loudspeaker to the output or plug in a pair of high impedance head phones so that voice announcements on the standard tape can be heard.

6. Thread the standard tape on the machine and set the tape in motion in the Play mode of operation.

7. Adjust the Playback Level Control (R437), for a reading of +10 on the VU Meter on the 1,000 cycle tone. Retain this setting for all the following adjustments except Record Equalization.

8. Adjust the Playback head azimuth as discussed under HEAD ALIGNMENT.

9. PLAYBACK EQUALIZATION: The Playback Amplifier is factory equalized by means of the High Frequency Playback Equalizer (R432), Figure 9, in accordance with the standard voltage curve shown in Figure 6. The recommended method for adjusting the Playback Amplifier response is to connect an audio oscillator and vacuum tube voltmeter to the Playback Amplifier as shown in Figure 6. Adjust the Playback Equalizer (R432) to give the frequency response of the standard 50 microsecond curve. Deviation from this curve is not recommended.

The above will properly align the playback circuit for operation at both speeds.

The 15 inch standard tape will play back within ±2 db to 15,000 cycles when the Playback Amplifier is adjusted to the standard curve. Failure for the standard tape to play back within these tolerances after the Playback Amplifier has been aligned indicates one of the following:

a. Trouble in the Head Assembly such as worn heads.
b. A faulty Standard Tape which has been partially erased at the high frequencies by passing over magnetized heads, etc.

An overall frequency response check will isolate the trouble. Good overall response indicates a faulty Standard Tape. Poor overall response indicates one of the following:

a. Faulty Heads.
b. Tape deficiency.
c. Record or Playback Amplifier improperly equalized.
d. Incorrect bias.

Alignment of the Record Circuits as described in the next sub-section will further isolate the trouble. It should be remembered that the equalization curves have been established with Minnesota Mining and Manufacturing Company type 111 tape, construction 5RBA. Tapes of other manufacture may produce slight deviations in performance.

III. ALIGNMENT OF THE RECORD CIRCUITS: Refer to Figure 1.

The 7 1/2" and 15" per second record alignment should not be attempted until the playback is properly aligned.

Perform the following in the order indicated:

1. Bias Adjustment:

   a. Output of Playback Amplifier must be properly terminated as in Playback Alignment.
   b. Set the Speed Switches (S402 and S502) to 15" per second.
   c. Thread blank tape on the machine and set the tape into motion in the Play mode of operation.
   d. Connect an audio oscillator to the Input Connector (J401S), set the Input Transfer Switch (S401) for unbalanced input, and adjust the frequency to 1,000 cycles.
   e. Push the Record Button (S403).
   f. Adjust Bias Control (R449) on top of the chassis for maximum playback level of 1,000 cycle tone while recording and playing back simultaneously. It is desirable to be within 1/2 db of the maximum efficiency point in order to achieve wide frequency range recording at 7 1/2" per second.
   g. The Bias Meter Calibration is adjusted as follows: After the bias is adjusted, meter the bias in the normal fashion and adjust the Meter Shunt (R450) for 0 (zero) reading on the VU scale of the meter. R450 is located on top of the chassis.

2. Noise Balance: A noise balance control is provided to eliminate excessive low frequency noise and null second harmonic distortion. The noise balance should not be touched unless all heads have been thoroughly demagnetized with an AMPEX Head Demagnetizer or equivalent (See Section V). If noise of a crackling nature is still found to exist in the output of the machine connect a 1 mfd. condenser across the output of the machine and adjust the Noise Balance Control, (R424), Figure 9, for minimum record noise as read on a sensitive meter or heard in a loudspeaker connected to the machine output through a power amplifier.

3. Record Level Meter Calibration: The Record Level Meter Calibration Control (R413), Figure 9, is adjusted so that the program level as read on the VU Meter is the same as monitored from the Playback Head or the incoming line. This is accomplished by recording a 400 cycle tone (or program in the absence of an audio oscillator) at 0 (zero) on the VU Meter with the Meter and Output Switch in the PLAYBACK-LEVEL position. Then switch the Meter and Output Switch to the RECORD-LEVEL position and adjust the Record Level Meter Calibration Control for 0 (zero) on the VU Meter.

4. Record Equalization: The 7 1/2 inch and 15 inch record equalization circuits have been factory adjusted to the curves shown on Figure 7. These curves have been found to produce flat overall response, when recording on Minnesota Mining and Manufacturing Company type 111 tape, construction 5RBA. Other tapes may require resetting of equalization and Bias Control. Badly worn tapes may produce loss in high frequency response at the 7 1/2 inch speed and should not be used.

The adjustment procedure for flat overall response on any tape is as follows:

A. 7 1/2 inch Record Equalization Adjustment.

1. Reset oscillator to 400 cycles.

2. Set Playback Level Control for maximum gain (fully clockwise).

3. Set Record Level Control (R409) so that the VU Meter monitoring Playback reads "0".

4. Adjust record head azimuth as discussed under HEAD ALIGNMENT.

5. Reset oscillator to 8,000 cycles.

6. Adjust 7 1/2 inch Record Equalizer (C406), Figure 9, so the VU Meter monitoring Playback reads -10.

7. Frequency response should be ±2 db from 40 to 8,000 cycles. Due to tape saturation, frequency checks cannot be made at 7 1/2 inch tape speed, at this level, beyond 8,000 cycles.

In order to run response checks beyond 8,000 cycles reduce input level so that output as read on VU Meter is -10 at 1 KC. Run response check at this level.

B. 15 inch Record Equalizer:

1. Set Speed Switches (S402 and S502) to the 15 inch positions.

2. Reset oscillator to 400 cycles.

3. Set Record Level Control (R409) so that the VU Meter monitoring Playback reads "0".

4. Reset oscillator to 8,000 cycles.

5. Adjust 15 inch Record Equalizer (C407), Figure 9, so the VU Meter monitoring Playback reads "0".

Reference Number	Description	Ampex Catalog Number
	III. ELECTRONIC ASSEMBLY - Catalog #3621	
C401	.25 MFD 400 V. Metalized Paper Condenser	CO-45
C402	25 MFD 25 V. Electrolytic Condenser	CO-59
C403	4 MFD 150 V. Electrolytic Condenser	CO-53
C404	25 MFD 25 V. Electrolytic Condenser	CO-59
C405	.25 MFD 400 V. Metalized Paper Condenser	CO-45
C406	.0001 MFD Padder Condenser	CO-92
C407	.0001 MFD Padder Condenser	CO-92
C408	.1 MFD 400 V. Metalized Paper Condenser 5%	CO-101
C409	25 MFD 25 V. Electrolytic Condenser	CO-59
C410	10 MFD 450 V. Electrolytic Condenser	CO-55
C411	.05 MFD 400 V. Metalized Paper Condenser	CO-43
C412	1 MFD 400 V. Metalized Paper Condenser	CO-47
C413	16 MFD 150 V. Electrolytic Condenser	CO-56
C414	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C415	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C416	.1 MFD 200 V. Metalized Paper Condenser	CO-97
C417	25 MFD 25 V. Electrolytic Condenser	CO-59
C418	4 MFD 150 V. Electrolytic Condenser	CO-53
C419	.01 MFD 300 V. Mica Condenser 5%	CO-14
C420	.01 MFD 400 V. Metalized Paper Condenser	CO-42
C421	4 MFD 450 V. Electrolytic Condenser	CO-54
C422	25 MFD 25 V. Electrolytic Condenser	CO-59
C423	.005 MFD 500 V. Mica Condenser 5%	CO-12
C424	.0025 MFD 500 V. Mica Condenser 5%	CO-8
C425	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C426	.5 MFD 400 V. Metalized Paper Condenser	CO-46
C427	25 MFD 25 V. Electrolytic Condenser	CO-59
C428	2000 MFD 15 V. Electrolytic Condenser	CO-66
C429	20 MFD 450 V. Electrolytic Condenser	CO-57
C430	.0004 MFD 500 V. Mica Condenser 5%	CO-89
C431	.0004 MFD 500 V. Mica Condenser 5%	CO-89
C432	.002 MFD 500 V. Mica Condenser 5%	CO-7
C433	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C434	.0005 MFD 500 V. Mica Condenser 5%	CO-5
C435	.001 MFD Padder Condenser	CO-91
C436	.0002 MFD 500 V. Mica Condenser	CO-90
C437	.02 MFD 600 V. Tubular Condenser 5%	CO-96
C438	.015 MFD 200 V. Mica Condenser 5%	CO-230
C439	.004 MFD 500 V. Mica Condenser 5%	CO-11
C440	.004 MFD 500 V. Mica Condenser 5%	CO-11

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
C601	20 MFD 450 V. Electrolytic Condenser	CO-57
C602	20 MFD 450 V. Electrolytic Condenser	CO-57
C603	30-30-20 MFD 475 V. Electrolytic Condenser	CO-244
C604	20 MFD 450 V. Electrolytic Condenser	CO-57
F401	1 Ampere "Slo-Blo" Type 3AG Fuse	FU-7
F402	2 Ampere Type 3AG Fuse	FU-2
J401S	Cannon XL-3-13 Chassis Connector	PL-58S
J402P	AN-3102-10S-3P Box Mount Connector	PL-59P
J403S	Phone Jack - Open Circuit	JA-3
J404P	Cannon XL-3-14 Chassis Connector	PL-4P
J405P	AN-3102-10S-4P Box Mount Connector	PL-61P
J406P	AN-3102-10S-2P Box Mount Connector	PL-62P
J407S	Jones S-304-AB Chassis Connector	PL-56S
J408S	Jones S-308-AB Chassis Connector	PL-54S
J409P	Hubbell #7466 Chassis Connector	PL-104P
J601P	Jones P-308-CCT-L Cable Connector	PL-103P
K401	Record Relay 3PDT 115 V. DC	RL-8
L401	20 MH R.F. Choke	CH-8
L601	8 Hy. 80 Ma. Filter Choke	1155
L602	8 Hy. 80 Ma. Filter Choke	1155
M401	VU Meter	
NE401	Record Pilot Lamp	DL-4
R401	150,000 OHM 1 Watt Composition Resistor	RE-27
R402	100 OHM 1 Watt Composition Resistor 5%	RE-38
R403	100 OHM 1 Watt Composition Resistor 5%	RE-38
R404	150,000 OHM 1 Watt Composition Resistor	RE-27
R405	1 Megohm 1 Watt Composition Resistor	RE-32
R406	1,200 OHM 1 Watt Composition Resistor	RE-261
R407	330,000 OHM 1 Watt Composition Resistor	RE-30
R408	100,000 OHM 1 Watt Composition Resistor 1%	RE-205
R409	100,000 OHM Audio Taper Potentiometer	RE-227
R410	2,200 OHM 1 Watt Composition Resistor	RE-7
R411	47,000 OHM 1 Watt Composition Resistor	RE-22
R412	1 Megohm 1 Watt Composition Resistor 5%	RE-48
R413	100,000 OHM Audio Taper Potentiometer	RE-227
R414	100,000 OHM 1 Watt Composition Resistor	RE-26

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
R415	39,000 OHM 1 Watt Composition Resistor 5%	RE-44
R416	2,200 OHM 1 Watt Composition Resistor	RE-7
R417	47,000 OHM 1 Watt Composition Resistor	RE-22
R418	470,000 OHM 1 Watt Composition Resistor	RE-31
R419	2,200 OHM 1 Watt Composition Resistor	RE-7
R420	470 OHM 1 Watt Composition Resistor	RE-2
R421	22,000 OHM 2 Watt Composition Resistor	RE-171
R422	47,000 OHM 1 Watt Composition Resistor	RE-22
R423	1 Megohm 1 Watt Composition Resistor	RE-32
R424	50,000 OHM Linear Taper Potentiometer	RE-226
R425	470,000 OHM 1 Watt Composition Resistor	RE-31
R426	15,000 OHM 10 Watt Wire Wound Resistor	RE-92
R427	100,000 OHM 1 Watt Composition Resistor	RE-26
R428	1 Megohm 1 Watt Composition Resistor 1%	RE-211
R429	330,000 OHM 1 Watt Composition Resistor 1%	RE-209
R430	2,200 OHM 1 Watt Composition Resistor	RE-7
R431	1 Megohm 1 Watt Composition Resistor 1%	RE-211
R432	20,000 OHM Audio Taper Potentiometer	RE-240
R433	22,000 OHM 2 Watt Composition Resistor	RE-171
R434	1 Megohm 1 Watt Composition Resistor	RE-32
R435	330,000 OHM 1 Watt Composition Resistor	RE-30
R436	2,700 OHM 1 Watt Composition Resistor	RE-8
R437	1 Megohm Audio Taper Potentiometer	RE-232
R438	560 OHM 1 Watt Composition Resistor	RE-3
R439	47,000 OHM 1 Watt Composition Resistor	RE-22
R440	1 Megohm 1 Watt Composition Resistor	RE-32
R441	1 Megohm 1 Watt Composition Resistor	RE-32
R442	2,200 OHM 1 Watt Composition Resistor	RE-7
R443	560 OHM 1 Watt Composition Resistor	RE-3
R444	100 OHM 1 Watt Composition Resistor	RE-260
R445	10,000 OHM 2 Watt Composition Resistor	RE-168
R446	47,000 OHM 1 Watt Composition Resistor	RE-22
R447	47,000 OHM 1 Watt Composition Resistor	RE-22
R448	7 OHM 1 Watt Composition Resistor 1% (2-14 OHM in Parallel)	RE-257
R449	40,000 OHM Wire Wound Potentiometer	RE-278
R450	500 OHM 10 Watt Wire Wound Resistor-Adjustable	RE-277
R451	3600 OHM 1 Watt Composition Resistor 1%	RE-258
R452	100 OHM 1 Watt Composition Resistor	RE-260
R453	100 OHM 1 Watt Composition Resistor	RE-260
R454	470,000 OHM 1 Watt Composition Resistor	RE-31
R455	470 OHM 1 Watt Composition Resistor 5%	RE-365
R456	680,000 OHM 1 Watt Composition Resistor	RE-480
R457	2,000 OHM 10 Watt Wire Wound Resistor	RE-82

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
S401	Input Switch - 3P3T Selector Switch	SW-7
S402	Equalization Switch - 3P2T Selector Switch	SW-8
S403	Record Pushbutton SPST - Normally Open	SW-34
S404	Line Termination Switch - SPST Toggle	SW-9
S405	Meter and Output Switch - 3P4T Selector Switch	SW-13
S406	AC Power Switch - SPST Toggle	SW-9
SR601	Selenium Rectifier - Full Wave	SR-3
T401	Microphone Input Transformer	1153
T402	Output Transformer	1154
T403	Erase Transformer	1011
T601	Power Transformer	3953
V401	12SJ7 Vacuum Tube	TU-11
V402	12SJ7 Vacuum Tube	TU-11
V403	12SJ7 Vacuum Tube	TU-11
V404	6C5 or 6J5 Vacuum Tube	TU-3
V405	VR 150/0D3 Vacuum Tube	TU-2
V406	12SJ7 Vacuum Tube (Selected)	TU-12
V407	12SJ7 Vacuum Tube	TU-11
V408	6C5 or 6J5 Vacuum Tube	TU-3
V409	6SN7-GT Vacuum Tube	TU-13
V601	5Y3-G Vacuum Tube	TU-14
	AC Power Cable	2413
	Power Supply Cable	2435
	Octal Tube Socket	SO-8
	Turret Tube Socket	1208
	Fuse Extractor Post	FE-1
	Equalization and Meter Switch Knobs	KN-3
	Record and Playback Gain Knobs	KN-4
	Input Switch Knob	KN-8

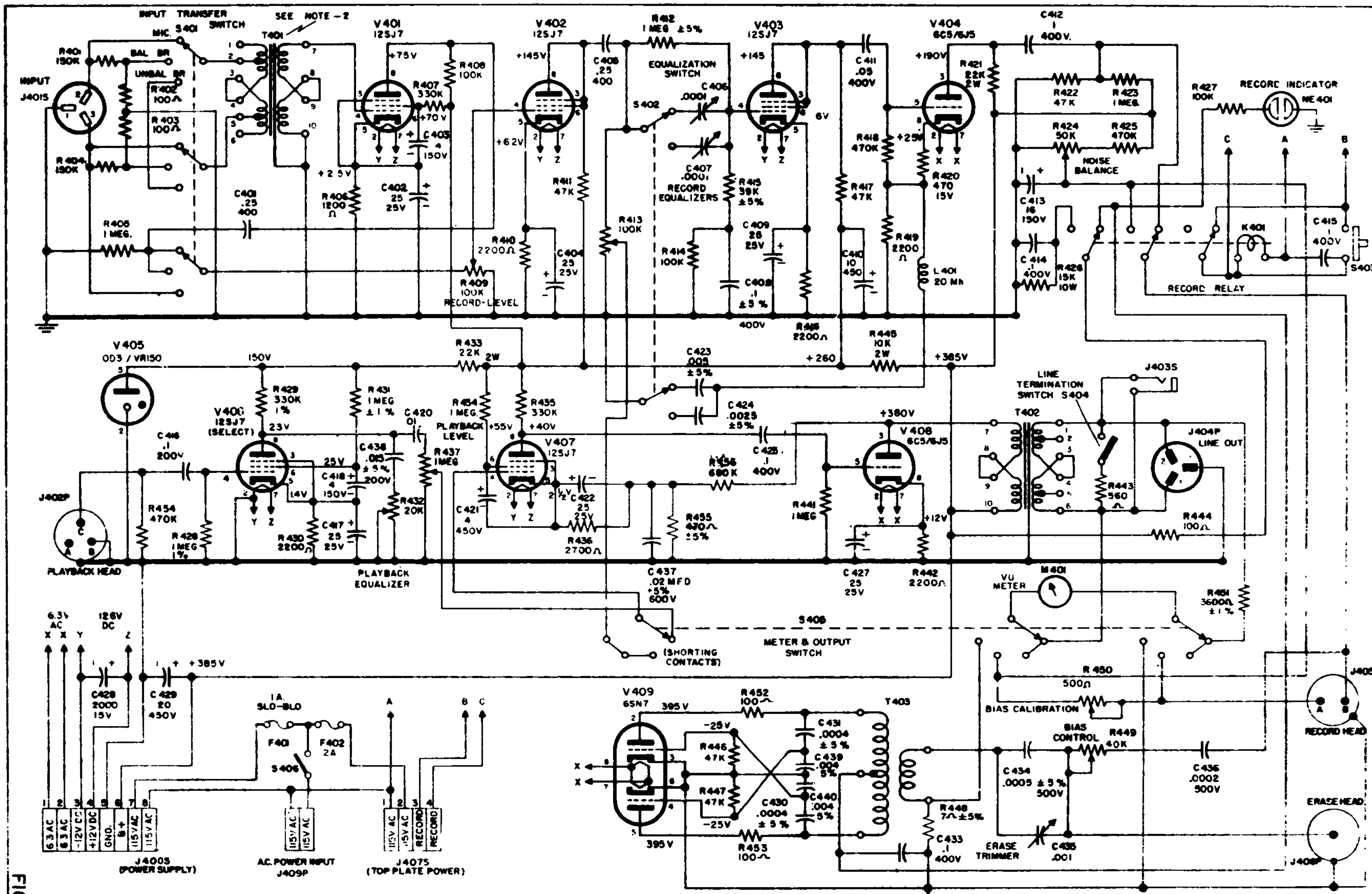


FIG. I

NOTES:

1-ALL CAPACITIES IN MICROFARADS

2-FOR 30 & 50 OHMS MICROPHONE SEE INSTALLATION

3-ALL VOLTAGES MEASURED WITH 20,000 OHMS PER VOLT METER WITH 117 V AC LINE VOLTAGE. ALL READING EXCEPT V409 OSCILATOR VOLTAGES TAKEN WITH K401 DE-ENERGIZED.

