INSTRUCTION MANUAL

MODEL 641

STEREOPHONIC DISK RECORDING SYSTEM

Serial No.______

Fairchild Recording Equipment Corporation
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SECTION I

SPECIFICATIONS (Each channel, unless otherwise specified)

INPUT IMPEDANCE	600Ω
INPUT LEVEL REQUIREMENTS	-5 dbm to +15 dbm for 4.3 cm/sec. stereo velocities or 6.1 cm/sec. lateral velocity (RCA 12-5-49 Test Record).
INPUT ATTENUATORS	20 steps, 1 db/step
FREQUENCY RESPONSE1)	±2 db 30 cycles to 15 kc (see graph for typical response).
CHANNEL-TO-CHANNEL SEPARATION2)	Better than 20 db, 20 cps to 10 kc.
NOISE LEVEL2)	65 db below 4.3 cm/sec simultaneous stereo velocities, or 6.1 cm/sec lateral velocity (RCA 12-5-49 Test Record).
TOTAL RMS HARMONIC DISTORTION2)	Less than 0.5% at 14 cm/sec. (1 kc to 15 kc), and at 2-mil amplitude (30 cps to 1 kc).
DIFFERENCE TONE INTERMODULATION2)	Less than .15% 14 kc and 14.05 kc at 30 cm/sec.
VERTICAL TRACKING ANGLE	$20^\circ \pm 1^\circ$
STYLUS	Tapered shank (heated)
POWER REQUIREMENTS	117 V, 12A or 220/230V, 6A.
MECHANICAL FEATURES	Suction nozzle, advance ball, and stylus heat attachment are permanent parts of the cutter-head.
INSTALLATION	The unit is self-contained, no wiring except input and monitor leads required. Fairchild supplies all plug-in-interconnect cables.
MECHANICAL DIMENSIONS	Cutterhead: Standard 1-1/8" centers (see outline drawing). Adapters available for most cutting lathes. Power Amplifier: Standard 19" rack mounting, 17-1/2" vertical rack space, 11" depth behind panel. Power Supply: Standard 19" rack mounting, 14" vertical rack space, 11" depth behind panel.
WEIGHT	Cutterhead 3-1/2lbs. Power Amplifier, Power Supply, and Beta Amplifier approximately 300 lbs.

TUBE COMPLEMENT	644	10-12BH7; 4-4CX250B; 1-12AT7 1-OA2;
	643	1-12BH7; 2-12AX7; 2-6CB6; 2-6AL5

NOTE: 1) Measured by light pattern.
2) Measured at the output of feedback monitor.

SECTION II

BASIC SYSTEM DESCRIPTION

1. GENERAL DESCRIPTION

The Model 641 Stereophonic Disk Recording System is designed for cutting two independent stereophonic channels into one record groove. The system is self-contained, incorporating all mechanical and electrical elements necessary to accomplish the recording of stereo disks. See block diagrams in Figs. 1, 2 and 3. In addition to stereo disks, the unit is also suitable for cutting commercial monophonic (lateral) disks as well as compatible records employing the UNI-GROOVE technique. The UNI-GROOVE technique is a special cutting procedure where the vertical components of the stereo signal is reduced in amplitude at frequencies below 100, 200 or 300 cps. by choice, at a rate of 6 db/oct.

The two main advantages of this procedure are improved bass reproduction for a given playing time and increased compatibility. A record cut using this technique will retain its stereo information even after extensive playing with monophonic cartridges. Monophonic playback will result in same quality as LP records.

The system consists of four basic parts:

Model 642 Cutterhead
Model 643 Beta Amplifier
Model 644 Power Amplifier
Model 645 Power Supply

2. MODEL 642 CUTTERHEAD

The Model 642 Cutterhead is a single armature, moving-coil type. Fig. 4 shows the basic magnetic structure of this Cutterhead using a single non-magnetic armature. There are two independent electrical windings wound onto the armature. Mechanically, this Cutterhead is of the vertical-lateral type.

The motion is produced by feeding current into one or both of the coils placed in the magnetic gaps. The polarity of the magnetic poles alternates in order to produce in-phase motion from either side of each coil. This moving-coil assembly uses only high-temperature materials and with reasonable care should last indefinitely. See Fig. 5 for basic construction.

The basic Cutterhead without feedback resonates at approximately 1,300 cycles and 16 kc and is free of spurious resonances. Both the primary resonance at 1,300 cycles as well as the secondary resonance at 16 kc are damped by electrical feedback. The electrical feedback pickups are placed near the cross-shaped stylus chuck. The pickups consist of small pancake-shaped coils mounted onto a miniature coaxial terminal. Fig. 6 shows the outside view of the Cutterhead identifying the various functional elements which comprise the Cutterhead.

3. MODEL 643 BETA AMPLIFIER - FEEDBACK SYSTEM

The function of the Beta Amplifier is to convert the impulses from the feedback pickups into an appropriate audio voltage proportional to amplitude below 500 cycles and to velocity above 500 cycles, and to amplify this voltage to an appropriate level before it is fed back to the Power Amplifier, Model 644. See Fig. 7, block diagram of Beta Amplifier.

The feedback transducers in the 642 Cutterhead which convert motional data into electrical are small inductors (L-1 and L-2) whose instantaneous inductance is influenced by their proximity to the small metallic discs mounted on the armature. A radio frequency current, originating from the 10 MC oscillators in the Beta Amplifier, flows through these inductors; the RF voltage developed across them is dependent on their instantaneous inductance. This RF voltage is fed to a detection circuit in the Beta Amplifier via the coaxial cables. The detectors convert the RF voltages to DC voltages whose magnitude is linearly related to armature displacement. As regards the lateral system, two transducers are used in push-pull, whereas in the vertical only one is used.

The lateral part of the system will be described in detail. See circuit diagram of Model 643 Beta Amplifier, Fig. 8. After detection, the AC (audio) component is coupled to the grid of the first tube of a 3-stage amplifier comprising V503A, V503B, V504A. This 3-stage amplifier is highly stable by virtue of inverse feedback via R519, R516, and C517. As mentioned above this RC network also provides a desired frequency characteristic for the complete system.

The RF Oscillator comprises V502, T501, C509, C510, and the transducer inductors, L1 and L2, modified by the coaxial cables and associated circuitry. The frequency of oscillation is determined principally by L504, C509, C510, L1 and L2. R508 and R509 preclude high-frequency parasitic oscillations. The Oscillator is stabilized by an AVC circuit comprising R505, R506, R507, C511, C512, CR501, and CR502. Neon tube V505 provides the reference level for oscillation. C513, and C514 are RF bypass capacitors. Diode CR501 rectifies the RF level appearing across L 505. This rectified DC voltage across R506 after filtering by C511 is added algebraically to the reference voltage developed across R507 and applied to the grid of the oscillator tube V502, as a means of controlling the gain and thereby maintaining the RF voltage across L504 substantially constant. Diode CR502 is instrumental in keeping the grid somewhat negative by way of R510 in the cathode during the warmup period, before oscillation starts, in order that favorable conditions exist to insure the start of oscillations.

L501, L502, C501 and C502 are audio decoupling networks for isolating any spurious audio signals, such as ground currents and audio voltages picked up at the Cutterhead, a feature possible only in a carrier (RF) system.

L506 and L505 are the plate and grid windings of the oscillator coil, respectively, properly phased for oscillation. Diodes V501A and V501B are the envelope detectors for the RF voltage developed across the transducers.

The detected audio output is coupled to the grid of V503B by C507. V503A, V503B and V504A comprise a 3-stage Amplifier of conventional design, with inverse feedback from the third cathode to the first cathode. Inverse feedback and the cathode follower provide an extremely low impedance source for cabling to the Recording Amplifier.

The vertical part of the system is similar, except that it has only one pickup coil.

4. MODEL 644 POWER AMPLIFIER

The function of the Power Amplifier is to matrix the two incoming stereo signals into lateral and vertical, apply equalization, and furnish sufficient amplification and output power to drive the Cutterhead. See Fig. 9, schematic diagram of Model 644 Power Amplifier.

The input signals are passed through R101 and R201 (1 db per step attenuators) into the input transformers, T101 and T201, which will matrix the stereo signal into its lateral and vertical components and also provide a voltage step-up. The secondary of T101 supplies the lateral and T201, the vertical information to the respective treble pre-emphasis networks The bass equalization is as described in Section II, 3, for Beta Amplifier plus the lift provided by C127, C128, R185, R179, R106 and R107 (lateral). A 3-position switch, S301, provides three different equalizations:

1. "Flat," which has no treble boost.