ELECTRONICS
MODEL-402-403

AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

T402 TRANSFORMER IMPEDANCE CONNECTIONS
R445 MUST BE ADJUSTED FOR OUTPUT IMPEDANCE

500 to 600 OHMS CONNECT TO 1 & 6, JOIN 3 TO 4
333 OHMS CONNECT TO 1 & 5, JOIN 3 TO 4

200 to 250 OHMS CONNECT TO 2 & 5, JOIN 3 TO 4
125 to 150 OHMS CONNECT TO 1 & 4, JOIN 1 TO 3 & 4 TO 6
50 OHMS CONNECT TO 2 & 4, JOIN 2 TO 3 & 4 TO 5

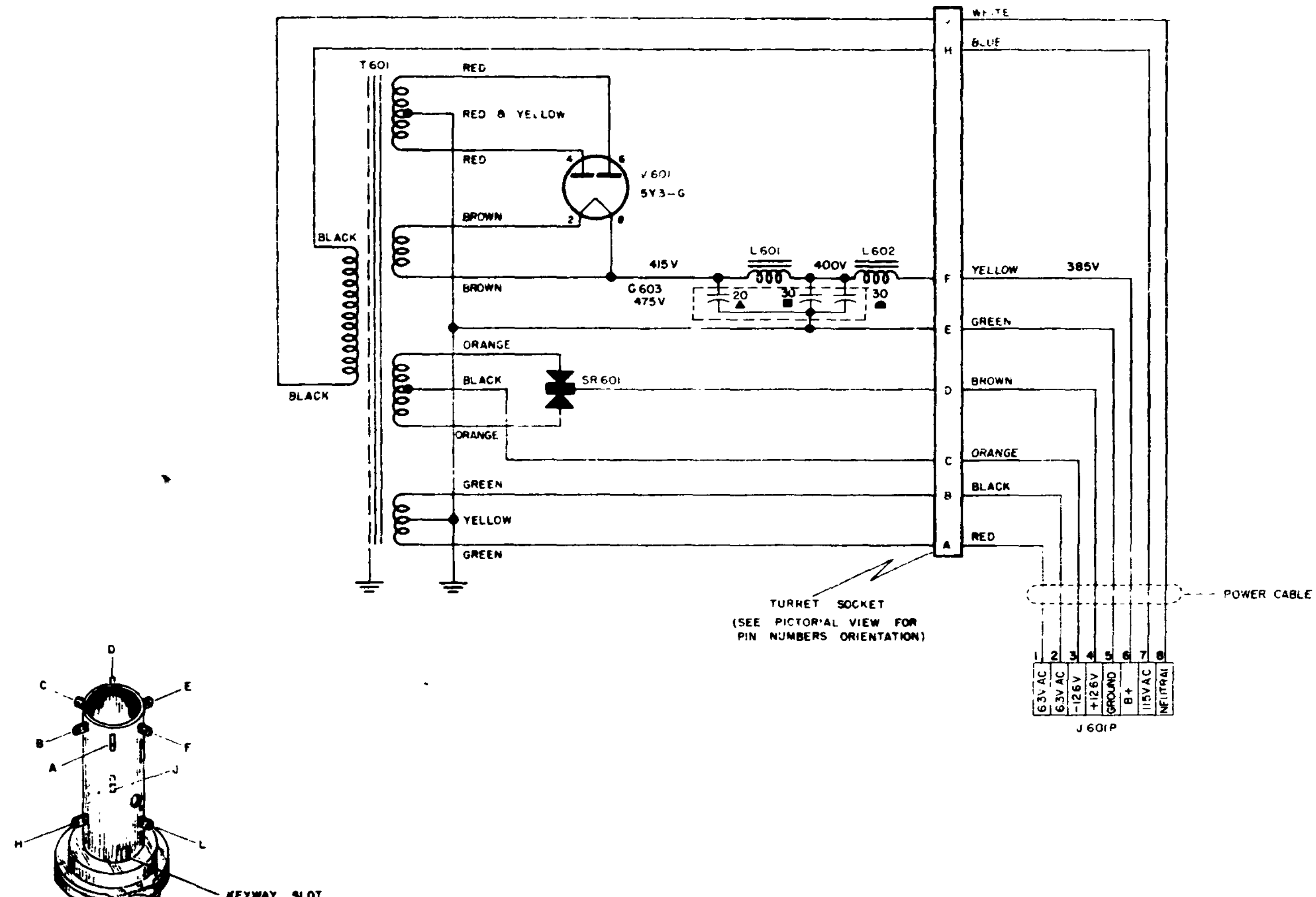


FIG.2

POWER SUPPLY
MODEL 402, 403
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

NOTE: ALL VOLTAGES MEASURED WITH 20,000 OHMS PER VOLT METER WITH 117V AC POWER INPUT J601P IS CONNECTED TO THE ELECTRONICS WITH THE RECORD RELAY DE-ENERGIZED

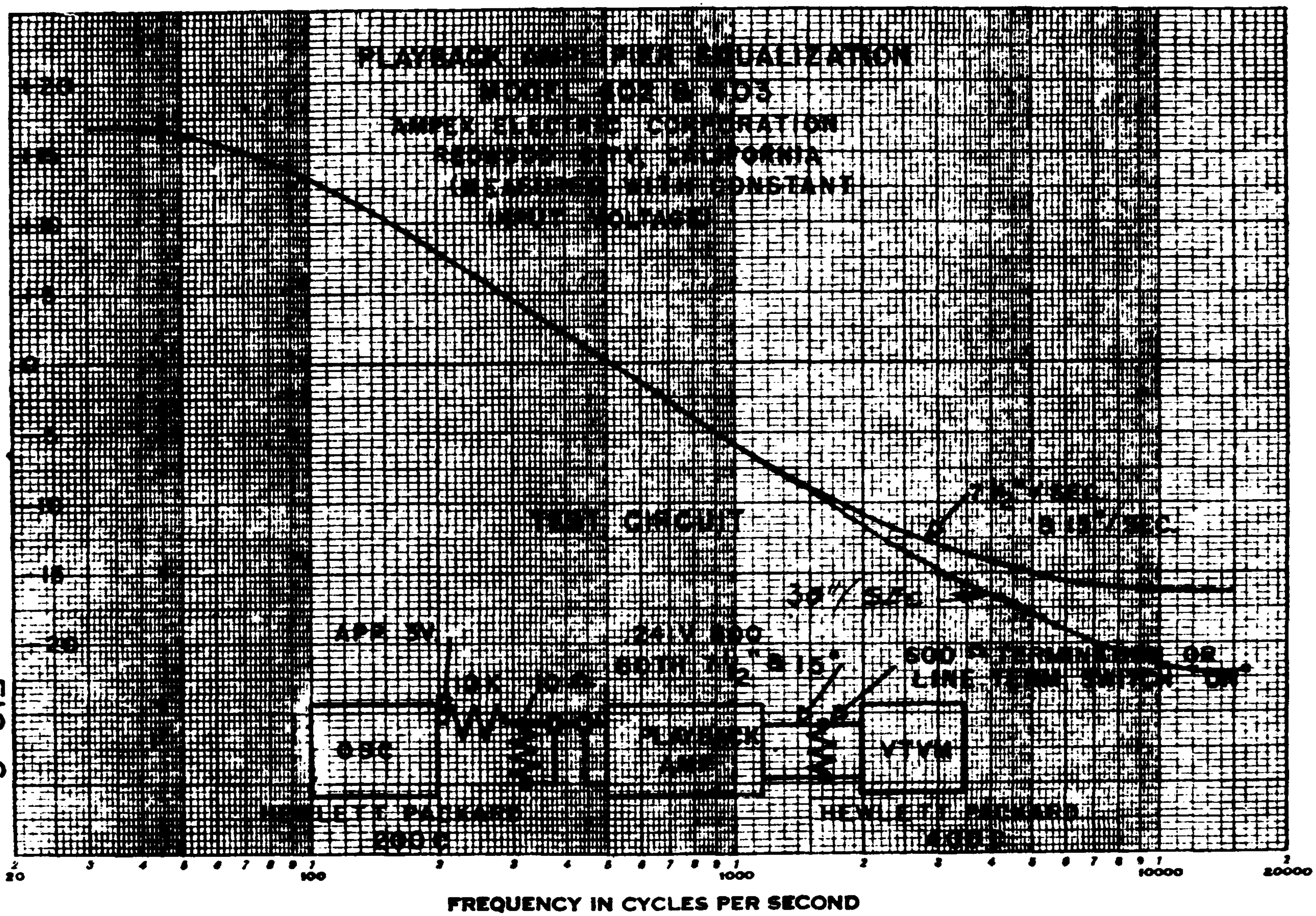
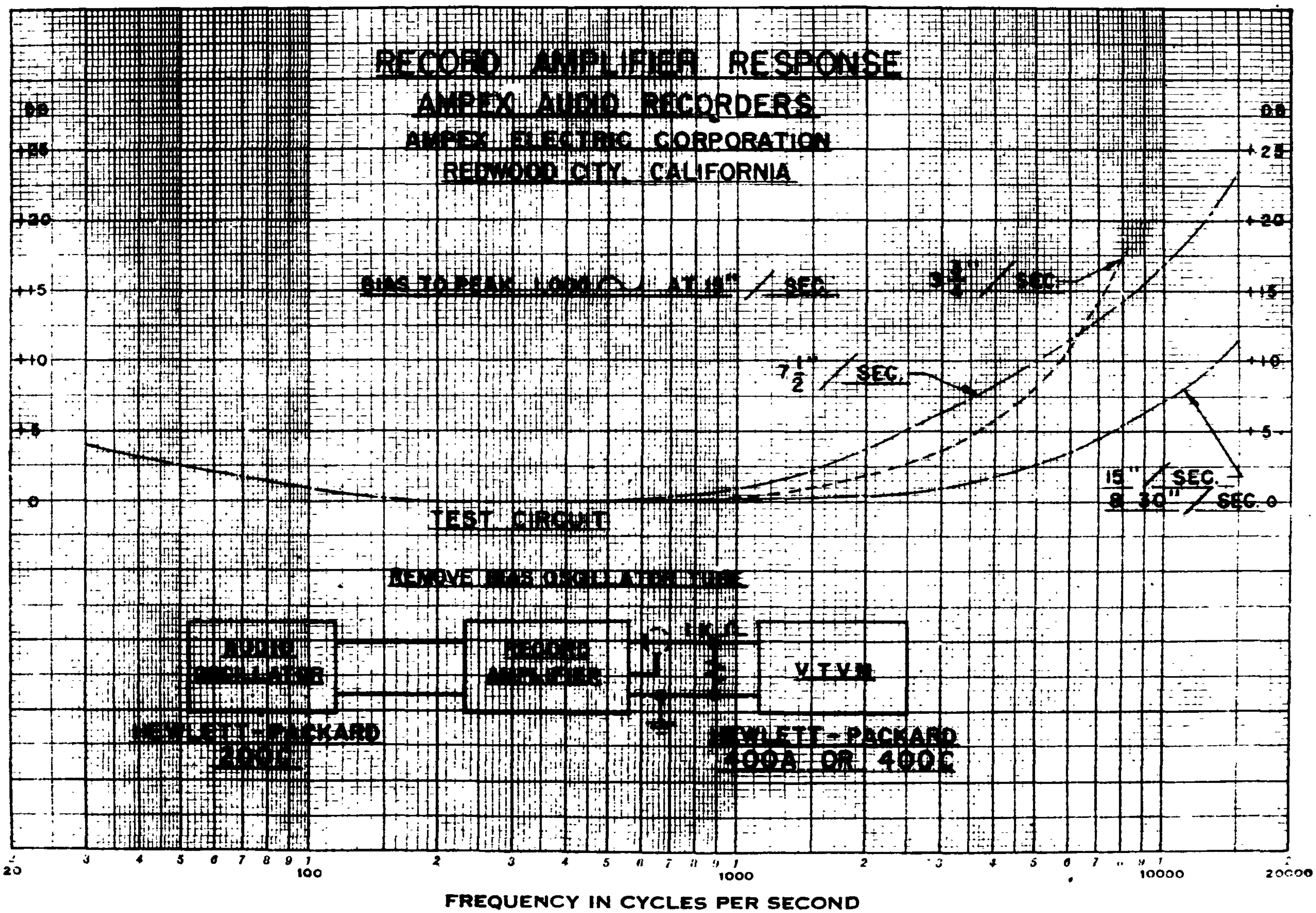
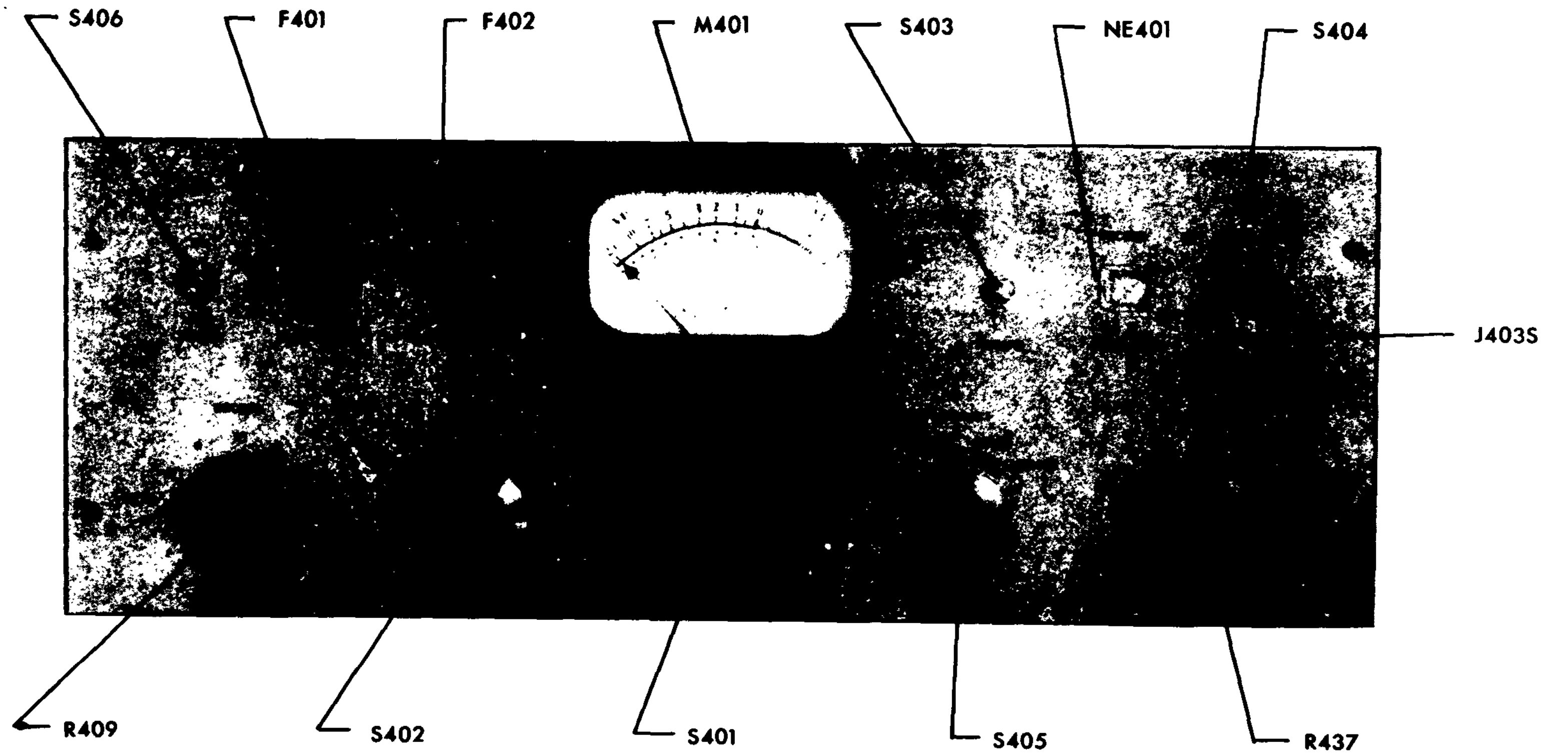

TEST CIRCUIT
OSC
VTVM
20
100
1000
10000
20000
FREQUENCY IN CYCLES PER SECOND

FIG. 6


RECORD AMPLIFIER RESPONSE
AMPEX AUDIO RECORDERS
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA
DB
+25
+20
+15
+10
+5
0
7 1/2" / SEC.
15" / SEC.
& 30" / SEC.
TEST CIRCUIT
V.T.V.M.
HEWLETT-PACKARD
400A OR 400C
20
100
1000
10000
20000
FREQUENCY IN CYCLES PER SECOND

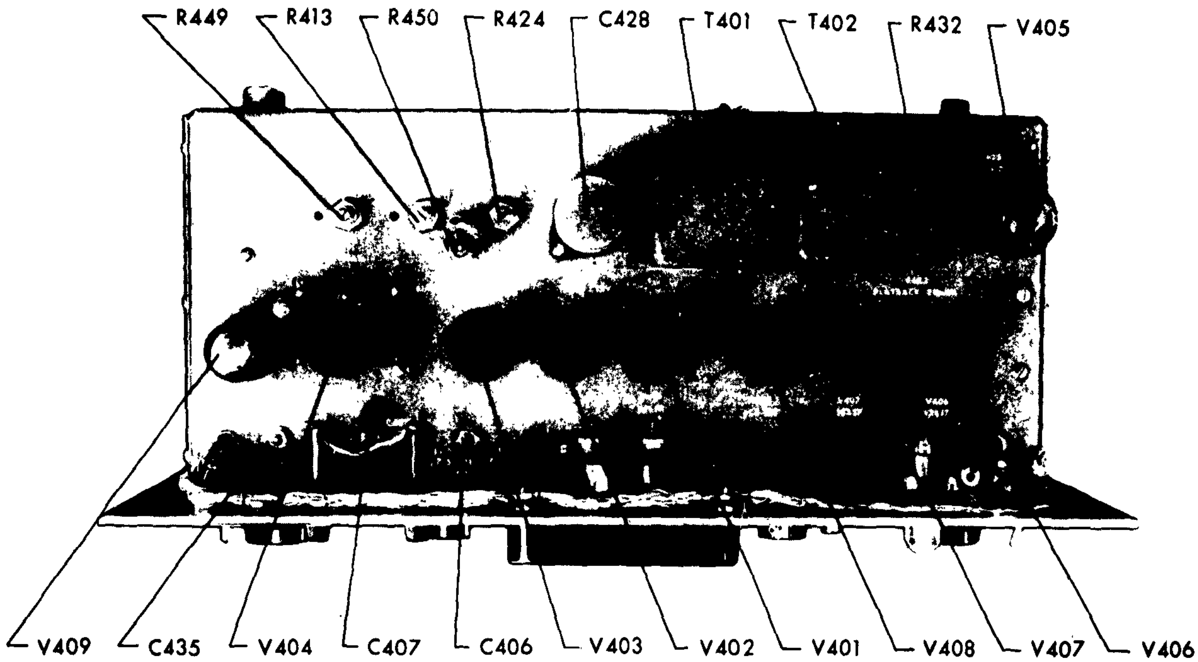
9-5-52

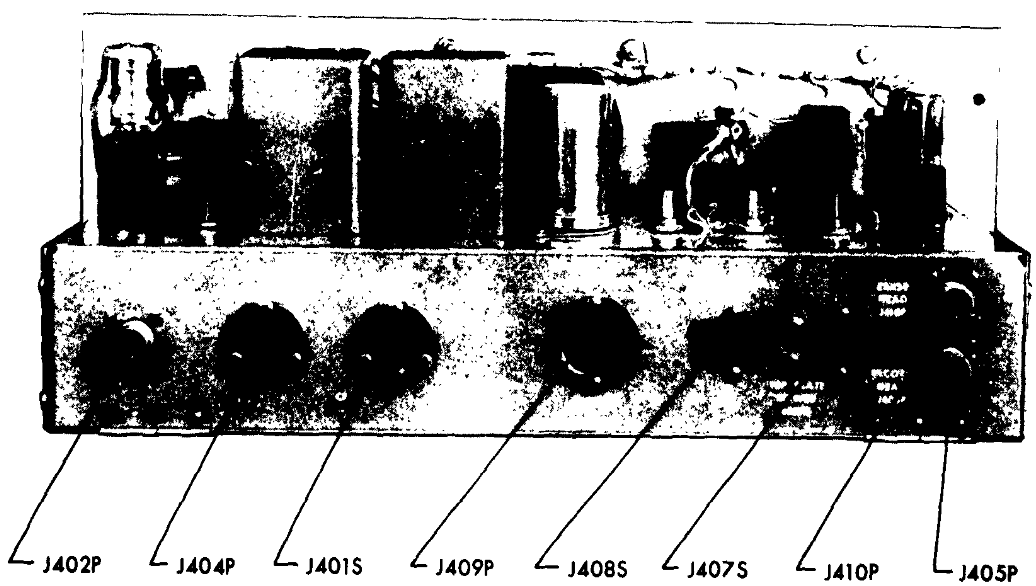
FIG. 7



ELECTRONIC ASSEMBLY
FRONT PANEL
MODELS 402 & 403
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