2. "RIAA" which is the standard curve (3,180 µS, 318 µS, and 75 µS.)

3. "POP", with slightly increased bass, a few db more between 1 and 3 kc, and approximately 4 db less at 15 kc, compared to RIAA so as to make it possible to record higher apparent levels.

NOTE: RIAA and POP treble equalizations are adjustable from the front (screwdriver controls in front panel).

In order to obtain maximum separation, these controls, if changed from factory set positions, should be carefully adjusted to maximum separation at higher frequencies.

Another switch, S302, provides different amounts of low frequency roll-off of the vertical component, and in position "LAT ONLY" will also deactivate the complete vertical amplifier for cutting of lateral records. The gain in this position is increased by 6 db to correct for the difference in lateral component level between monophonic and stereophonic groove modulation.

From the switches the signal travels into the first amplification stage which contains two equalizing filters: one to adjust 2 kc level R187, and the other to adjust 10 kc level R186. The vertical channel also has a level adjustment, R206, which permits the setting of identical vertical and lateral cutting levels for maximum separation between the 45° stereo channels.

In order to obtain maximum separation, it is necessary that amplitude as well as phase are identical in the lateral and vertical channels at all frequencies.

As the amplifiers are identical from this tube to the output transformer, only the lateral channel will be described.

V101A is a plate-loaded stage with relatively large cathode resistors, R110 and R111, being bypassed with a frequency-discriminating network consisting of C108, and R113, R186 and L101 and a plate resistor shunted by a frequency-discriminating network consisting of C107, R112, R187, and L102.

V102A is also plate-loaded but has unbypassed cathode. To this cathode is applied motional feedback from the Beta Amplifier through R118, R119 and C110, and electrical feedback from the output transformer secondary. The respective RC networks are included to compensate for phase shift at high frequencies. R175 adjusts the amount of electrical feedback and thereby also the amount of motional feedback as well as Cutterhead response at midhigh frequencies.

It has been found desirous to control the electrical rather than the motional feedback in order to retain correct gain and phase relationship.

V102A is directly coupled to the grid of V102B split-load phase inverter. The potentiometer, R128, in its plate circuit, is used to balance the drive to the next stage and is adjusted to minimum I.M. distortion. V102B is capacitor-coupled to the grids of V103A and V103B. An auxiliary feedback loop from the output transformer secondary is returned to the cathodes (R139, R140, C121, and C122).

V103A and V103B are coupled via low-frequency phase-shift networks to the grids of the cathode follower drivers V106 and V107.

A third feedback loop for high-frequency phase correction is returned to the grids of the drivers, V106 and V107, from the plates of the output tubes.

The cathode followers are directly coupled to the control grids of the output tubes, V104 and V105, which in turn, are transformer-coupled to the Cutterhead coil. The output tubes are cooled by a small centrifugal blower and dissipate approximately 150 watts each. As they have a plate dissipation rating of 250 watts each, they work with a considerable safety margin and have demonstrated their remarkable ability to withstand severe overloads without damage.

To provide continuous motion monitoring while cutting, the Beta Amplifier output is fed through C130, R122, R123, R124, and R125 to the monitor output tube, V101B. A section of the pre-emphasis switch, S301B, provides for de-emphasis of the audio returned from the Beta Amplifier (R125 and C113).

The monitor circuit output transformers recombine the lateral and vertical information to left and right channels, a potentiometer, R123, (MON CAL) makes it possible to balance for maximum monitor separation. Nominal monitor output level is +4 VU.

Metering System

The Amplifier has two kinds of audio metering and a DC plate current metering. One kind of audio metering indicates the average signal level at the input of the system (at the secondaries of T101 and T201), and the other indicates the peak signal levels at the output, across the Cutterhead.

The input metering is similar to VU-Meter reading. The signal passes from the secondary of the input transformer T101 to a voltage divider on the metering switch S101A which changes the VU-Meter range. V301A amplifies the signal and feeds it to instrument rectifier CR101 and then to the front panel meter M101.

The output metering device is a peak reading meter with fast attack time (R173 and C135) and slow release time (C135, R171 and R172). This will show the voltage peaks across the Cutterhead which, because of the RIAA treble pre-emphasis and the efficiency characteristics of the Cutterhead, will reach maximum at high frequencies. The meter is set so that clipping will occur a few db above "+3" reading, with the meter in PEAK position corresponding to a peak power of approximately 2,000 watts.

In the PLATE CURRENT positions are measured the D.C. voltages across R157 and R158 in the cathodes of the output tubes. The plate current adjustments on the front panel are R143 and R144 which will vary the negative bias of the driver tubes V106 and V107.

5. MODEL 645 POWER SUPPLY

The unit supplies the necessary plate and filament currents to the 644 Power Amplifier and the 643 Beta Amplifier. The power transformer can be strapped for both 117 and 220 volt line voltage. See Fig. 10, schematic diagram of Model 645 Power Supply and Section III: Installation.

The high voltage transformer, T401, is connected to a full wave rectifier employing silicon diodes (CR401 and CR402), and has a choke input filter. The resultant D.C.voltage is added to the lower D.C. voltage supplied by the T402. This also employs a silicon rectifier, CR403, in full wave configuration and choke input filter.

The high voltage is the plate supply voltage. A voltage divider, R403, R404, R405 and C402 supplies 550 Volts plate voltage to the tubes V103A, and V103B, which precede the cathode follower driver stage.

The 340 volts bus supplies plate voltage to the rest of the tubes in the 644 Power Amplifier and to the 643 Beta Amplifier. The filter condensers are the plastic-cased type, capable of withstanding high peak currents.

Transformer T402 supplies 6.3 V AC with centertap grounded to the filaments in Model 644, 12.6 V D.C. to the filaments in the Model 643, and-200 volts for the biasing of the driver and the output stages. The commercial grade transformers are rugged and conservative in rating, and the rest of the components are very reliable, working well within their specified limits.

The T402 primary, the T301 filament transformer primary (644) and the fan are connected parallel to the 117 volt winding of the T401 transformer, which therefore also acts as an autotransformer when strapped for 220 volts line voltage.

SECTION III
INSTALLATION

1. POWER LINE REQUIREMENTS

The 641 system requires a 117 or 220 volt, 50 or 60 cycle power source (Strapped to 117 volts at factory). The normal power consumption of the unit is approximately 8 amps (117 volt operation) quiescent. However, current peaks as high as 15 amps are occasionally required. As in all high-power amplifiers it is definitely recommended that a separate power line circuit be used for this unit with the following wire sizes:

No. 12 Wire, 25 feet or less
No. 8 Wire, 50 feet or less
No. 6 Wire, 100 feet or less
No. 4 Wire, 150 feet or less

For wire length in excess of 50 feet, it might be advisable to use 230 volts. This will reduce wire size requirement by three sizes (i.e., No. 10 wire can be used for 100 feet.)

Fuse the system with Slo-Blo fuses or circuit breakers to either 15 or 20 amps. In many areas the line voltage varies radically during peak load periods, especially during the air-conditioning season. The Model 641 works best with a correct line voltage, and if possible steps should be taken to correct line voltage deficiencies. Line voltage can be corrected best by using an automatic Variac, such as General Radio, Type 1570-AL. Saturable reactor-type constant voltage transformer regulators should not be used because of variations in current drawn by the 641 system. Should one desire to control the line voltage manually a Variac of appropriate current capacity could be used (General Radio Variac Type W20, Powerstat Type 136 or equivalent). The voltage can be adjusted by using the plate current of the tubes as a reference on receipt of the system from the factory; that is, adjust the Variac so the plate currents read "0".

Variations in plate current of ±.5 db have no influence on the operating characteristics of the unit. Variations of +2 db and -4 db are tolerable. Such variations will not influence recording level or frequency response by more than 1 db, but they will, however, reduce the available power by about 3 db.

The system is connected to 117 volts line voltage when shipped from factory. 220-230 volts operation: Remove connection between 1 and 4 and between 3 and 6 on T401. Strap 3 and 4 together and replace the 117 volts plug on the line cord with a 220 volts. Make sure that there is adequate ventilation behind the rack where the 644 Amplifier is mounted so the warm air can escape.