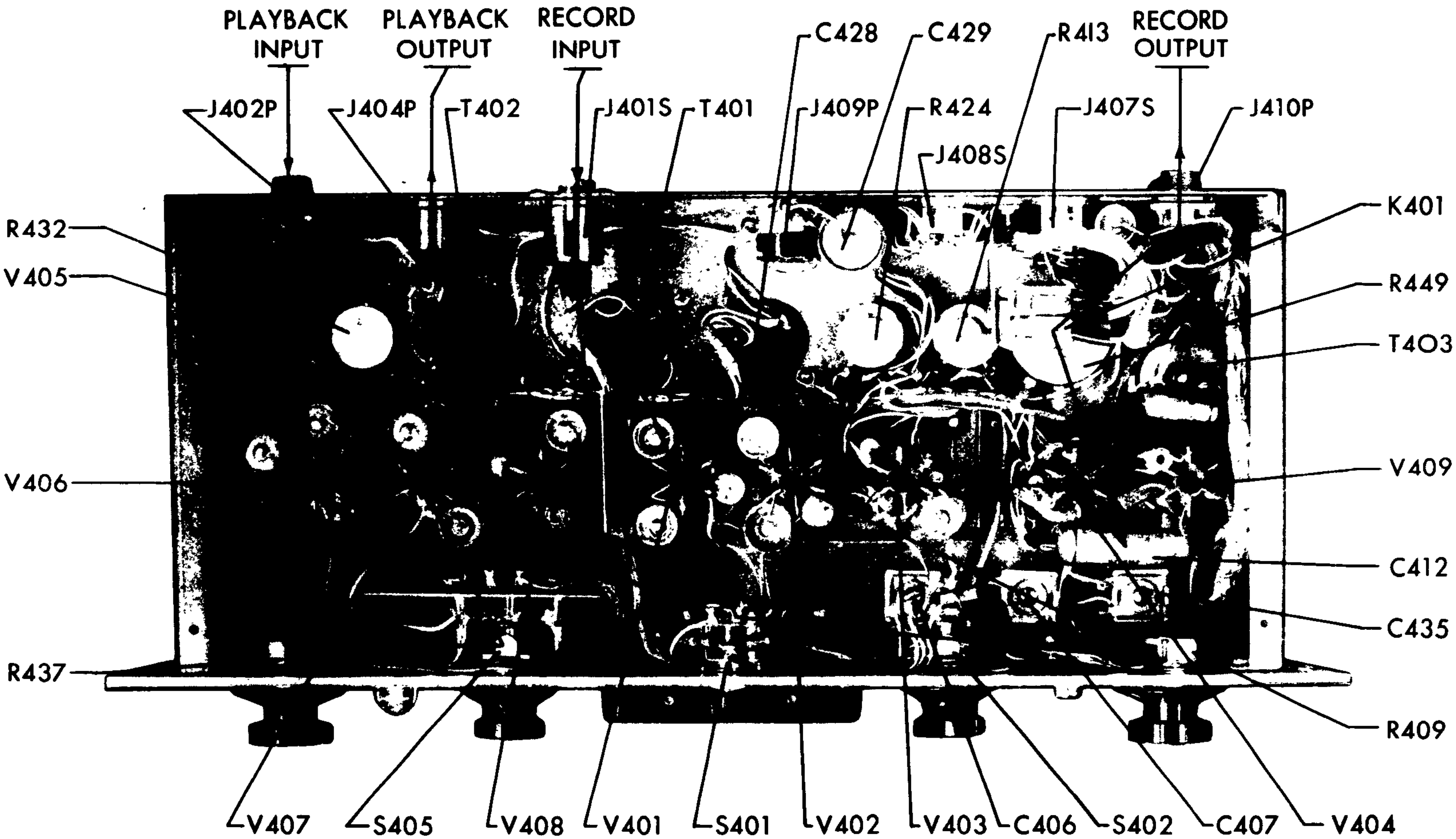
FIG 8





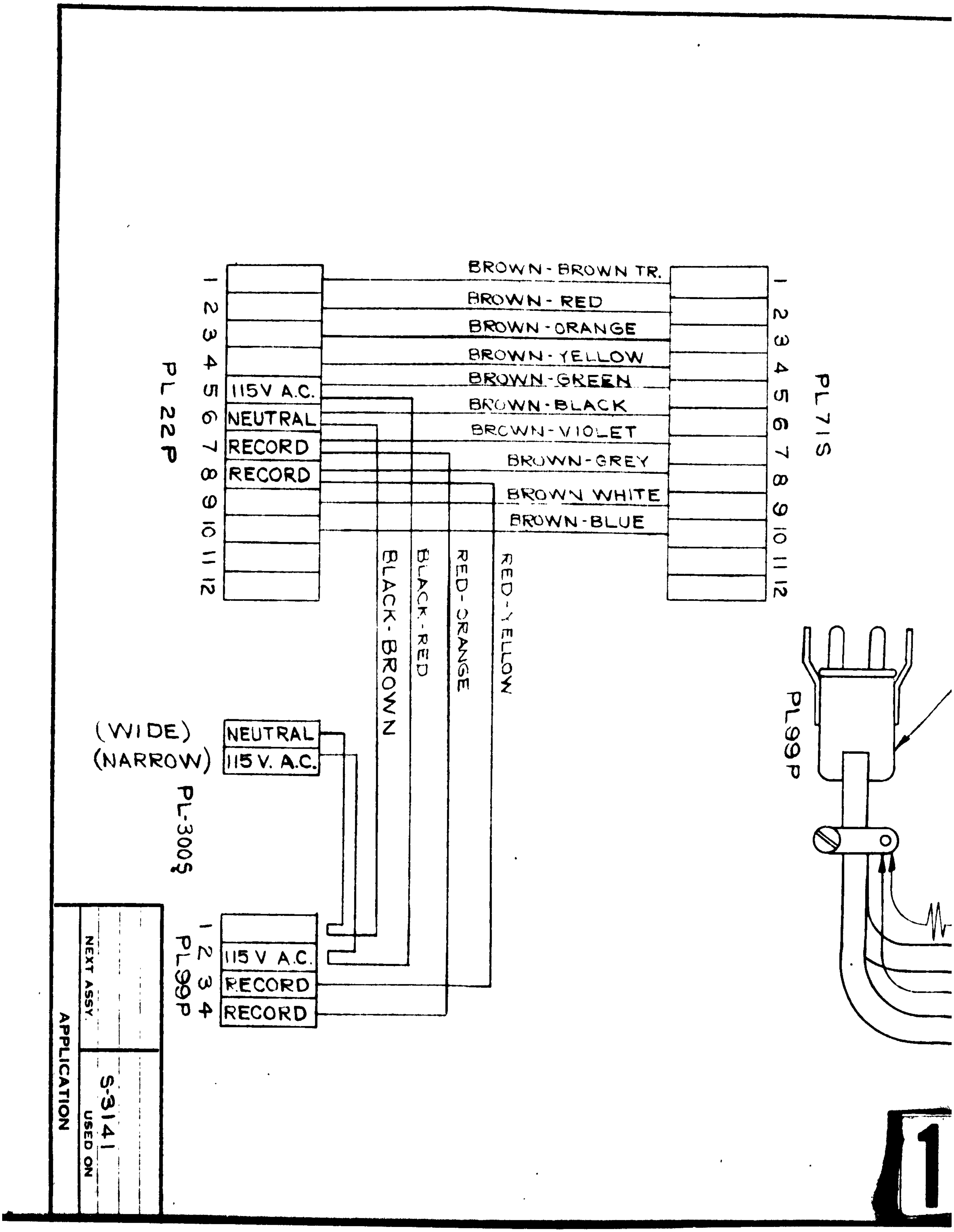
ELECTRONIC ASSEMBLY
TOP & REAR VIEWS
MODELS 402 & 403
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG 9

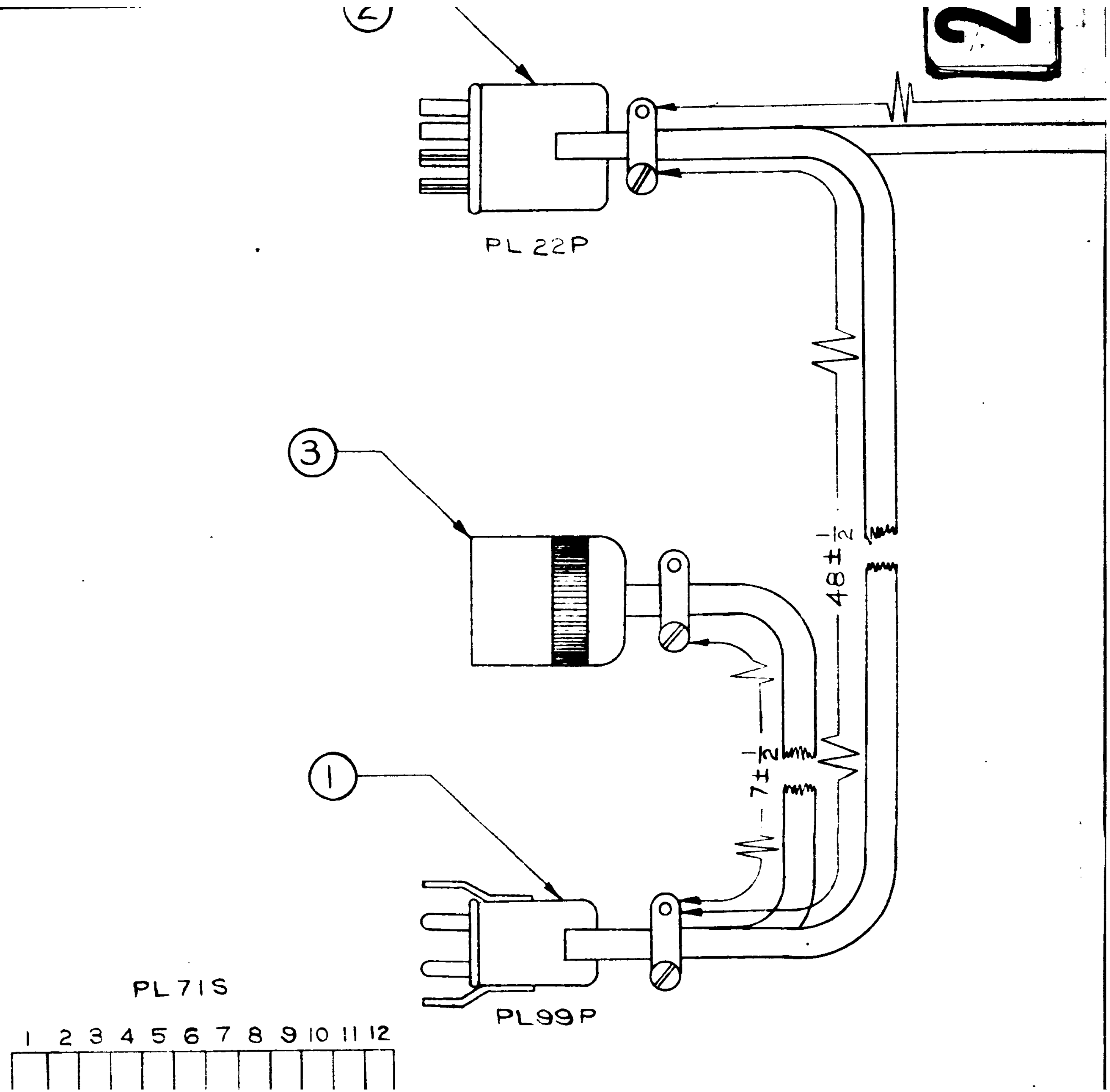


ELECTRONIC ASSEMBLY
BOTTOM VIEW
MODELS 402 & 403
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG 10



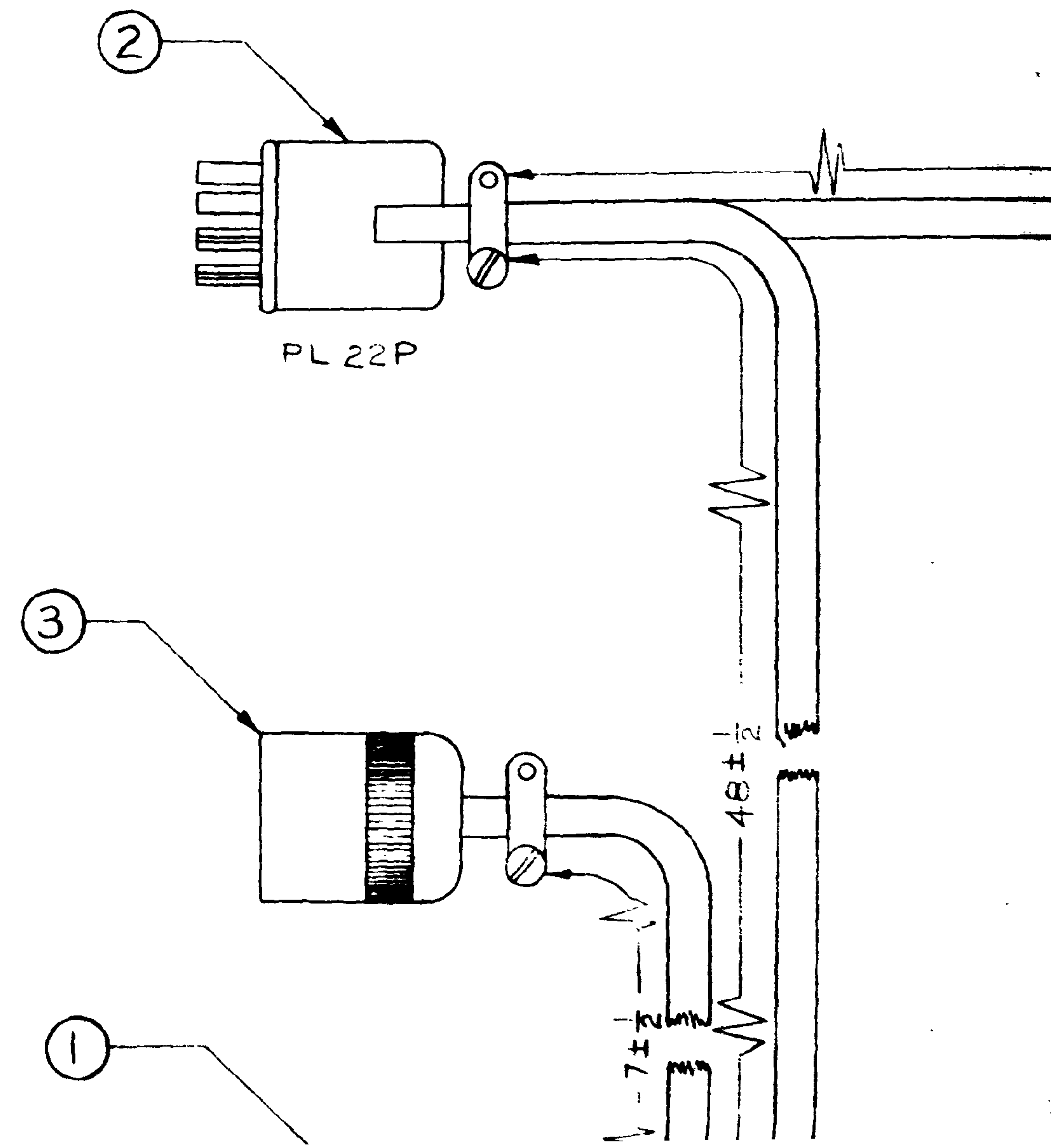
PL 22P
1 2 3 4 5 6 7 8 9 10 11 12
115V A.C.
NEUTRAL
RECORD
RECORD
BROWN-BROWN TR.
BROWN-RED
BROWN-ORANGE
BROWN-YELLOW
BROWN-GREEN
BROWN-BLACK
BROWN-VIOLET
BROWN-GREY
BROWN WHITE
BROWN-BLUE
PL71S
BLACK-BROWN
BLACK-RED
RED-ORANGE
RED-YELLOW
(WIDE)
(NARROW)
NEUTRAL
115 V. A.C.
PL-300S
PL99P
115 V A.C.
RECORD
RECORD
PL99P
NEXT ASSY.
S-3141
USED ON
APPLICATION
1



PL 22P
3
1
7 ± 1/2
48 ± 1/2
PL99P
PL71S
1 2 3 4 5 6 7 8 9 10 11 12

NOTICE: WHEN GOVERNMENT DRAWINGS, SPECIFICATIONS, OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE UNITED STATES GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATIONS WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE, OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

3



ITEM No	No REQ	PART No.	DESCRIPTION	MAT'L	MAT'L SPEC	UNIT WT.
9	1	PL-71S	JONES CONNECTOR - FEMALE - 12 PIN			
8	104"		1/4" NATVAR PLASTIC TUBING			
7	95"		#22 AWG SUPRENANT INSUL. WIRE RED-YELLOW			
6	95"		#22 AWG SUPRENANT INSUL. WIRE ~~RED-ORANGE~~			
5	104"		#18 AWG SUPRENANT INSUL. WIRE BLACK-BROWN			
4	104"		#18 AWG SUPRENANT INSUL. WIRE BLACK-RED			
3	1	PL-300S	#7427 HUBBEL			
2	1	PL-22P	JONES CONNECTOR -12 PIN			
1	1	PL-99P	JONES CONNECTOR - 4 PIN			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS ± DECIMALS ± ANGLES ±

DO NOT SCALE THIS DRAWING

MATERIAL

HEAT TREATMENT

AMPEX ELECTRIC CORP.

DRAWN	R.C. LUX	8-22-52
CHECKED	F.H.S.	8-26-52
APPROVED	E.H.B.	8-27-52

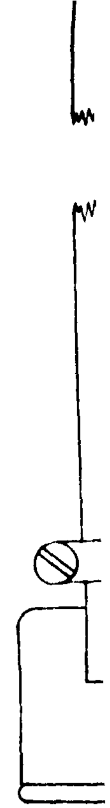
INTERCONNECTING CABLE

SCALE 1/1

UNIT WEIGHT

AMPEX ELECTRIC CORP.
SAN CARLOS, CALIF.

C-4451

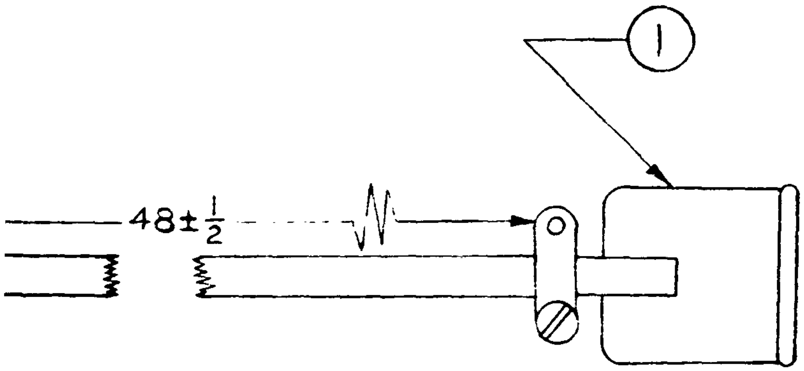


PL 71 S

5

6

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



PL 71 S

APPENDIX D

AMPEX MODEL 381 SPEEDLOCK EQUIPMENT

INSTRUCTIONS

INSTRUCTION MANUAL

FOR

MODEL 381 - SPEED LOCK EQUIPMENT

TABLE OF CONTENTS

SECTION I

GENERAL DATA

FOR MODEL 381 SPEED LOCK EQUIPMENT

I. COMPONENTS

The Model 381 Speed Lock Equipment, for rack mounting, Catalog No. 2621-2, consists of the following components:

Item	Components	Catalog Number
1.	Control Track Generator, for rack mounting	2189-1*
2.	Playback Demodulator, for rack mounting	2190*
3.	Model 375 60 Cycle Amplifier, for rack mounting	841
4.	Power Cable - Control Track Generator	2620
5.	Power Cable - Playback Demodulator	2478
6.	Power Cable - 60 Cycle Amplifier	3429
7.	60 Cycle Amplifier Signal Cable	2500
8.	Control Track Modulation Cable	2666-1
9.	Control Track Mixing Cable	2651

The Control Track Generator can be supplied to mount in the console cabinet of Ampex Series 300 Recorders. In this case the catalog numbers change as indicated:

1.	Model 381 Speed Lock complete	2621-1
2.	Control Track Generator	2189
3.	Control Track Modulation Cable	2666

II. GENERAL DESIGN CHARACTERISTICS

The Model 381 Speed Lock Equipment is primarily designed for telemetering applications to insure that data will be reproduced from tape at the same rate it was recorded. It is specifically designed to operate with Ampex Models 302, 307 and 500 Magnetic Tape Recorders in the recording of telemetering data supplied by the standard 7-1/2 percent deviated FM/FM system. In this system the Speed Lock Equipment will compensate for DC errors due to power line frequency changes or tape dimensional changes produced by temperature, humidity, etc. With minor modifications it will operate with many of the other recorders designed for data recording.

*NOTE: Equipment with different control track frequencies is available on special order.

Fundamentally, Speed Lock is accomplished by recording on the tape the output of the precision 60 Cycle Amplifier that supplies power to the capstan motor. On playback this frequency is reproduced and compared with the signal from the 60 Cycle Amplifier. The speed of the recorder is controlled so these frequencies are accurately matched, thereby insuring that the data reproduced is the same frequency as when recorded.

The Control Track Generator and the 60 Cycle Amplifier are required during the recording process to add the precision reference frequency to the tape. An 18.24 KC* oscillator in the Control Track Generator is modulated by the 60 Cycle Amplifier output signal, which also drives the capstan motor. The resulting control track is mixed with the telemetering data through a resistance network. The combined signal is recorded on the tape.

The Playback Demodulator and the 60 Cycle Amplifier are required during the playback process to provide power to the capstan motor of the recorder, controlled in frequency to provide the proper tape speed. The output of the tape recorder is fed to the Playback Demodulator where the control track carrier is separated from the data and demodulated. The resulting 60 cycle signal is compared with the output of the Tuning Fork Oscillator in the 60 Cycle Amplifier to provide a variable frequency correction signal. This signal is amplified by the power amplifier in tne 60 Cycle Amplifier to drive the capstan motor of the tape recorder. Thus, any difference between the reproduced comparison frequency and the precision 60 cycle reference frequency results in a change of frequency to the recorder capstan motor to correct its speed in a manner to eliminate any difference. The correcting action is extremely smooth and accurate with no tendency to hunt or over-shoot.

III. GENERAL PERFORMANCE DATA

CORRECTION CHARACTERISTICS: After the Speed Lock Correction System has stabilized, the average frequency reproduced from the tape will be within .02% of the original recorded frequency, providing there is no change in the precision reference frequency supplied by the 60 Cycle Amplifier Tuning Fork Oscillator. This oscillator has a stability of 5 parts per million per degree centigrade. The rate of correction is directly proportional to the error in capstan speed. At the start of reproduction this will produce a frequency error appreciably greater than .02%. This starting error can be limited to .1% or less by following the operating procedure described in Section III-II.

DATA LIMITATIONS: Any data components equal to or greater than the control track level between 16.5 KC and 20.0 KC may cause the improper operation of the Speed Lock Equipment.

DATA FREQUENCY RESPONSE: ±1 db 0 to 100,000 cycles.

*NOTE: Equipment with different control track frequencies is available on special order.

DATA NOISE LEVEL: Speed Lock will add no noise components to the data signal provided Research and Development Board recommended subcarrier frequencies are employed and the 22 KC channel is deviated only 7-1/2%.

INPUT IMPEDANCE: The data input impedance is approximately 100K unbalanced bridging and is designed to bridge any input from 0 to 10,000 ohms.

OUTPUT IMPEDANCE: The data output is unbalanced and will be the same impedance as the output of the playback amplifier of the magnetic tape recorder as long as this impedance does not exceed 47,000 ohms.

CONTROL TRACK: 18.24 KC carrier amplitude modulated by the 60 cycle precision reference frequency.

60 CYCLE OUTPUT: 110 V., 65 Watts, variable frequency for driving the capstan motor of the magnetic tape recorder.

IV. POWER INPUT REQUIREMENTS

Control Track Generator: .001 ampere at 390 V. DC) obtained from magnetic
.15 ampere at 6.3 V. AC) tape recorder.

Playback Demodulator: 1.5 amperes at 115 V. 60 cycle

60 Cycle Amplifier: 2.5 amperes at 115 V. 60 cycle

V. PHYSICAL DATA

Control Track Generator - for rack mounting:

Dimensions: Occupies 7" of rack space, 6 1/2" deep.
Weight: 6 pounds.

Control Track Generator for Console mounting:

Dimensions: 9 1/2" long x 5" wide x 6 1/2" high.
Weight: 5 pounds.

Playback Demodulator:

Dimensions: Occupies 14" of rack space, 10" deep.
Weight: 45 pounds.

60 Cycle Amplifier:

Dimensions: Occupies 12 1/4" or rack space, 9 1/2" deep.
Weight: 60 pounds.

SECTION II

INSTALLATION

The following installation procedures apply to Ampex Series 300 Magnetic Tape Recorders.

I. INSTALLATION FOR RECORDING AND PLAYING BACK AT THE SAME LOCATION

1. Connect the Control Track Generator to the tape recorder as shown in Figure 4. Connect a 1.23 Volt RMS data input signal to Connector J1302S of the Control Track Mixing Cable. NOTE: There is a 4 db mixing loss in this cable. This will require increasing the gain in the record amplifier of Ampex Series 300 Tape Recorder to arrive at the recommended tape record level.

2. Connect the Playback Demodulator to the tape recorder and the 60 Cycle Amplifier as shown in Figure 4. 1.23 Volt RMS data output appears at the Demodulator Signal Output Connector J202P when the data input is 1.23 Volts and the tape recorder has been properly adjusted. See Tape Recorder Instruction Manual.

3. For Ampex Model 307 Recorders, connect the 60 Cycle Amplifier to the tape recorder as shown in Figure 4. Connect the Power Factor Correction Condenser across the output by strapping pin 7 to pin 5 on the Power Connector J2302P. See Figure 1. The power fuse on the tape recorder must be increased by 3 amperes to accommodate the additional load of the 60 Cycle Amplifier. For Model 302 Recorders connect the 60 Cycle Amplifier Cable to the recorder as explained in Sub-section IV.

II. INSTALLATION FOR RECORDING ONLY.

Connect the Control Track Generator and the 60 Cycle Amplifier to the tape recorder as explained in Sub-section I above. The Playback Demodulator is not required during the recording process. Insert Dummy Plug 2414 in the Signal (In and Out) Connector J2304S of the 60 Cycle Amplifier in place of the catalog number 2500 60 Cycle Signal Cable.

III. INSTALLATION FOR PLAYBACK ONLY.

Connect the Playback Demodulator and the 60 Cycle Amplifier to the tape recorder as explained in Sub-section I. The Control Track Generator is not required during the playback process. The Record-Playback Switch on the Demodulator must be in the playback position.

IV. 60 CYCLE AMPLIFIER POWER CONNECTIONS WITH MODEL 302 RECORDER

On Ampex Model 302 Recorders the 60 Cycle Amplifier Power Connections are made at the Capstan Drive Motor Terminal Strip TS-501.

A. Connections for Model 302 Recorders, serial number 1 through 500:

1. Remove the strap between Terminals 4 and 5 on TS-501 and move the drive motor solenoid lead from Terminal 4 to Terminal 5.

2. Remove the male Connector J2402P from the Power Cable 3429 and connect to TS-501 as follows:

Black to Terminal 3, White and Brown to Terminal 1.
Red to Terminal 5.

3. For recorders whose drive motors have been replaced with a Bodine Motor, it is necessary to connect the Power Factor Correction Condenser across the 60 Cycle Amplifier output. To do this strap Pin 7 to Pin 5 on the 8 Pin Power Connector J2302P.

B. Connection for Model 302 Recorders, serial number 501 and up.

1. Remove the strap between Terminals 4 and 5 on TS-501.

2. Remove the male Connector J2402P from the Power Cable 3429 and connect to TS-501 as follows:

Black to Terminal 4. Brown and White to Terminal 1.
Red to Terminal 5.

3. For recorders with a Bodine Drive Motor (Serial Numbers 600 and up) it is necessary to connect the Power Factor Correction Condenser across the 60 Cycle Amplifier output. To do this, strap Pin 7 to Pin 5 on the 8 Pin Power Connector J2302P.

SECTION III

OPERATION

I. RECORD

After the Control Track Generator and 60 Cycle Amplifier have been connected to the tape recorder as explained in Section II, turn on the AC Power Switch of the tape recorder. The recorder supplies power to the Control Track Generator and the 60 Cycle Amplifier. (NOTE: On Model 302 Recorders, Serial 501 and up, the tape must be threaded before power is supplied to the 60 Cycle Amplifier.) Place the Amplifier-Power Line Switch S2301 on the 60 Cycle Amplifier in the Amplifier position. If the Playback Demodulator is connected in the system, set the Record-Playback Switch in the record position.

Start the tape and set the 60 Cycle Amplifier Voltage Adjustment Control R2311 for 110 Volts as read on the voltmeter. This adjustment should be made under load conditions only. Under no-load conditions the voltage will rise above 150 Volts and pin the meter. This is normal and will in no way damage the meter as the no-load voltage is for less than the overload rating of the meter. Once the voltage adjustment is set, it should not be necessary to change it unless the tape speed is changed or a different tape recorder is used.

The data input signal of 1.23 Volts RMS should be fed to the Mixing Cable. The control track should be adjusted to the recommended level as explained in Section V-I. The record system is now ready for operation. The tape recorder should be operated in the usual manner with the exception that the record amplifier gain should be set 4 db higher than normal to compensate for the 4 db loss in the Mixing Cable.

II. PLAYBACK

After the Playback Demodulator and 60 Cycle Amplifier have been connected to the Recorder as explained in Section II, turn on the AC Power Switch on both the Demodulator and the tape recorder. The Red Pilot Light A102 on the Demodulator will light. Place the Amplifier-Power Line Switch S2301 of the 60 Cycle Amplifier in the amplifier position. Set the Record-Playback Switch on the Demodulator in the playback position. Adjust the 60 Cycle Amplifier output voltage as explained under RECORD.

The playback system is now ready for operation. The data output level will be the same level as the tape recorder output since there is no loss in the Demodulator. The Demodulator Green Control Track Pilot Light A101 indicates that the control signal is being received and will be lit when the system is in operation. The tape recorder should be operated in the usual manner.

At the start of reproduction the frequency error will be high until the correction system is stabilized. Should it be necessary to start with minimum error the following procedure should be observed:

1. Start the tape in the usual manner and play back approximately 15 seconds of the tape. This will stabilize the correction system.

2. Open the head housing gate on the recorder and rewind the tape.

3. Close the head housing gate and restart the tape. The starting error will be less than .1% and will drop to .02% within 5 seconds.

SECTION IV

CIRCUIT DESCRIPTION

I. CONTROL TRACK GENERATOR

The purpose of the Control Track Generator is to add the precision 60 cycle reference frequency to the tape. It consists of a plate modulated oscillator V701 tuned to 18.24 KC by C701. The 110 V. 60 cycle modulation signal enters at Connector J703P, passes through the modulation transformer T702 in series with the DC plate supply and voltage regulator NE701, which prevents too high a percentage of modulation. The 18.24 KC oscillator is thus amplitude modulated to produce the control track. The control track is adjusted in level by R703 and passes to the Control Track Signal Connector J702S. The plate and filament supply for the Control Track Generator are obtained from the Electronic Assembly of the magnetic tape recorder through Connector J701P.

II. PLAYBACK DEMODULATOR

The purpose of this unit is to demodulate the control track carrier, compare the resulting signal with the precision reference frequency, and supply a variable frequency correction signal to vary the speed of the tape recorder.

The Playback Demodulator consists of the following:

1. Demodulator and Amplifier which demodulates, limits, reshapes, and amplifies the control track recorded on the tape to produce the comparison frequency.

2. Power Amplifier which amplifies the precision 60 cycle reference frequency.

3. Variable Frequency Oscillator which produces a signal to vary the speed of the tape recorder.

4. Differential Motor Assembly which compares the comparison frequency with the precision reference frequency and controls the Variable Frequency Oscillator accordingly.

The combined data and control track signal enter the Playback Demodulator at the Signal Input Connector J201S and is fed to the Demodulator and Amplifier. The control track carrier is separated from the data by the Control Track Pass Filter which consists of a parallel resonant L-C filter in the grid circuit of a voltage amplifier, V201. The output of V201 is detected by diode V202 (1N34A) and the resulting comparison frequency is fed to a voltage amplifier, V203.

The comparison frequency then passes through two stages of limiting, V206 and V205 (6AC7's), thus assuring the proper control voltage for input variations of $\pm$20 db. The screen voltage of the second limiter, V205, is varied by R226 to change the stage gain, thus providing the Differential Motor Voltage Adjustment. The output of the second limiter passes to V206 (6L6) the grid circuit of which is tuned to 60 cycles by a parallel resonant tuned circuit. The output of V206 is fed to contact #3 on relay K201 and to the coil of the relay through a selenium rectifier SR201. If the control track is not present, the relay is de-energized and a dummy load R231 is connected across V206. When the control track is present the 60 cycle output of V206 is rectified to energize the relay. This transfers the output of V206 from the dummy load to the Differential Motor B202 of the Differential Motor Assembly

The precision reference frequency from the 60 Cycle Amplifier Tuning Fork Oscillator enters the Power Amplifier section of the Playback Demodulator at the 60 Cycle Out Connector J203P. It is adjusted in level by the Reference Motor Voltage Control R244 and passes to a two stage voltage amplifier V210. The output of V210 is fed to the power stage V211, the grid circuit of which is tuned to 60 cycles by a parallel resonant tuned circuit L205 and C230. The output of V211 is fed through the coupling condenser C231 to contact #1 on relay K201. When the relay is energized the output of V211 is transferred from Dummy Load R229 to the Reference Motor B201 of the Differential Motor Assembly.

The Differential Motor, B202, driven by the comparison frequency is mounted so that its stator is free to rotate. The Reference Motor, B201, driven from the precision reference frequency is stationary mounted with its shaft locked to the Differential Motor. If the two frequencies fed to these motors do not agree perfectly, the stator of one motor rotates with respect to the other and in so doing drives the Differential Potentiometer, R234. The Differential Potentiometer is located in the grid circuit of the Variable Frequency Oscillator, V208, and controls the frequency of the oscillator. The output of this oscillator is fed through a level control R241 to the Record Playback Switch S202. When this switch is in the playback position the variable frequency signal is transferred to the 60 Cycle Out Connector J203P. It is amplified by the 60 Cycle Amplifier to drive the capstan drive motor of the tape recorder. Thus any difference between the comparison frequency and the precision reference frequency results in a change of frequency to the magnetic recorder capstan motor to correct its speed in a manner to eliminate any difference.

III. 60 CYCLE AMPLIFIER

The purpose of this unit is to supply during both record and playback the 60 cycle precision reference frequency and the power to drive the capstan motor of the tape recorder.

The 60 Cycle Amplifier consists of a precision 60 Cycle Tuning Fork Oscillator and a Power Amplifier. The power supply for this unit is self contained and receives its AC power through the control circuits of the tape recorder and the

Power Connector J2302P (Pins 1 and 4). V2310 and V2311 (5U4G's) provide the plate current and a selenium rectifier SR2301 provides the negative bias voltage for the output tubes V2306 and V2307 and the limiter tube V2303.

The Tuning Fork Oscillator consists of a two stage RC coupled amplifier V2301 and V2302 with a tuning fork feedback circuit from the plate of V2302 to the grid of V2301. The voltage at the grid of V2302 is limited in amplitude by two diodes V2303 (6H6). They are biased at 1 1/2 volts to prevent excessive feedback voltages from overdriving the tuning fork. The precision 60 cycle output, appearing at pin 6 of J2304S, is fed to the Power Amplifier in the Playback Demodulator during playback and is fed directly to 60 Cycle Amplifier Power Amplifier during record.

The Power Amplifier of the 60 Cycle Amplifier consists of a two stage voltage amplifier, V2312, a driver stage, V2305, and a push-pull output stage V2306 and V2307. The Power Amplifier is fed from the Tuning Fork Oscillator during record and from the Variable Frequency Oscillator of the Playback Demodulator during playback. The signal enters at Pin 2 of Connector J2304S and is fed to the voltage amplifier V2312 (6SN7). The grid circuit of the second stage contains a parallel resonant tuned circuit tuned to 60 cycles, and a gain control, R2311, to adjust the 60 Cycle Amplifier output voltage. The output of V2312 is fed to a driver stage, V2305 (6F6) where negative feedback from the output transformer, T2302, is fed to the cathode. This in turn feeds the push-pull output stage, V2306, and V2307 (807's) through the drive transformer, T2301. The signal passes through the output transformer, T2302 to Power Connector J2302P (Pins 5 and 8). The Power Factor Correction Condenser, C2319, appears across Pins 7 and 8 of the Power Connector and can be strapped across the output, if required by the capstan motor of the tape machine. (Recorders that require this correction are indicated in Section II, Installation.)

SECTION V

ALIGNMENT AND ADJUSTMENTS

The following alignment procedure has been performed at the factory prior to shipment and all controls locked by the shaft locks. No further adjustments should be necessary except as required by routine maintenance.

The following test equipment is required for complete alignment:

1. Audio Oscillator - - Range 20 to 20,000 c.p.s. Example, Hewlett-Packard 200-C.

2. Vacuum Tube Voltmeter - - Accurate to 20,000 cycles. Example, Hewlett-Packard 400-C.

3. Oscilloscope.

4. Accurate Frequency Standard or Frequency measuring equipment. Example, Berkeley Scientific Events Per Unit Time Meter #554.

I. CONTROL TRACK GENERATOR. Refer to Figure 3.

1. CONTROL TRACK OSCILLATOR FREQUENCY. The adjustment of the control track frequency requires the use of a frequency source of 18,240 cycle ±200 cycles. This is necessary to assure the interchangeability of Speed Lock recordings. Calibrate an audio oscillator to 18.24 KC with an Events Per Unit Time Meter or any accurate frequency measuring device. Connect this calibrated frequency to the horizontal input of the oscilloscope. Connect the Control Track Signal Output J702S to the vertical input of the oscilloscope. Adjust the oscilloscope controls to show a Lissajous pattern. Adjust the Control Track Frequency Control C701 to provide a 1 to 1 frequency ratio.

2. CONTROL TRACK LEVEL. The Control Track Level Control R703 has been factory adjusted to provide 1.23 Volts RMS at the Control Track Signal Output J702S. This will produce the recommended control track level of .245 Volts RMS at the input of the record amplifier of the tape recorder since there is a 14 db control track signal loss in the Mixing Cable. This recommended level applies only to an Ampex Model 307 Recorder with a Meter Panel set for 10 db attenuation. It should be noted that the data level and control track level are the same at the input of the tape recorder. Refer to Figure 5.

	Data Levels	Control Track Signal Levels
Line Input Level	+4 dbm(1.23V)	+4 dbm (1.23V)
Loss in Meter Panel with Record Control set at 10	-10 db	- - -
Loss in Mixing Cable	-4 db	-14 db
Record Amplifier Input Level	-10 dbm (.245V)	-10 dbm (.245V)

When the tape recorder is used without a meter panel the data input signal to the record amplifier will be 0 dbm (.774V). The control track signal level at the input to the record should also be 0 dbm (.774V). The Level Control should therefore be readjusted to provide +14 dbm (3.88V) at the Control Track Signal Output J702S.