2. INPUT AND OUTPUT CONNECTIONS

Input and Output Connections appear on a barrier-type terminal strip in the rear of the 644 Amplifier:

LEFT CHANNEL - INPUT (Z=600Ω)	Terminal 1 Tie point (no internal connection)
	Terminal 2 High
	Terminal 3 Low
	Terminal 4 Ground (Chassis)

RIGHT CHANNEL - INPUT (Z= 600Ω)	Terminal 5 Tie point (no internal connection) Terminal 6 High Terminal 7 Low NOTE: If a floating circuit is used, it is necessary that Terminals 3 and 7 be strapped to Terminal 4.
LEFT CHANNEL - MONITOR OUTPUT (Z= 600Ω)	Terminal 8 High Terminal 9 Low Terminal 10 Ground (Chassis)
RIGHT CHANNEL - MONITOR OUTPUT (Z= 600Ω)	Terminal 11 High Terminal 12 Low NOTE: If a floating circuit is used, it is necessary that Terminals 9 and 12 be strapped to Terminal 10. The Monitor Outputs shall be terminated.

3. MOUNTING OF THE CUTTERHEAD

In the rear of the Cutterhead are three mounting holes with 10-32 thread. Different adapters can be supplied to mount the Cutterhead on different brand lathes.

The Cutterhead can be installed on any Scully lathe which will accommodate a Westrex Stereo Cutterhead, and several Presto, Neumann and Fairchild lathes.

As Iron turntables will attract the Cutterhead, it is recommended that a 1/2" thick aluminum platter be used on top of these if possible.

a.) Stylus Replacement

Bring the Cutter to a position where the stylus is accessible and easy to observe, either by tilting the Cutterhead or by dismounting it. Move the suction tube away from the stylus to assure more working space. Press the two buttons on the front of the Cutterhead and disengage the heater wires.

With a pair of nonmagnetic tweezers (Fairchild No.___), grab the stylus as close to the root as possible. Using the aluminum cover as a leverage support, pry the stylus from the tapered hole. See Fig. 11.

NOTE: A strong magnetic field exists around the Cutterhead especially near the cutting stylus so care should be exercised if using tools made of iron or steel as they will be pulled against the stylus or advance ball assembly with destructive results. Watches may be magnetized.

b.) Insertion of New Stylus

Hold the stylus by the two heater wires, and insert it lightly into the chuck. Clamp the wires under the contact buttons on the front of the Cutterhead allowing enough slack in the wires for free motion of the stylus.

Using the nonmagnetic tweezers, align the cutting surface of the stylus at right angles to the groove motion. When the stylus is positioned properly, press it gently with a finger or a soft eraser into the hole.

Check the position of the advance ball. It should be close behind the stylus slightly offset to one side (away from suction tube), so that eventual advance ball smear will fall within a cut groove. Move the suction tube back into place about 1/8" away from the stylus.

Connect the suction hose and heater wires (6 volts AC variable).

Mount the Cutterhead on the lathe and make sure that the stylus is exactly vertical when cutting and that its lateral movement is in line with the center pin. See Section IV 3.c. for Light-Pattern Adjustment. Lower the Cutter onto a rotating lacquer disc, adjust the advance ball to proper depth of cut, a counterbalancing spring shall be adjusted until the advance ball rests on the lacquer with a pressure of approximately 50 grams (2 oz.) and the Cutter is ready for recording.

Do not energize the heater coil unless the suction system is in operation. Adjust the heater current until the wires are cherry red.

According to RIAA standards, the normal groove width may vary between 2.2 mils and 3.2 mils. This corresponds to a variation of from 227 to 156 lines per inch for equal land and groove widths.

c.) Resetting Range of Depth Adjustment

As many styli available today vary in length, it may be necessary to reset the range of adjustment of the advance ball.

The adjustment screw has differential thread so the depth variation per turn of the screw is determined by the difference in pitch between the two screws: 2.7 mils per revolution. The total range of adjustment is approximately .050 inches, so larger variations in stylus lengths will necessitate a resetting of the adjustment range. The procedure is as follows:

Remove the Cutterhead from the lathe. Remove the advance ball holder and unscrew the differential screw all the way. With a pair of pliers, pull out or push in the round tube which held the advance ball holder the desired additional length, reinsert the differential screw, and then the advance ball holder, adjusting the ball to be close behind the cutting stylus slightly offset in the direction away from the suction tube.