These input levels will produce the recommended tape operating level (point of 1% harmonic distortion) when the record amplifier of the tape recorder is set for an additional 4 db gain as described in Section II-I. Should the recommended control track level cause interference in the telemetering system, it can be reduced up to 10 db without affecting the performance of Speed Lock.

II. PLAYBACK DEMODULATOR. Refer to Figure 2.

1. CONTROL TRACK PASS FILTER ADJUSTMENT. Connect a 1 Volt source of 18.24 KC to the Demodulator Input Connector J201S. Connect a vacuum tube voltmeter to the plate of Diode V202 (located on the turret of V201). Adjust the Pass Filter Control C202 for maximum output as read by the voltmeter.

2. DIFFERENTIAL MOTOR VOLTAGE ADJUSTMENT. Connect a source of control track signal, such as an aligned Control Track Generator or a tape recorded from it, to the Demodulator Input J201S. Connect the vacuum tube voltmeter to Terminals 5 and 6 of the Differential Assembly Terminal Strip TS201. (Terminals read from left to right when chassis lettering is right side up.) Adjust the Differential Motor Voltage Control R226 to provide 110 Volts as read on the meter.

3. REFERENCE MOTOR VOLTAGE ADJUSTMENT. It is necessary to connect the 60 Cycle Amplifier to the tape recorder and Demodulator before this adjustment can be made. Connect a voltmeter across Terminals 1 and 2 of the Differential Assembly Terminal Strip TS201. (Terminals read from left to right when chassis lettering is right side up.) With the 60 Cycle Amplifier turned on, adjust the Reference Motor Voltage Control R244 to provide 110 V. as read by the voltmeter.

4. DEMODULATOR VARIABLE FREQUENCY OSCILLATOR ADJUSTMENT. Remove any input signal from the Demodulator. Connect

Terminal C and B of the 60 Cycle Output Connector J203P to the horizontal input of the oscilloscope. Set the Demodulator Record-Playback Switch S202 in the playback position. Connect the AC power line frequency to the vertical input of the oscilloscope. Turn the Demodulator on and adjust the oscilloscope controls to show a Lissajous pattern. Position the Differential Motor Assembly by hand to center the Differential Potentiometer R234. Adjust the Demodulator Variable Frequency Oscillator Control R232 to provide a 1 to 1 frequency ratio as determined by the Lissajous pattern.

5. VARIABLE FREQUENCY OSCILLATOR VOLTAGE ADJUSTMENT. It is necessary to connect the 60 Cycle Amplifier to the tape recorder and Demodulator before this adjustment can be made. With the Demodulator Playback-Record Switch S202 in the record position, adjust the 60 Cycle Amplifier output voltage to 110 V. as explained in Section III-I. This adjustment should be made under load conditions only. Reset the Demodulator Record-Playback Switch to the playback position. Adjust the Oscillator Voltage Control R241 to provide 110 V. to the capstan motor as read on the 60 Cycle Amplifier Voltmeter.

III. 60 CYCLE AMPLIFIER. Refer to Figure 1.

1. OUTPUT TUBE BIAS ADJUSTMENT. The bias on the 807 output tubes V2306 and V2307 should be adjusted to -30 Volts by an adjustable tap on Resistor R2322 (located underneath chassis).

2. TUNING FORK OSCILLATOR LEVEL. The Tuning Fork Oscillator level is determined by the bias on the Diode Limiter V2303. Connect a vacuum tube voltmeter to Pin 5 of V2303 and chassis ground. Adjust the appropriate tap on Resistor R2322 to provide -1 1/2 Volts bias.

SECTION VI

PARTS LIST

Schematic Reference Number	Description	Ampex Catalog Number
	I. CONTROL TRACK GENERATOR - Catalog #2189 or #2189-1	
C701	.0001 MFD Variable Air Trimmer Condenser	CO-124
C702	.0006 MFD 1000 V. Mica Condenser 2%	CO-226
C703	.002 MFD 500 V. Mica Condenser	CO-21
C704	.005 MFD 500 V. Tubular Condenser	CO-26
C705	.01 MFD 600 V. Tubular Condenser	CO-29
C706	10 MFD 450 V. Electrolytic Condenser	CO-144
C707	.01 MFD 600 V. Tubular Condenser	CO-29
J701P	Power Connector - Jones P-310-AB	PL-139P
J702S	Control Track Output Connector - Cannon XL-4-13	PL-138S
J703P	Modulation Connector - Jones P-308-AB	PL-8P
NE701	Neon Voltage Regulator	2598
R701	10,000 ohm 1 Watt Composition Resistor	RE-15
R702	100,000 ohm 1 Watt Composition Resistor	RE-26
R703	200 ohm Wire Wound Potentiometer	RE-280
R704	10,000 ohm 1 Watt Composition Resistor	RE-15
R705	47,000 ohm 1 Watt Composition Resistor	RE-22
R706	4,700 ohm 1 Watt Composition Resistor	RE-11
T701	Oscillator Transformer	2596
T702	Modulation Transformer	2660
V701	6C4 Vacuum Tube	TU-26
	7 Pin Miniature Tube Shield	SD-4
	7 Pin Miniature Tube Shield Base	SD-3
	II. PLAYBACK DEMODULATOR - Catalog #2190	
A201	120 V. 6 Watt Lamp - Candelabra Screw	LA-6
	Green Pilot Lamp Base	DL-8
A202	120 V. 6 Watt Lamp - Candelabra Screw	LA-6
	Red Pilot Lamp Base	DL-7
B201	Reference Motor	See Note 1 - Page 4
B202	Differential Motor	See Note 1 - Page 4

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
C201	.0005 MFD 500 V. Mica Condenser 2%	CO-225
C202	.0001 MFD Air Trimmer Condenser	CO-124
C203	25 MFD 25 V. Electrolytic Condenser	CO-59
C204	4x20 MFD 450 V. Electrolytic Condenser	CO-65
C205	.01 MFD 600 V. Tubular Condenser	CO-29
C206	.0005 MFD 500 V. Mica Condenser	CO-19
C208	.01 MFD 600 V. Tubular Condenser	CO-29
C209	50 MFD 25 V. Electrolytic Condenser	CO-60
C210	.1 MFD 400 V. Metalized Paper Condenser	CO-44
C211	4 MFD 450 V. Electrolytic Condenser	CO-54
C212	50 MFD 25 V. Electrolytic Condenser	CO-60
C213	.05 MFD 600 V. Tubular Condenser	CO-32
C214	4x20 MFD 450 V. Electrolytic Condenser	CO-65
C215	50 MFD 25 V. Electrolytic Condenser	CO-60
C216	1.0 MFD 400 V. Metalized Paper Condenser	CO-47
C217	3.75 MFD 330 V. AC Condenser	CO-84
C218	20 MFD 450 V. Electrolytic Condenser	CO-57
C219	4 MFD 450 V. Electrolytic Condenser	CO-54
C220	50 MFD 25 V. Electrolytic Condenser	CO-60
C221	.5 MFD 600 V. Tubular Condenser	CO-36
C222	.45 MFD 250 V. AC Condenser	CO-205
C223	.5 MFD 400 V. Metalized Paper Condenser	CO-46
C224	.45 MFD 250 V. AC Condenser	CO-205
C225	.01 MFD 500 V. Mica Condenser	CO-121
C226	.01 MFD 500 V. Mica Condenser	CO-121
C227	.02 MFD 600 V. Tubular Condenser	CO-31
C228	.02 MFD 600 V. Tubular Condenser	CO-31
C229	1.0 MFD 400 V. Metalized Paper Condenser	CO-47
C230	3.75 MFD 330 V. AC Condenser	CO-84
C231	20 MFD 450 V. Electrolytic Condenser	CO-57
C232	.5 MFD 400 V. Metalized Paper Condenser	CO-46
C233	4 MFD 450 V. Electrolytic Condenser	CO-54
C234	50 MFD 25 V. Electrolytic Condenser	CO-60
C235	16 MFD 500 V. Electrolytic Condenser	CO-56
F201	3 Ampere Fuse	FU-3
F202	3 Ampere Fuse	FU-3
J201S	Input Connector - Cannon XL-3-13	PL-58S
J202P	Output Connector - Cannon XL-3-14	PL-4P
J203P	60 Cycle Connector - AN3102-10S-3P	PL-59P

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
K201	3 PDT 115 V. DC Relay	RL-8
L201	125 MH Torroidal Inductance	1644
L202	2 Henry Torroidal Inductance	CH-7
L203	14 Henry Choke	CH-11
L204	12 Henry Choke	3479
L205	2 Henry Torroidal Inductance	CH-7
L206	14 Henry Choke	CH-11
R201	470,000 ohm 1 Watt Composition Resistor	RE-31
R202	47,000 ohm 1 Watt Composition Resistor	RE-22
R203	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R204	25,000 ohm 10 Watt Wire Wound Resistor	RE-95
R205	100,000 ohm 1 Watt Composition Resistor	RE-26
R206	220 ohm 1 Watt Composition Resistor	RE-1
R207	68,000 ohm 1 Watt Composition Resistor	RE-24
R208	68,000 ohm 1 Watt Composition Resistor	RE-24
R210	1200 ohm 1 Watt Composition Resistor	RE-261
R211	47,000 ohm 1 Watt Composition Resistor	RE-22
R212	15,000 ohm 1 Watt Composition Resistor	RE-16
R213	100,000 ohm 1 Watt Composition Resistor	RE-26
R214	220,000 ohm 1 Watt Composition Resistor	RE-28
R215	220 ohm 1 Watt Composition Resistor	RE-1
R216	50,000 ohm 10 Watt Wire Wound Resistor	RE-99
R217	10,000 ohm 1 Watt Composition Resistor	RE-15
R218	100,000 ohm 1 Watt Composition Resistor	RE-26
R219	2,000 ohm 10 Watt Wire Wound Resistor	RE-82
R220	1 Megohm 1 Watt Composition Resistor	RE-32
R221	1 Megohm 1 Watt Composition Resistor	RE-32
R222	220 ohm 1 Watt Composition Resistor	RE-1
R223	25,000 ohm 10 Watt Wire Wound Resistor	RE-95
R224	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R225	10,000 ohm 1 Watt Composition Resistor	RE-15
R226	50,000 ohm 4 Watt Wire Wound Potentiometer	RE-291
R227	300 ohm 10 Watt Wire Wound Resistor	RE-70
R228	100,000 ohm 1 Watt Composition Resistor	RE-26
R229	3500 ohm 10 Watt Wire Wound Resistor	RE-326
R230	470 ohm 1 Watt Composition Resistor	RE-2
R231	7,000 ohm 10 Watt Wire Wound Resistor	RE-284
R232	20,000 ohm Carbon Potentiometer	RE-240
R233	1,000 ohm 1 Watt Composition Resistor.	RE-5
R234	40,000 ohm 4 Watt Wire Wound Potentiometer	2269

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
R235	39,000 ohm 1 Watt Composition Resistor	RE-21
R236	4,700 ohm 1 Watt Composition Resistor	RE-11
R237	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R238	4,700 ohm 1 Watt Composition Resistor	RE-11
R239	1 Megohm 1 Watt Composition Resistor	RE-32
R240	1 Megohm 1 Watt Composition Resistor	RE-32
R241	250,000 ohm Carbon Potentiometer	RE-364
R243	10,000 ohm 2 Watt Composition Resistor	RE-168
R244	250,000 ohm Carbon Potentiometer	RE-238
R245	47,000 ohm 1 Watt Composition Resistor	RE-22
R246	3,300 ohm 1 Watt Composition Resistor	RE-9
R247	1 Megohm 1 Watt Composition Resistor	RE-32
R248	15,000 ohm 2 Watt Composition Resistor	RE-169
R249	1,000 ohm 1 Watt Composition Resistor	RE-5
R250	39,000 ohm 1 Watt Composition Resistor	RE-21
R251	400 ohm 10 Watt Wire Wound Resistor	RE-72
R252	1,500 ohm 1 Watt Composition Resistor	RE-6
S201	SPST Toggle Switch	SW-9
S202	DPDT Toggle Switch	SW-5
SR201	Half Wave Selenium Rectifier	SR-7
T201	Power Transformer	3477
TS201	Differential Assembly Terminal Strip	TS-7-9N
TS202	Power Terminal Strip	TS-9-2
V201	6SJ7 Vacuum Tube	TU-10
V202	1N34A Germanium Diode	TU-18
V203	6J5 Vacuum Tube	TU-23
V204	6AC7 Vacuum Tube	TU-4
V205	6AC7 Vacuum Tube	TU-4
V206	6L6 Vacuum Tube	TU-6
V207	OD3/VR150 Vacuum Tube	TU-2
V208	6SN7 Vacuum Tube	TU-13
V209	5U4G Vacuum Tube	TU-1
V210	6SN7 Vacuum Tube	TU-13
V211	6L6 Vacuum Tube	TU-6
	Differential Motor Assembly (See Note 1)	2309
	Motor Coupling Sleeve	2280
	Reference Motor Terminal Board with commutators	2282
	Differential Motor Terminal Board with springs	2285

NOTE 1: The Differential Motor Assembly should be replaced only as a complete unit with the exception of the Differential Potentiometer, R234, Terminal Boards and Motor Coupling Sleeve.

Schematic Reference Number	Description	Ampex Catalog Number
	III. 60 CYCLE AMPLIFIER - Catalog #841	
A2301	6-8 V. Panel Lamp - Bayonet Base	LA-2
	Red Pilot Lamp Base	DL-3
C2301	.5 MFD 600 V. Tubular Condenser	CO-36
C2302	1.0 MFD 400 V. Tubular Condenser	CO-37
C2303	50 MFD 25 V. Electrolytic Condenser	CO-60
C2304	.1 MFD 600 V. Tubular Condenser	CO-33
C2305	10 MFD 450 V. Electrolytic Condenser	CO-55
C2306	.1 MFD 600 V. Tubular Condenser	CO-33
C2307	50 MFD 25 V. Electrolytic Condenser	CO-60
C2308	1.0 MFD 400 V. Tubular Condenser	CO-37
C2309	3.75 MFD 330 V. AC Condenser	CO-84
C2311	10 MFD 450 V. Electrolytic Condenser	CO-55
C2312	.1 MFD 600 V. Tubular Condenser	CO-33
C2313	.25 MFD 600 V. Tubular Condenser	CO-35
C2314	10 MFD 450 V. Electrolytic Condenser	CO-55
C2315	50 MFD 25 V. Electrolytic Condenser	CO-60
C2316	50 MFD 25 V. Electrolytic Condenser	CO-60
C2317	100 MFD 50 V. Electrolytic Condenser	CO-63
C2318	15 MFD 1,000 V. Oil Condenser	CO-51
C2319	7.5 MFD 330 V. AC Condenser	CO-85
C2320	.05 MFD 600 V. Tubular Condenser	CO-32
F2301	3.2 Ampere Slo-Blo Fuse	FU-8
J2301S	Input Jack - Closed Circuit	JA-1
J2302P	Power Connector - Jones P-308-AB	PL-8P
J2303S	Strobo Connector - Jones S-308-AB	PL-75S
J2304S	Signal Connector - Jones S-306-AB	PL-55S
L2301	2 Henry Torroidal Inductance	CH-7
L2302	Swinging Filter Choke - 5 to 25 Henry	CH-18
M2301	AC Voltmeter	ME-1
R2301	2200 ohm 1 Watt Composition Resistor	RE-7
R2302	1 Megohm 1 Watt Composition Resistor	RE-32
R2303	100,000 ohm 1 Watt Composition Resistor	RE-26
R2304	10,000 ohm 1 Watt Composition Resistor	RE-15
R2305	1 Megohm 1 Watt Composition Resistor	RE-32
R2306	680 ohm 1 Watt Composition Resistor	RE-36
R2307	25,000 ohm 10 Watt Wire Wound Resistor	RE-95

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
R2308	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R2309	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R2311	250,000 ohm Carbon Potentiometer	RE-238
R2312	2,200 ohm 1 Watt Composition Resistor	RE-7
R2313	47,000 ohm 1 Watt Composition Resistor	RE-22
R2314	6,800 ohm 1 Watt Composition Resistor	RE-13
R2315	1 Megohm 1 Watt Composition Resistor	RE-32
R2316	680 ohm 1 Watt Composition Resistor	RE-36
R2317	3,000 ohm 50 Watt Wire Wound Resistor	RE-140
R2318	100,000 ohm 2 Watt Composition Resistor	RE-179
R2319	470 ohm 1 Watt Composition Resistor	RE-2
R2320	1,000 ohm 1 Watt Composition Resistor	RE-5
R2321	220 ohm 1 Watt Composition Resistor	RE-1
R2322	500 ohm 50 Watt Adjustable Wire Wound Resistor	RE-221
R2323	10 ohm 1 Watt Composition Resistor	RE-308
R2324	10 ohm 1 Watt Composition Resistor	RE-308
R2325	100 ohm 1 Watt Composition Resistor	RE-260
R2326	100 ohm 1 Watt Composition Resistor	RE-260
R2327	100 ohm 1 Watt Composition Resistor	RE-260
R2328	100 ohm 1 Watt Composition Resistor	RE-260
R2329	100,000 ohm 1 Watt Composition Resistor	RE-26
R2330	150,000 ohm 1 Watt Composition Resistor	RE-27
R2331	1,000 ohm 1 Watt Composition Resistor	RE-5
R2332	15,000 ohm 1 Watt Composition Resistor	RE-16
R2333	220 ohm 1 Watt Composition Resistor	RE-180
S2301	3 PDT Toggle Switch	SW-19
SR2301	Full Wave Selenium Rectifier	SR-5
T2301	Driver Transformer	TR-9
T2302	Output Transformer	1138
T2303	Power Transformer	1186
TF2301	60 Cycle Tuning Fork	846-1
V2301	6SJ7 Vacuum Tube	TU-10
V2302	6F6 Vacuum Tube	TU-8
V2303	6H6 Vacuum Tube	TU-9
V2305	6F6 Vacuum Tube	TU-8
V2306	807 Vacuum Tube	TU-7
V2307	807 Vacuum Tube	TU-7

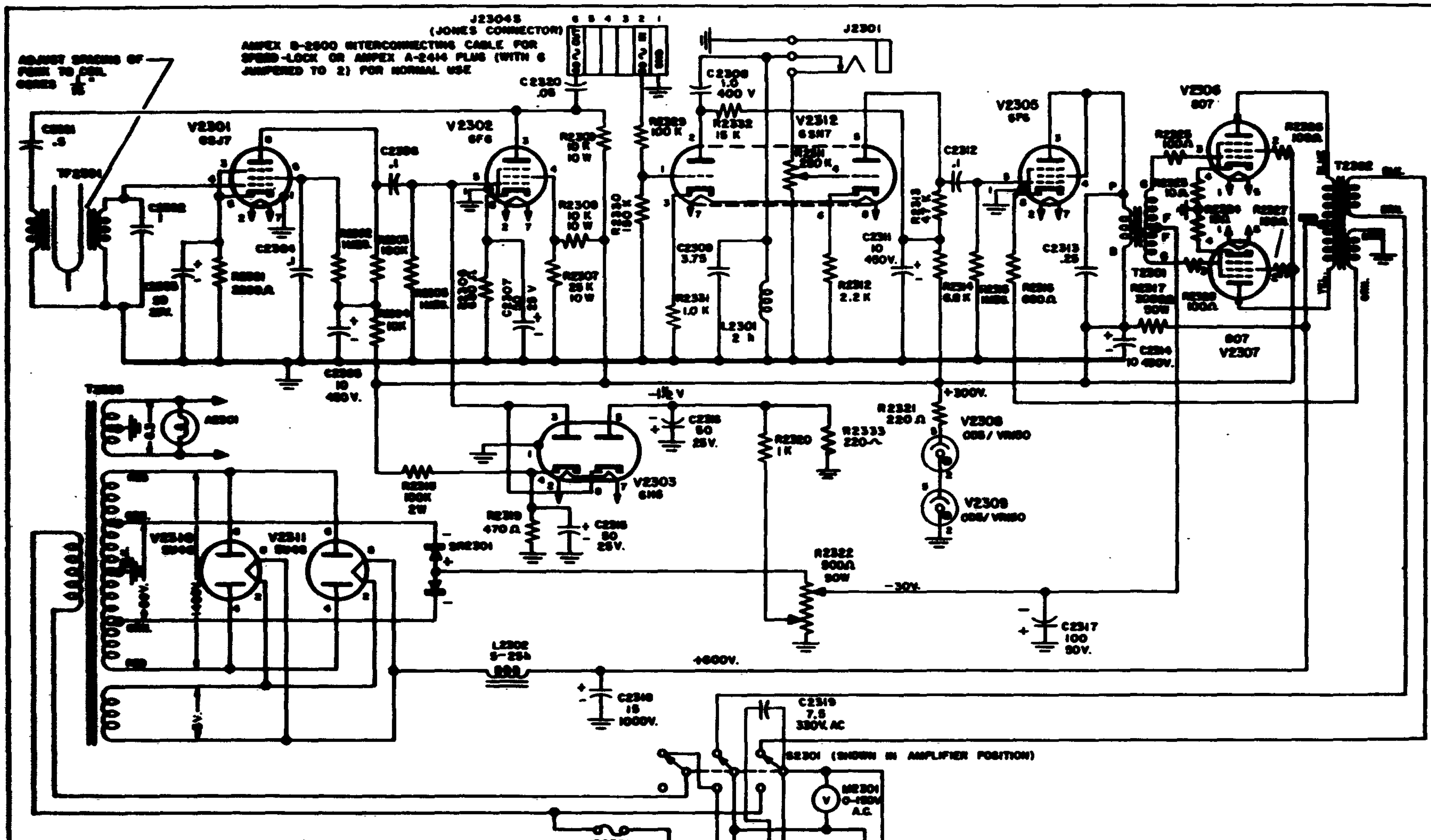
NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
V2308	OD3/VR150 Vacuum Tube	TU-2
V2309	OD3/VR150 Vacuum Tube	TU-2
V2310	5U4G Vacuum Tube	TU-1
V2311	5U4G Vacuum Tube	TU-1
V2312	6SN7 Vacuum Tube	TU-13
	Voltage Control Knob	KN-1

IV. MISCELLANEOUS

	Cannon XL-3-12 Male Cable Connector	PL-33P
	Cannon XL-3-11 Female Cable Connector	PL-1S
	Octal Tube Socket 1 5/16 Mounting	SO-13
	Octal Tube Socket 1 1/2 Mounting	SO-8
	5 Prong Tube Socket	SO-2
	Octal Turret Tube Socket	1208
	Condenser Socket	SO-9
	Fuse Extractor Post	FE-1
	Shaft Lock	SM-1

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!



NOTES:

1. ALL CAPACITORS RATED AT 600V. UNLESS OTHERWISE STATED
2. ALL CAPACITIES IN MFD.
3. ALL RESISTORS RATED AT 1W. UNLESS OTHERWISE STATED
4. ALL VOLTAGES MEASURED WITH 20,000 Ω/VOLT METER
5. POWER FACTOR CORRECTION CAPACITOR—SEE PAGE 3

PRECISION 60 ∿ CAPSTAN MOTOR AMPLIFIER
MODEL 375
AMPEX ELECTRIC CORPORATION

FIG. 1

11-1-51

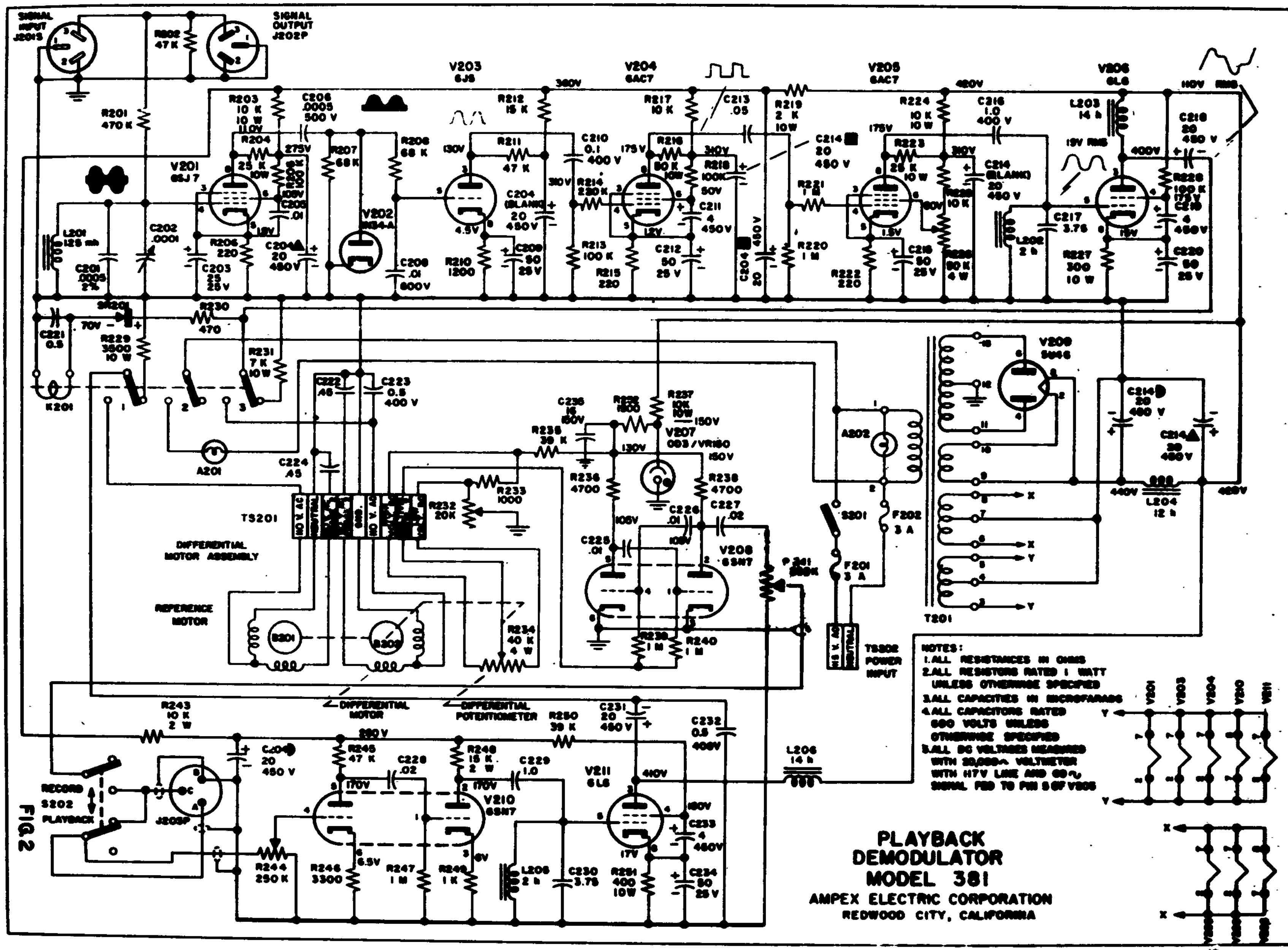


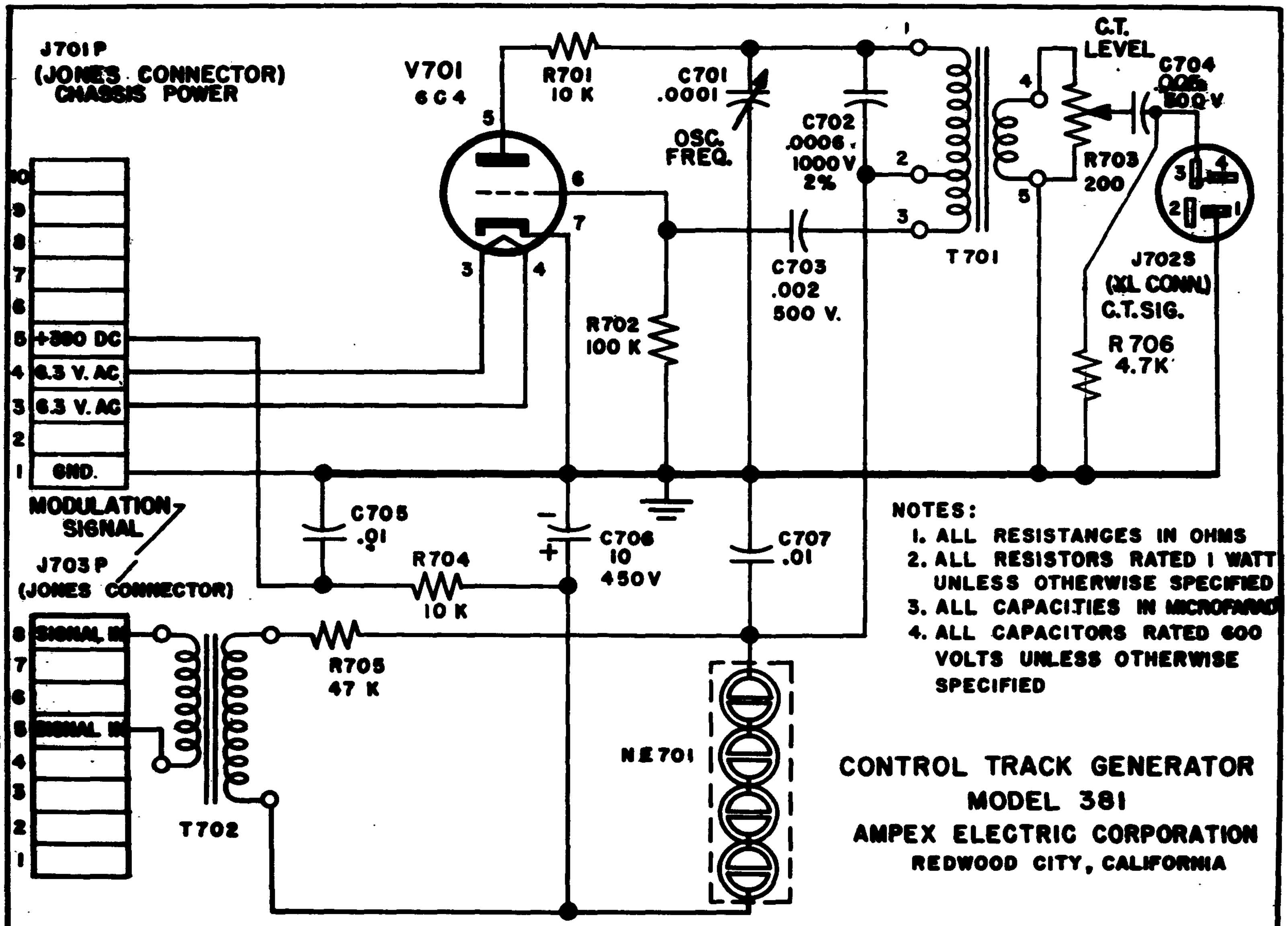
FIG. 2

NOTES:

1. ALL RESISTANCES IN OHMS
2. ALL RESISTORS RATED 1 WATT UNLESS OTHERWISE SPECIFIED
3. ALL CAPACITIES IN MICROFARADS
4. ALL CAPACITORS RATED 600 VOLTS UNLESS OTHERWISE SPECIFIED
5. ALL DC VOLTAGES MEASURED WITH 20,000Ω/V VOLTMETER WITH 117V LINE AND 60~ SIGNAL FED TO PIN 5 OF V205

PLAYBACK DEMODULATOR MODEL 381

AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA



NOTES:
1. ALL RESISTANCES IN OHMS
2. ALL RESISTORS RATED 1 WATT UNLESS OTHERWISE SPECIFIED
3. ALL CAPACITIES IN MICROFARAD
4. ALL CAPACITORS RATED 600 VOLTS UNLESS OTHERWISE SPECIFIED

CONTROL TRACK GENERATOR
MODEL 381
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

FIG. 3
2-9-52

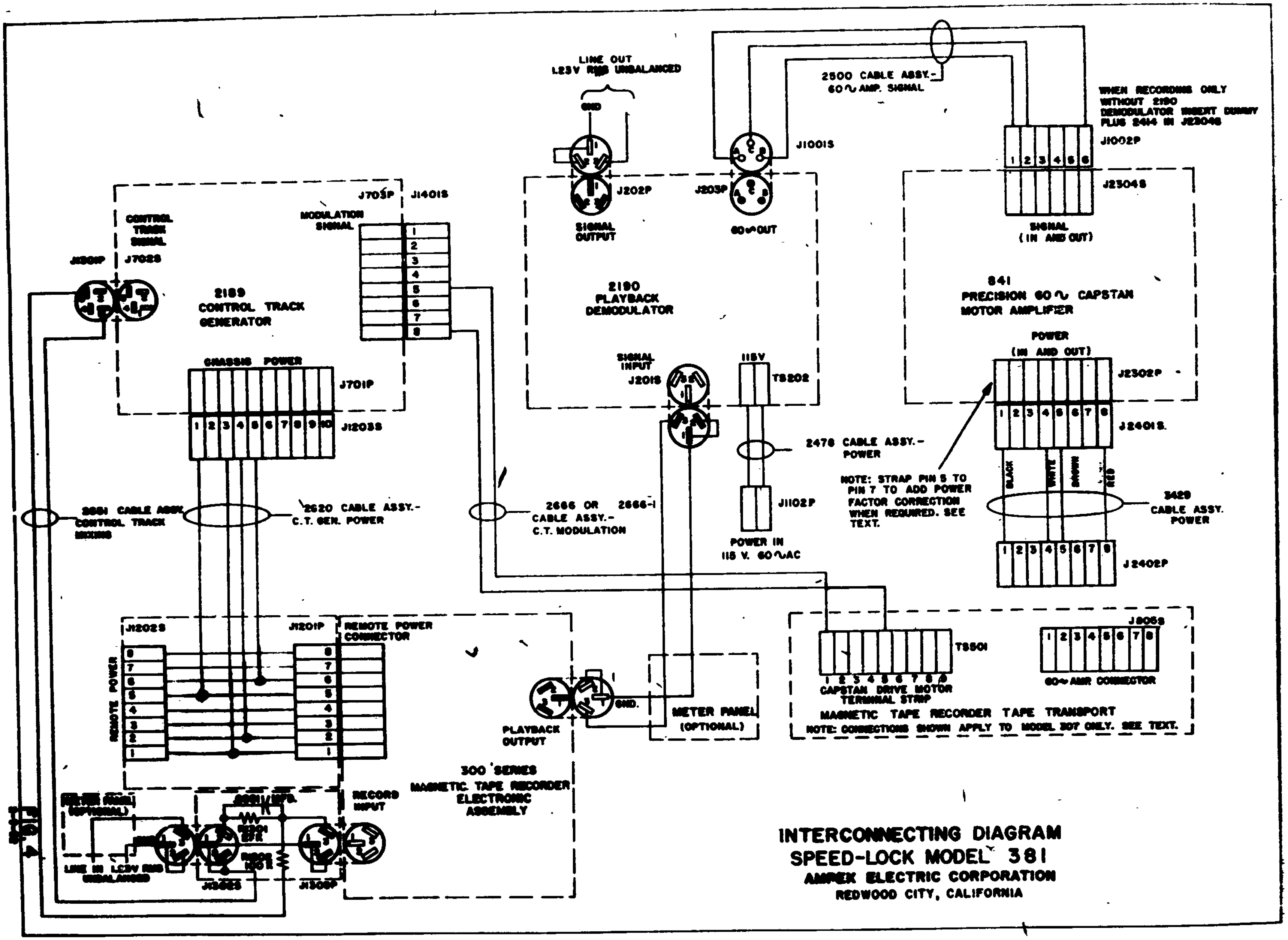

INTERCONNECTING DIAGRAM
SPEED-LOCK MODEL 381
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA
2189 CONTROL TRACK GENERATOR
CONTROL TRACK SIGNAL
J702S
MODULATION SIGNAL
J703P
J1401S
CHASSIS POWER
J701P
J1203S
2620 CABLE ASSY.- C.T. GEN. POWER
CONTROL TRACK MIXING
2190 PLAYBACK DEMODULATOR
LINE OUT 1.23V RMS UNBALANCED
GND
J202P
SIGNAL OUTPUT
J203P
60~OUT
J1001S
2500 CABLE ASSY.- 60~ AMP. SIGNAL
WHEN RECORDING ONLY WITHOUT 2190 DEMODULATOR INSERT DUMMY PLUG 2414 IN J2304S
J1002P
J2304S
SIGNAL (IN AND OUT)
841 PRECISION 60~ CAPSTAN MOTOR AMPLIFIER
POWER (IN AND OUT)
J2302P
J2401S
SIGNAL INPUT
J201S
115V
TS202
2478 CABLE ASSY.- POWER
J1102P
POWER IN 115 V. 60~AC
2666 OR 2666-1 CABLE ASSY.- C.T. MODULATION
NOTE: STRAP PIN 5 TO PIN 7 TO ADD POWER FACTOR CORRECTION WHEN REQUIRED. SEE TEXT.
BLACK
WHITE
BROWN
RED
3429 CABLE ASSY. POWER
J2402P
J1202S
J1201P
REMOTE POWER
REMOTE POWER CONNECTOR
PLAYBACK OUTPUT
GND.
METER PANEL (OPTIONAL)
300 SERIES MAGNETIC TAPE RECORDER ELECTRONIC ASSEMBLY
RECORD INPUT
LINE IN 1.23V RMS UNBALANCED
J1302S
J1303P
TS501
CAPSTAN DRIVE MOTOR TERMINAL STRIP
J305S
60~ AMP. CONNECTOR
MAGNETIC TAPE RECORDER TAPE TRANSPORT
NOTE: CONNECTIONS SHOWN APPLY TO MODEL 307 ONLY. SEE TEXT.

FIG. 4

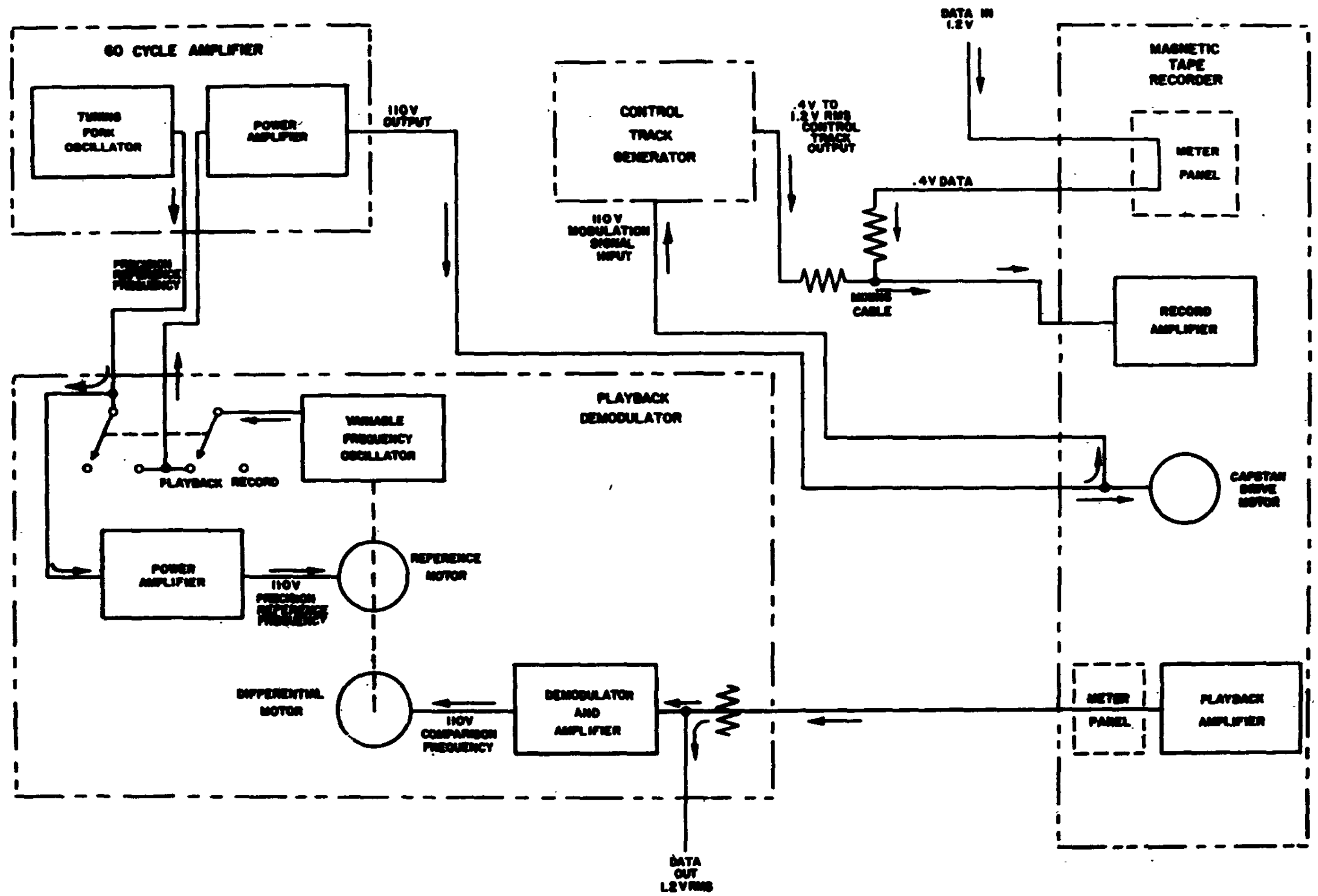


FIG. 5

BLOCK DIAGRAM SPEED LOCK
MODEL 361
AMPEX ELECTRIC CORPORATION
REDWOOD CITY, CALIFORNIA

APPENDIX E

AMPEX MODEL 375 PRECISION 60 CYCLE
CAPSTAN MOTOR SUPPLY

INSTRUCTIONS

APPENDIX F

EAGLE SIGNAL CORP. MULTIFLEX TIMER

INSTRUCTIONS

INSTRUCTION MANUAL
FOR
MODEL 375 60 CYCLE AMPLIFIER

The Ampex Model 375 Amplifier is a 60 cycle oscillator and power amplifier designed to supply constant frequency from unstable power sources. It will deliver 70 watts of 60 cycle power when fed from a power source having a frequency from 50 to 400 cycles.