4. LIMITATIONS IN THE CUTTING OF STEREO AND MONOPHONIC RECORDS

In order to operate under optimum conditions it is important that the limitations of the medium are known.

Stereo disk recording is a process where two different signals are engraved in the same groove. Each signal modulates a groove-wall in a direction 45° to the disk surface. The fact that the movement of only one cutting stylus creates both modulations makes it possible to divide the motion of the stylus into lateral and vertical components. This is essential because the characteristics of the two are basically different.

The severest limitations are imposed on the vertical component. The amplitude is restricted by the thickness of the lacquer and the velocity is restricted by the "vertical" cutting angle of the cutterhead and the back angle of the cutting stylus. Playback cartridge capabilities as well as playing time of the record also impose serious limitations. If the vertical velocity is high compared to the linear groove speed it may be impossible to process the master because the "master" and the "mother" will be hooked together by the grooves. Before this happens however, the back of the cutting stylus may start embossing the already cut groove.

What kind of limitations does the thickness of the lacquer coating impose? A survey has revealed that minimum thickness is 5 - 5 1/2 mils. If the playback stylus radius is maximum .7 mil, the minimum groove width will be 1.0 mil. and minimum depth .5 mil. The maximum permissible amplitude can then be found from: $2\,A_V + d_{min} = 5$ mils, where Av is vertical amplitude and d minimum groove depth under maximum modulation condition. In other words:

$$A_v = \frac{5-d}{2} = 2.5 - .25 = 2.25 \text{ mils}$$

As the amplitude is 12 db or 4 times higher at 30 cps than at 1 kc for constant input level and RIAA equalization, the 1 kc amplitude is max: 2.25/4= .56 mil if the music to be recorded has bass levels comparable to midfrequency level. .56 mil corresponds to $\frac{.56 \times 2.54}{1000} \times 2\pi\sqrt{1000} = 8.9$ cm/sec peak velocity at 1 kc as absolute maximum.

As peaks in the program material often rise up to 10db above the VU - meter reading, "0" on the VU meter should not result in more than $\frac{8.9}{3.16} = 2.8$ cm/sec vertical velocity. This vertical standard recording level is not exactly impressive compared with the lateral standard of approximately 6 cm/sec (RCA 12-5-49).

In order to get maximum separation between the standardized 45° channels the vertical and lateral components have to be similar in phase and amplitude. In order to increase the vertical standard recording level at mid and high frequencies it will be necessary to either use heavier lacquer coating on the blank which is not a good idea because the resulting deeper cut will shorten the already reduced playing time considerably, or reduce the bass. Here are two alternatives:

1. Similar bass attenuations in both stereo channels. This will give poor bass response when played back but good separation.

2. Bass attenuation of vertical component only. This gives good bass reproduction in both stereo channels when played back, but the separation at the lowest frequencies will have decreased slightly. However this loss in separation is normally more tolerable than lack of bass level.

This important feature which is named UNI-GROOVE is incorporated in the 641 cutting system as a "Vertical Rool-off" switch.

If the remaining large lateral amplitudes still take up too much groove space it may be necessary to either reduce the overall level or roll-off the bass in the individual stereo channels.

When the bass is rolled off, higher amplitudes can be recorded at higher frequencies.

2.25 mil Amplitude at 1 kc equals 4x8.9=35.6 cm/sec which is the maximum possible vertical velocity at 1 kc. The width of the unmodulated groove will have to be 5.5 mil with 4.5 mil land between. 2.25 mil Amplitude at 15 kc equals $2\pi fa = 2\pi \times 15000 \times 2.254/1000 = 540$ cm/sec.

The vertical velocity limitations are imposed by the "back angle" of the cutting stylus and the "vertical" cutting angle. In the inner grooves of a 33 1/3 rpm record cut with a vertical cutting angle of 20 - 23° the velocity is limited to approximately 54 cm/sec. A cutting stylus back angle of 47° will produce embossing into already cut material if the vertical velocity exceeds approximately 45 cm/sec.

The lateral component has fewer restrictions than the vertical. The only amplitude restrictions are the ones set by playing time and playback cartridge capabilities. Playing time will, besides level, depend upon eventual automatic pitch control, and playback cartridge capabilities may also have to be considered. Popular records, which are more liable to be played on less expensive phonographs with low eompliance cartridges will have lower bass amplitudes than records made for more expensive playback systems where high compliance cartridges are used.