The Model 375 is composed of two component sections, a precision tuning fork controlled 60 cycle oscillator and a power amplifier, either of which may be used independently. The tuning fork oscillator supplies a 7 volt 60 cycle output (500,000 ohm unbalanced) with a frequency accuracy of 5 parts per million per degree centigrade.

The power amplifier will maintain constant output frequency over a range from 50 to 75 cycles when fed from an external signal generator. The frequency range may be extended to 400 cycles by changing one capacitor. See Operation.

SPECIFICATIONS

<u>Output Power:</u> 70 Watts
<u>Output Frequency:</u> 60 c.p.s. when using tuning fork oscillator
50 to 400 c.p.s. when using external signal generator.
<u>Output Voltage:</u> 0 to 135 volts
<u>Input Power Source:</u> 117 volts, 50 to 400 c.p.s., 275 watts.
<u>Dimensions:</u> Built to mount on standard 19 inch relay rack. Occupies 12-1/4 inches of rack space.
<u>Weight:</u> 60 pounds.
<u>Front Panel Controls:</u>

1. Output voltage control R2311
2. Output voltmeter M2301
3. Output transfer switch, S2301, which allows the load to be fed either through the amplifier or directly from the power line.
4. Indicator lamp, A2301, indicates when power is supplied to the amplifier.
5. Stroboscope supply socket, J2303S, which provides a source of power for a two watt neon lamp.
6. Power Amplifier input jack, J2301, which allows connecting an external signal source to the power amplifier.
7. Fuses for protection of the amplifier.

INSTALLATION

Both power input and power output connections of the Model 375 Amplifier are made with a single eight pin connector J2302P. Pins 1 and 4 are the power line input connections, and Pins 5 and 8 are the amplifier output connections. A four #18 wire cable is required between the 60 cycle amplifier and the tape recorder.

The six pin receptacle J2304S contains the output connections of the tuning fork circuit and the input connections to the power amplifier. Dummy plug #2414 should be inserted in this receptacle except when the Model 375 is used with Model 381 Speed Lock Equipment.

INSTALLATION WITH MODEL 300, 301 and 302 RECORDERS

Input and output connections are made to terminal strip TS-501 mounted on the capstan motor support bracket underneath the Model 300 top plate. In order to accommodate the additional load the two 5 ampere line fuses on the Model 300 Recorder should be increased to 8 amperes.

CONNECTIONS FOR MODEL 300 RECORDER-Serial 1 thru 500.

(1) Remove the strap between Terminals 4 and 5 on TS-501 and move the drive motor solenoid lead from Terminal 4 to Terminal 5.
(2) Pin 1 of the Model 375 connects to Terminal 3 of TS-501.
(3) Pins 4 and 5 of the Model 375 connect through separate wires to Terminal 1 of TS-501. It is necessary to run separate leads as the common impedance of a single lead will cause unnecessary hunting of the capstan drive motor.
(4) Pin 8 of the Model 375 connects to Terminal 5 of TS-501.

CONNECTIONS FOR MODEL 300 RECORDERS - Serial 501 and up.

(1) Remove the strap between Terminals 4 and 5 on TS-501.
(2) Pin 1 of the Model 375 connects to Terminal 4 of TS-501.
(3) Pins 4 and 5 of the Model 375 connect through separate wires to Terminal 1 of TS-501. It is necessary to run separate leads as the common impedance of a single lead will cause unnecessary hunting of the capstan drive motor.
(4) Pin 8 of the Model 375 connects to Terminal 5 of TS-501.
(5) For Recorders using a Bodine Drive Motor (Serial Numbers (600 and up) it is necessary to connect the power factor correction condenser C2319 across the Model 375 output. To do this strap Pin 7 to Pin 5 on the eight pin power connector J2302P.
(6) A slight time interval from 8 to 15 seconds must be observed while the Model 375 warms up.

INSTALLATION WITH MODEL 306 and 307 RECORDERS

Connections from the Model 375 are made at connector J-805S located on the connector panel underneath the top plate. A four #18 wire cable is required, connecting terminals 1, 4, 5, and 8 of the two plugs. In order to accommodate the additional load the two 5 ampere line fuses on the 307 must be increased to 8 amperes. Strap pin 7 to pin 5 on power connector J2302P to connect the power factor correction condenser across the output.

OPERATION

After making the necessary connections, place the output transfer switch in the Amplifier position. This supplies power to the amplifier and connects the load to the amplifier. Adjust the output voltage control for the desired voltage as read on the voltmeter. When supplying power to Ampex Tape Recorders, it is recommended that the voltage be adjusted to 110 volts. Higher voltages will produce excess current drain in the amplifier, decreasing the life of the 807 vacuum tubes. NOTE: The voltage should be adjusted under load conditions only. If the load is removed, the voltage will rise above 150 volts and pin the meter. This will in no way damage the meter as no load voltage is far less than the overload rating of the meter.

To extend the frequency range of the power amplifier above 75 cycles, it is necessary to reduce the value of the Driver Transformer Tuning Condenser, C2313. To obtain optimum results at 400 cycles, remove the condenser entirely.

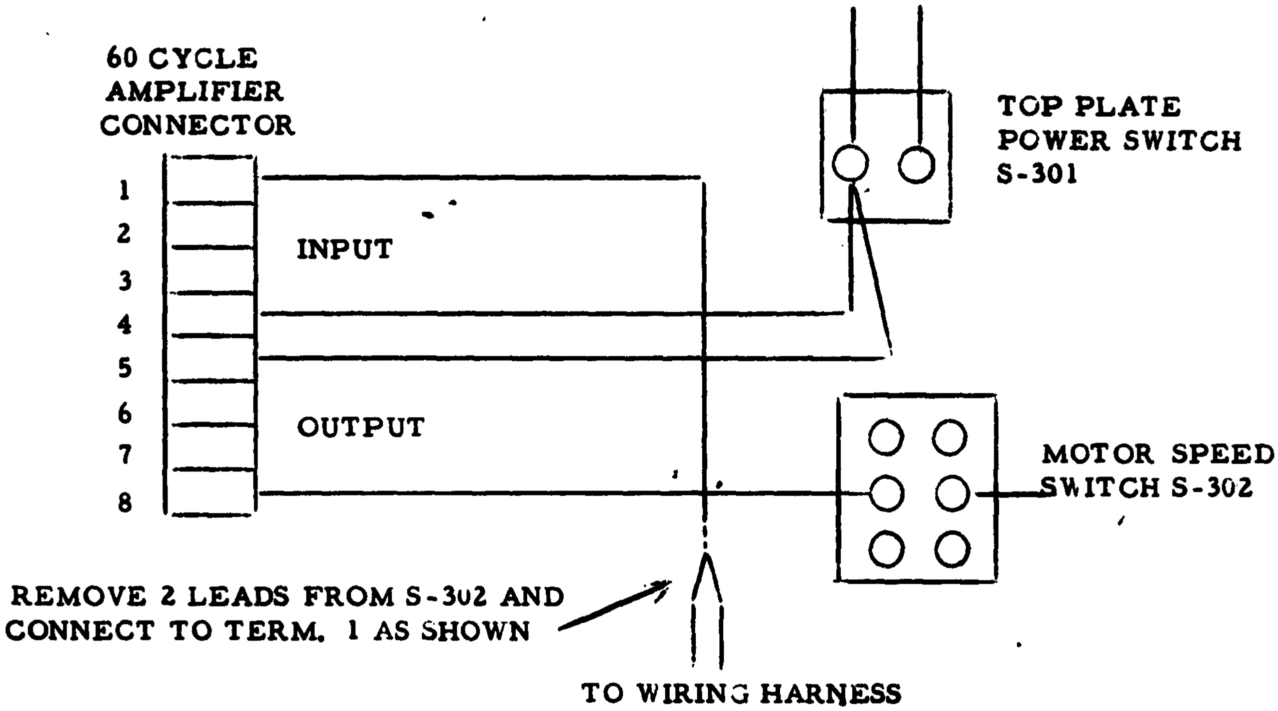
ADJUSTMENTS

The following adjustments have been made at the factory prior to shipment. Further adjustments are unnecessary except as required in routine maintenance.

1. OUTPUT TUBE BIAS ADJUSTMENT. The bias on the 807 output tubes V2306 and V2307 should be adjusted to - 30 Volts by an adjustable tap on Resistor R2322 (located underneath chassis).

2. TUNING FORK OSCILLATOR LEVEL. The Tuning Fork Oscillator level is determined by the bias on the Diode Limiter V2303. Connect a vacuum tube voltmeter to Pin 5 of V2303 and chassis ground. Adjust the appropriate tap on Resistor R2322 to provide -1 1/2 Volts bias.

INSTALLATION OF MODEL 375 AMPLIFIER WITH MODEL 400 AND 401 RECORDERS



1. Disconnect the two wires from the swinger of the motor speed switch S-302. This switch has two swingers, but only one has two wires connected to it. Connect these two wires to a line leading to Pin 1 of the Model 375 input-output connector J2302P.
2. Connect Pin 8 of the Model 375 to this swinger.
3. Refer to Fig. 3 of the 400 or 401 Instruction Book. Connect Pins 4 and 5 of the Model 375 through separate leads to the top plate power switch S301. There are two terminals on S301, the correct one being the terminal that connects to plug S-305P where the cable to the electronics connects. This terminal can be identified by tracing continuity from J-305P to the switch with the switch in the "off" position.
4. It is necessary to increase the size of the top plate fuse F-102 to 5 amperes.
5. The power factor correction capacitor, C-2319, in the 60 cycle amplifier is not necessary with the Model 400 or 401.
6. The output voltage of the 60 cycle amplifier should be adjusted to 110 volts. Setting up higher voltages will produce excessive current drain in the amplifier.

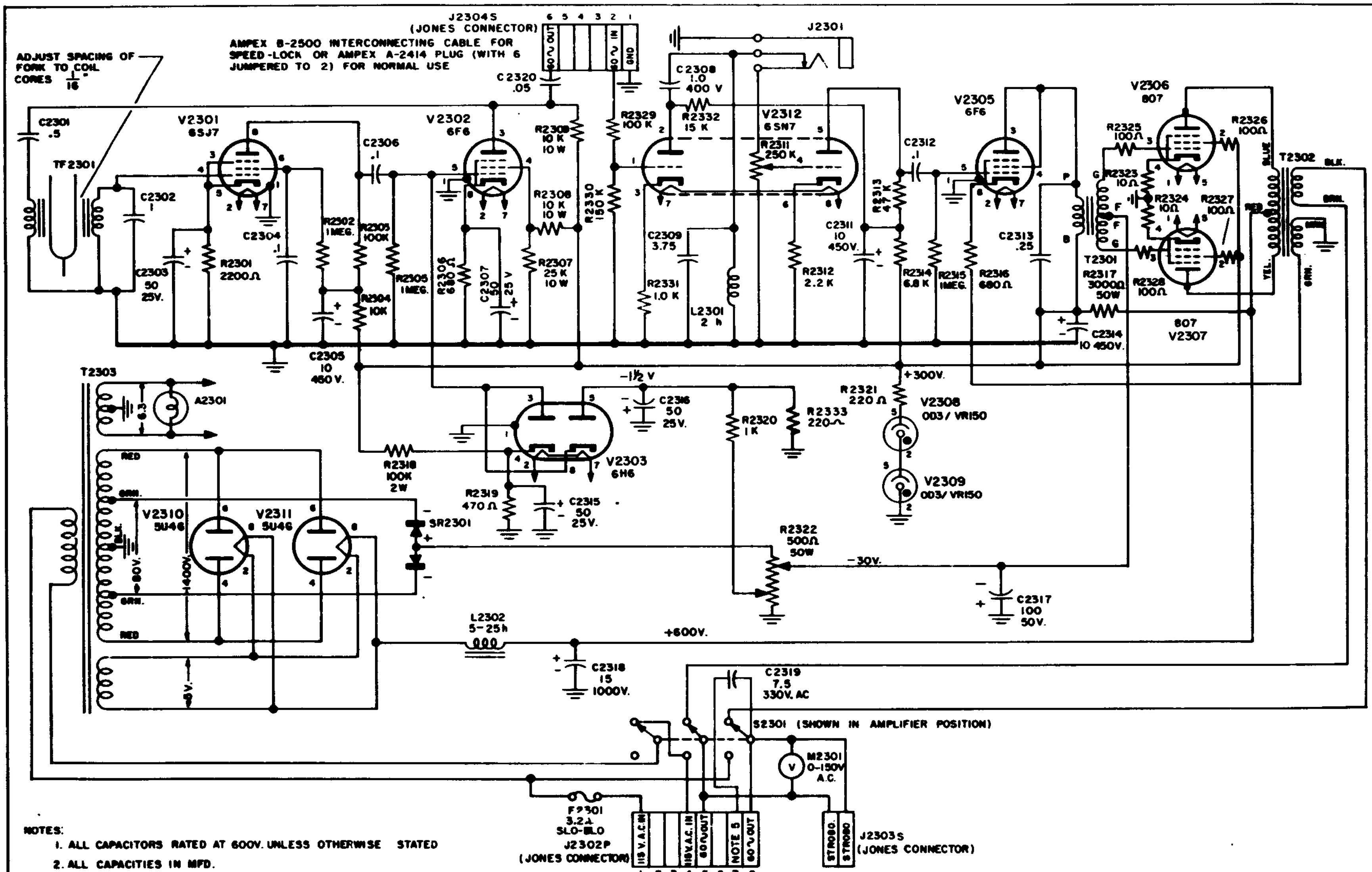
Schematic Reference Number	Description	Ampex Catalog Number
	III. 60 CYCLE AMPLIFIER - Catalog #841	
A2301	6-8 V. Panel Lamp - Bayonet Base	LA-2
	Red Pilot Lamp Base	DL-3
C2301	.5 MFD 600 V. Tubular Condenser	CO-36
C2302	1.0 MFD 400 V. Tubular Condenser	CO-37
C2303	50 MFD 25 V. Electrolytic Condenser	CO-60
C2304	.1 MFD 600 V. Tubular Condenser	CO-33
C2305	10 MFD 450 V. Electrolytic Condenser	CO-55
C2306	.1 MFD 600 V. Tubular Condenser	CO-33
C2307	50 MFD 25 V. Electrolytic Condenser	CO-60
C2308	1.0 MFD 400 V. Tubular Condenser	CO-37
C2309	3.75 MFD 330 V. AC Condenser	CO-84
C2311	10 MFD 450 V. Electrolytic Condenser	CO-55
C2312	.1 MFD 600 V. Tubular Condenser	CO-33
C2313	.25 MFD 600 V. Tubular Condenser	CO-35
C2314	10 MFD 450 V. Electrolytic Condenser	CO-55
C2315	50 MFD 25 V. Electrolytic Condenser	CO-60
C2316	50 MFD 25 V. Electrolytic Condenser	CO-60
C2317	100 MFD 50 V. Electrolytic Condenser	CO-63
C2318	15 MFD 1,000 V. Oil Condenser	CO-51
C2319	7.5 MFD 330 V. AC Condenser	CO-85
C2320	.05 MFD 600 V. Tubular Condenser	CO-32
F2301	3.2 Ampere Slo-Blo Fuse	FU-8
J2301S	Input Jack - Closed Circuit	JA-1
J2302P	Power Connector - Jones P-308-AB	PL-8P
J2303S	Strobo Connector - Jones S-308-AB	PL-75S
J2304S	Signal Connector - Jones S-306-AB	PL-55S
L2301	2 Henry Torroidal Inductance	CH-7
L2302	Swinging Filter Choke - 5 to 25 Henry	CH-18
M2301	AC Voltmeter	ME-1
R2301	2200 ohm 1 Watt Composition Resistor	RE-7
R2302	1 Megohm 1 Watt Composition Resistor	RE-32
R2303	100,000 ohm 1 Watt Composition Resistor	RE-26
R2304	10,000 ohm 1 Watt Composition Resistor	RE-15
R2305	1 Megohm 1 Watt Composition Resistor	RE-32
R2306	680 ohm 1 Watt Composition Resistor	RE-36
R2307	25,000 ohm 10 Watt Wire Wound Resistor	RE-95

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Schematic Reference Number	Description	Ampex Catalog Number
R2308	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R2309	10,000 ohm 10 Watt Wire Wound Resistor	RE-90
R2311	250,000 ohm Carbon Potentiometer	RE-238
R2312	2,200 ohm 1 Watt Composition Resistor	RE-7
R2313	47,000 ohm 1 Watt Composition Resistor	RE-22
R2314	6,800 ohm 1 Watt Composition Resistor	RE-13
R2315	1 Megohm 1 Watt Composition Resistor	RE-32
R2316	680 ohm 1 Watt Composition Resistor	RE-36
R2317	3,000 ohm 50 Watt Wire Wound Resistor	RE-140
R2318	100,000 ohm 2 Watt Composition Resistor	RE-179
R2319	470 ohm 1 Watt Composition Resistor	RE-2
R2320	1,000 ohm 1 Watt Composition Resistor	RE-5
R2321	220 ohm 1 Watt Composition Resistor	RE-1
R2322	500 ohm 50 Watt Adjustable Wire Wound Resistor	RE-221
R2323	10 ohm 1 Watt Composition Resistor	RE-308
R2324	10 ohm 1 Watt Composition Resistor	RE-308
R2325	100 ohm 1 Watt Composition Resistor	RE-260
R2326	100 ohm 1 Watt Composition Resistor	RE-260
R2327	100 ohm 1 Watt Composition Resistor	RE-260
R2328	100 ohm 1 Watt Composition Resistor	RE-260
R2329	100,000 ohm 1 Watt Composition Resistor	RE-26
R2330	150,000 ohm 1 Watt Composition Resistor	RE-27
R2331	1,000 ohm 1 Watt Composition Resistor	RE-5
R2332	15,000 ohm 1 Watt Composition Resistor	RE-16
R2333	220 ohm 1 Watt Composition Resistor	RE-180
S2301	3 PDT Toggle Switch	SW-19
SR2301	Full Wave Selenium Rectifier	SR-5
T2301	Driver Transformer	TR-9
T2302	Output Transformer	1138
T2303	Power Transformer	1186
TF2301	60 Cycle Tuning Fork	846-1
V2301	6SJ7 Vacuum Tube	TU-10
V2302	6F6 Vacuum Tube	TU-8
V2303	6H6 Vacuum Tube	TU-9
V2305	6F6 Vacuum Tube	TU-8
V2306	807 Vacuum Tube	TU-7
V2307	807 Vacuum Tube	TU-7

NOTE: ORDER PARTS BY AMPEX CATALOG NUMBER ONLY!

Reference Number	Description	Ampex Catalog Number
V2308	OD3/VR150 Vacuum Tube	TU-2
V2309	OD3/VR150 Vacuum Tube	TU-2
V2310	5U4G Vacuum Tube	TU-1
V2311	5U4G Vacuum Tube	TU-1
V2312	6SN7 Vacuum Tube	TU-13
	Voltage Control Knob	KN-1



NOTES:

1. ALL CAPACITORS RATED AT 600V. UNLESS OTHERWISE STATED
2. ALL CAPACITIES IN MFD.
3. ALL RESISTORS RATED AT 1W UNLESS OTHERWISE STATED
4. ALL VOLTAGES MEASURED WITH 20,000 Ω / VOLT METER
5. POWER FACTOR CORRECTION CAPACITOR — SEE PAGE 3

PRECISION 60∿ CAPSTAN MOTOR AMPLIFIER

MODEL 375

AMPEX ELECTRIC CORPORATION

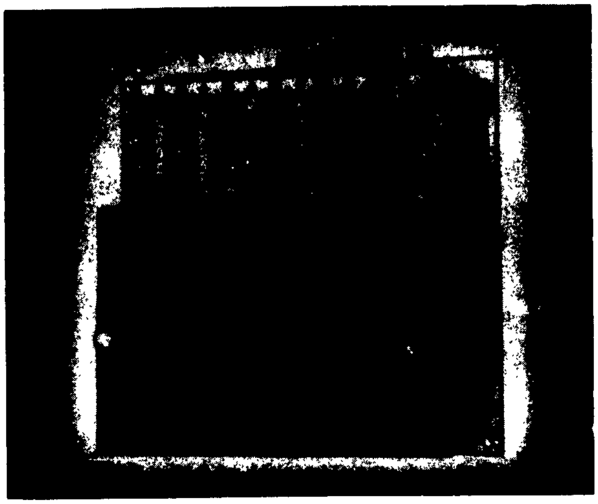
FIG. I

11-1-81

MULTIFLEX TIMER INSTRUCTIONS

BULLETIN 130 C

MARCH 1951



GENERAL

Each Multiflex Timer is custom built with features required for a given application. This bulletin lists general information applicable to their installation, operation and maintenance.

MOUNTING

Timers should always be mounted in a vertical position and enclosed in a suitable housing to keep the mechanism clean.

WIRING CIRCUITS

ARRANGEMENT No. 1 (Figs. 1 and 2)

A majority of the timers are ordered with the clutch solenoid assembled so that the contacts are spring held in their "reset" position with the clutch disengaged. Energizing the clutch solenoid engages the clutch and lowers the contact trip bars to ride on a sliding plate. The motor then drives the sliding plate downward. The contacts open or close as the trip bars drop off the downward moving plate in accordance with their sequence or time settings. De-energizing the clutch solenoid disengages the clutch and raises the trip bars allowing the sliding plate to reset by spring action to its original position. This cycle of operation is designated by Arrangement No. 1.

When timers are operated by means of a 2-wire pilot control (See Fig. 1) "no voltage" reset is provided. This means that the timer will reset and will automatically start over from "0" upon return of voltage. When timer is operated from a "start" push button or equivalent three-wire pilot control (See Fig. 2) "no voltage" protection is provided. This means that the timer will reset and not start upon return of voltage unless the "start" button is again operated.

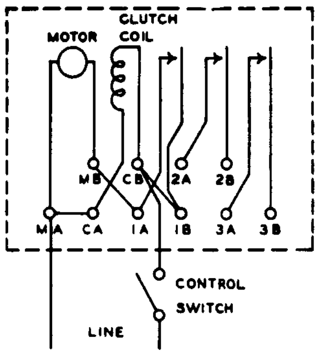


Figure 1

ARRANGEMENT No. 1 USING MAINTAINED CONTROL SWITCH

The control switch must remain closed longer than the time interval when connected as shown above. Closing control switch starts timing interval. Opening the control switch resets timer.

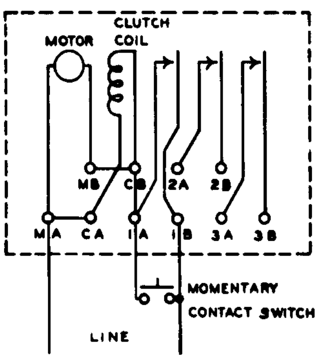


Figure 2

ARRANGEMENT No. 1 USING MOMENTARY CONTROL SWITCH

A momentary contact pilot switch to start timer is connected as shown above. Contact No. 1 (L. H. Side) is used as a holding circuit. Timer resets when holding circuit opens.

ARRANGEMENT No. 2 (Fig. 3)

The timers assembled for arrangement No. 2 have the clutch solenoid action reversed from that of arrangement No. 1. Voltage failure during timing does not reset timer.

The clutch solenoid must be energized to disengage clutch and reset timer. Timing starts when the control switch opens.

The control switch may be momentary or maintained and wired as shown in Fig. 3.

NOTE: All references in this bulletin to "energizing" or closing clutch solenoid will be changed to "de-energizing" or opening clutch solenoid when referring to Arrangement No. 2.

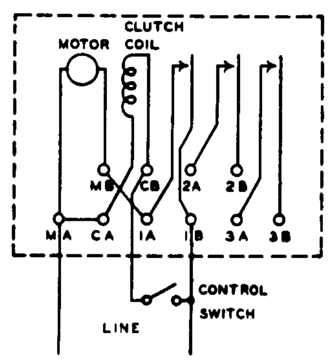


Figure 3

EAGLE SIGNAL CORPORATION

3M 4-51 MP PRINTED IN U.S.A.

MULTIFLEX TIME SETTINGS

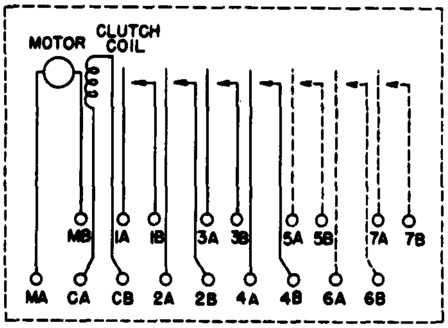


Figure 4

Terminal arrangement for 4, 5, 6 and 7 contact Multiflex Timers.

Each timer contact has a linear calibrated scale 1⅞" long. It is calibrated in increments corresponding to the gearing in the timer.

Each contact has an "ON" or "CLOSE" indicator and an "OFF" or "OPEN" indicator. The settings of these indicators along the linear scale determine the point at which the contact closes or opens. Each contact can be set to close and open once during the timing cycle.

MINIMUM INITIAL SETTINGS

The indicators can be set at the "0" end of the scale when the contact operation is to occur immediately at the start of the cycle. Otherwise, the setting should not be made less than ½ of a linear scale division (1/64") away from "0". This is to prevent the contact operation from occurring immediately.

MINIMUM INTERVAL BETWEEN CONTACT OPERATIONS

It is not practical to attempt setting two contact operations on the Multiflex Timer so that they will occur simultaneously. One operation is always apt to occur ahead or behind the other.

MINIMUM "ON" TIME

The "OFF" indicator should always be set a minimum of ¼ of a linear scale division later than the "ON" interval to insure obtaining a positive contact closure.

OMITTING "ON" OPERATION

In instances where it is desired to prevent a contact from closing during a cycle of operation without disconnecting the wire to the contact, adjust the "OFF" indicator ahead or above the "ON" indicator on timing scale.

VERNIER ADJUSTMENTS

Timers with vernier knobs on the indicators provide an easier and more accurate method of adjusting time settings. One turn of the vernier knob advances the indicator one linear scale division. One calibration on the vernier knob is equal to 0.1 of one linear scale division.

ACCURACY

Timing accuracy between settings of contact operations depends primarily upon accuracy with which indicators are adjusted and set.

Repeated operations with a given indicator setting will be extremely consistent since the Multiflex is synchronous motor driven.

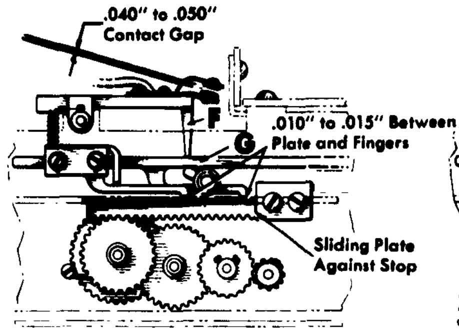
A maximum of 1% of full scale may be caused when starting the timer. This is due to (a) backlash in gearing; (b) engagement of clutch; (c) motor acceleration. This error, at the start of the cycle, will affect the timing of those contacts set to close at "0". The errors mentioned in this paragraph do not apply to contact closure intervals when the "ON" and "OFF" intervals are set beyond ½ scale division from "0". In this latter case, timing should be consistent to within ¼ of 1% of full scale on repeated operations when the indicators are not reset between operations.

MAINTENANCE

The Multiflex Timer is carefully adjusted at the factory. No further adjustment or maintenance is ordinarily required during its service. Should the timer fail in operation the following check list is furnished to aid in determining the malfunction.

CAUTION: It is not advisable to dismantle timers in the field without a thorough knowledge of their movement and the adjustments involved. Return all timers to EAGLE SIGNAL CORPORATION, Moline, Illinois, for repair and overhaul.

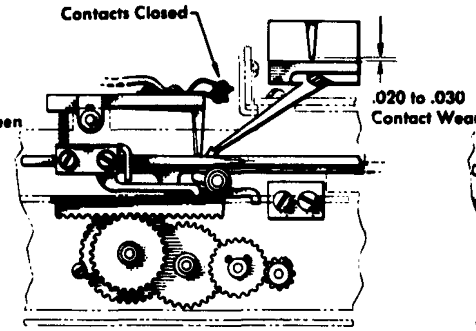
MULTIFLEX MAINTENANCE



OFF-RESET POSITION

a. Solenoid De-energized.
b. Timer Clutch Open.
c. Contact Fingers Raised.
d. Sliding Plate Against Stops.

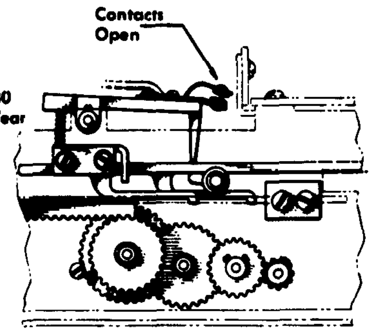
Figure 5



TIMING POSITION (Contacts Closed)

a. Solenoid Energized.
b. Motor Running.
c. Clutch Engaged.
d. Contacts Closed.

Figure 6



TIMING POSITION (Contacts Open)

a. Solenoid Energized.
b. Motor Running.
c. Clutch Engaged.
d. Contacts Open.

Figure 7

CHECK LIST FOR CAUSES OF MALFUNCTION

1. **Motor Fails to Operate**—Connect proper voltage to timer at terminals MA and MB. If motor fails to run, replacement is required.

2. **Clutch Solenoid Fails to Operate**—Connect proper voltage to terminals CA and CB. Clutch solenoid armature should close. If it does not check coil for open circuit and/or free movement of all linkage.

3. **Timer Fails to Reset When Clutch Solenoid Is Re-energized**—
   a. Sliding plate must reset freely. Pull plate down against its bottom stop by hand. It should "snap back" with sufficient force when released. If it does not, refer to instructions of Fig. 9, Page 4 for correcting.
   b. Armature return spring should pull armature down against its stop and the clutch must be open.
   c. Contact trip levers must clear sliding plate by approximately .010" to .015". (See Fig. 5).

4. **Contacts Fail to Close**—
   a. Contacts should assume position shown in Figs. 5, 6 and 7 during cycle of operation.
   b. In reset position (Fig. 5) bakelite fingers F should ride on trip bars G. When lifted away from trip bars G by hand, they should "snap back" with considerable force. Likewise, when in the contact closed position (Fig. 6), the top contact should "snap back" to ride on the bottom contact when lifted by hand and released. There should be approximately 2 ounces pressure on the contacts when closed. If contact fingers are found to have inadequate pressure, the contact lead wires may be restraining the free movement of the fingers. Reposition wires so they allow free movement.
   c. If current does not pass through contacts when closed with proper pressure, scrape contact surfaces clean with knife. Contacts are coin silver which do not require cleaning under ordinary conditions.

5. **Timing Does Not Agree With Indicator Setting**—
   a. On timers with vernier knobs, when vernier knob is set at "0" timing, linear indicator must coincide with "0" calibration on linear scale. This can be adjusted by loosening its screw and shifting indicator up or down as required.
   b. Turn vernier knob 4 or 5 divisions down the scale.
   c. Hold armature closed by hand so that trip bars ride on sliding plate. The plate should be reset against its top stop.
   d. Turn vernier knob back toward "0". Trip lever should drop off edge of plate 1 to 1½ vernier scale divisions before "0". (The 1 to 1½ division setting from "0" is to compensate for delay error in starting plate at beginning of timing cycle). If correction is required, turn nut D (Fig. 8) to advance or retard trip bar G in relation to time setting.
   e. On timers with thumb screw adjustments in place of verniers, set indicator at ¼ of a division from "0", and close armature by hand. Trip bar should just drop off edge of plate. Adjust nut D if necessary.

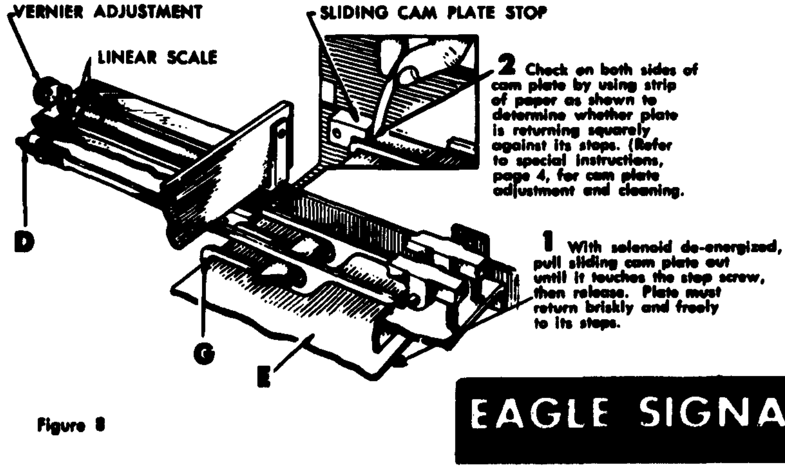


Figure 8

LUBRICATION

Lubrication is not ordinarily required. If the timer is removed for servicing, a drop of light grade instrument oil can be placed on each bearing.

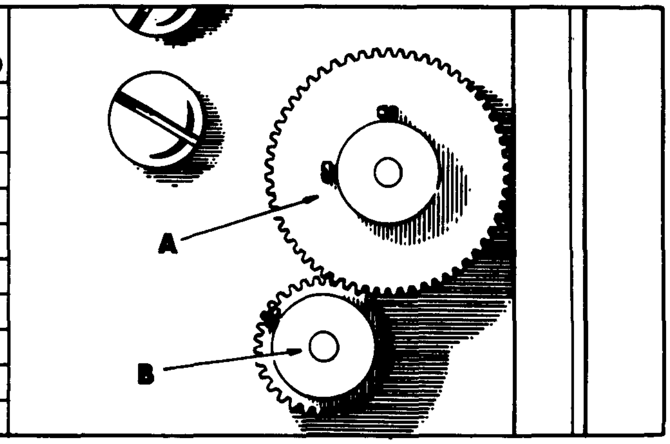
The synchronous motors have a sealed in supply of lubrication which should last several years depending upon the service. On timers having motors with the external coil and forged brass gear housing, the screw in the side of the gear housing may be removed to replenish the oil supply. Inject two cubic centimeters of oil obtained from EAGLE SIGNAL CORPORATION and replace screw. Motors with enclosed coils cannot be reoiled.

Do not lubricate the sliding plate nor its channels.

SPECIAL INSTRUCTIONS

Time Scales

Time Scale	Cat. Design.	Motor RPM	Gear A No. Teeth (Top Gear)	Gear B No. Teeth (Bot. Gear)
30 Secs.	C	10	40	20
60 Secs.	D	10	30	30
120 Secs.	E	10	20	40
5 Min.	G	1	40	20
10 Min.	H	1	30	30
15 Min.	J	1	24	36
30 Min.	L	1	15	45
60 Min.	M	1*	30	30
120 Min.	O	1*	20	40
5 Hr.	P	1*	10	50



*Motor has an accessory 1-6 reducer.

Table I

SPECIAL INSTRUCTIONS

CHANGING GEAR RATIO

The two gears on right side of timer can be changed to provide different time ranges in accordance with the chart designated as Table 1. Use a multiplier to make time scale read in seconds or minutes after changing the gears.

EXAMPLE: Assume the timer has a 10 minute scale. The new gear ratio gives a 30 minute timing cycle. The multiplier will then be 3.

When the use of a multiplier is not satisfactory, new linear scales may be purchased corresponding to the new gearing. When installed, this will necessitate rechecking the timer as explained in Check List, Item 5.

CORRECTION FOR FAILURE OF PLATE TO RESET

1. The side plates containing the channels in which the plate E, Fig. 8, slides may have been shifted by rough handling causing the plate to bind. When it is in its top position, you should be able to shift it laterally a few thousandths of an inch if it has sufficient side clearance. Pull the plate to its bottom position and check for side clearance again. If it is tight in either position, loosen side plate mounting screws in bottom plate. Tap side plate outward lightly and retighten screws.

2. The gearing or the sliding clutch sleeve (on L.H. Clutch Disc) may become dirty so that they do not rotate freely.

To clean clutch sleeve, place a few drops of carbon tetrachloride on each end of sleeve. Rotate the clutch sleeve by moving the sliding plate back and forth by hand. Reoil with a drop of light grade instrument oil on each end of sleeve. Clean the gearing with a brush but do not oil.

3. If the sliding plate channels in the side plates are dirty, clean by removing the sliding plate.

To remove sliding plate, release stop screw from the end of the plate channel in the right side plate. Remove sliding plate by pulling it out of its channels. Clean the plate and the channels in the side plates using carbon tetrachloride and a stiff bristled brush.

To replace plate, follow instructions in Fig. 9.

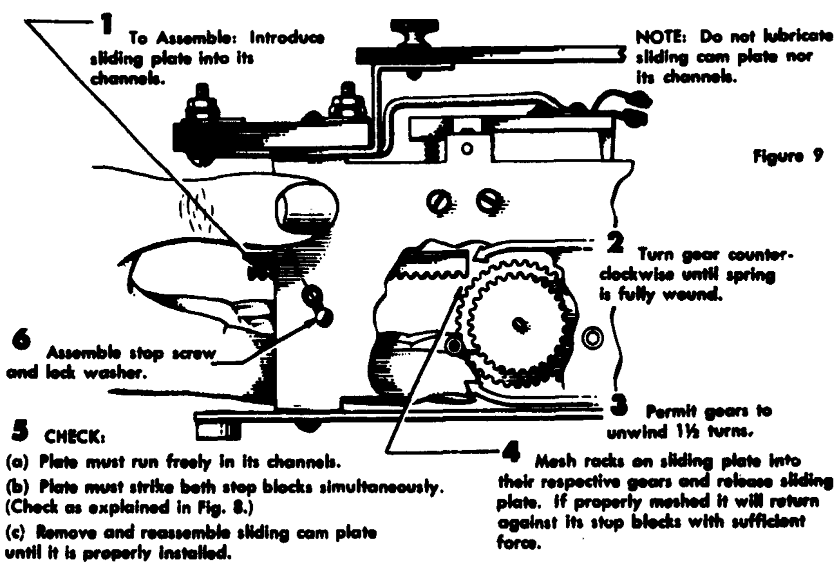


Figure 9