The recored lateral velocity is, besides playback limitations such as stylus shape and size, only restricted by the side angles of the cutting stylus. If the velocity becomes too high compared with linear groove speed, embossing of already recorded program material will take place.

A cutting stylus side angle of 30°, cutting the inner grooves of a 33 1/3 rpm record will emboss if the velocity exceeds 36.4 cm/sec. If the angle is 45° the maximum velocity will be 21 cm/sec.

These have been the vertical and lateral limitations. How will these influence the stereo channels?

First amplitude. Lacquer thickness is the most serious limitation. As similar signals of opposite phase in the two stereo channels will produce a vertical signal 3 db higher in level than the stereo signals, maximum stereo amplitudes should not exceed a level of 3 db below 2.25 mils (see above). If limiters are used in the stereo channels the threshold should be set so that maximum amplitude at 30 cps is 3 db below 2.25 mils. The combination of the two stereo signals will then be unable to produce vertical amplitudes above 2.25mils

If, however, the limiter is capable of limiting vertical and lateral components instead of left and right components (Fairchild 670) it will be possible to record 6 db higher amplitudes in the stereo channels before limiting.

This maximum stereo amplitude: $2.25 \cdot \sqrt{2} = 3.2$ mils on the record, will require 10 mils groove width however, and therefore a pitch of only 100 lines per inch; the unmodulated groove width will have to be 5.5 mils with 4.5 mils land inbetween and a vertical-lateral limiter will have to be used. It is then, and only then, possible to record maximum stereo amplitudes limited by the lacquer's thickness alone. 100 lines per inch is very uneconomical but may be tolerated for short periods if correct automatic depth and pitch controls are used and the program material does not contain consistently high bass levels.

If the stereo signal on the tape contains more difference information than sum information it is advisable to have a phase reversal switch in one of the stereo channels so the highest levels always can appear as lateral component of the groove modulation. Eventual ground connections may have to be changed in the line feeding the cutting amplifier when this has unbalanced input. (641)

To detect whether lateral or vertical levels are predominant, the FAIRCHILD 670 Limiter can be used in vertical-lateral position. The peak reading meter in the 641 System will also show which component is larger.

Is a 3 channel tape machine feeding the 641 System 3 phasing switches may have to be incorporated in the set-up. See Fig. 11a.

The procedure is as follows:

1.- Feed from 2 only. Switch III until lateral reading.
2.- Feed from 1 and 3 only. Switch II until lateral reading.
3.- Feed from 1, 2 and 3 - switch I until lateral reading.

Adjustment of two track stereo tape machines

With the tape machine connected to the 641 cutting system, play a full track monophonic test tape and watch the lateral and vertical VU meter on the 641 system. If the vertical (lower) meter reads at any frequency - adjust azimuth until there is no deflection at any frequency from 15 kc down.

SECTION IV

TESTING, CHECKING AND ADJUSTING

1. PRECAUTIONARY MEASURES TO OBSERVE BEFORE CHECKING THE AMPLIFIER

Turn the power switch off at least two minutes prior to removing cables, tubes, or the screen around the output stages so as to allow the capacitor to discharge.

Make sure that the fan is in place and running whenever the 4CX250B output tubes are drawing plate current.

As some of the tubes (V106, V107, V206 and V207) have sockets which are not accessible because they are mounted inside the pressure chamber, use a tube socket test adapter such as PECO Test Socket Adapter, Model TVS-9Δ in series with these tubes when checking the voltages.

CAUTION: The cooling fins on the 4CX250B are at HIGH VOLTAGE level, more than 1000 volts above ground!

Do not run the unit at high level when no load is connected, such as if a Cutterhead fuse (located in the 643 Amplifier) is blown, or an interconnecting cable is disconnected. Two 8Ω, 200 Watt resistors are required as loads, if the Cutterhead is not connected.

Do not apply more than 10 volts across the Cutterhead coils for any length of time, at any frequency. This can be checked by using the Fairchild Test Box ____ and an AC Voltmeter.

In order to adjust the amplifiers to optimum performance, it is necessary to use dummy loads. Fairchild No.______ contains two 8Ω, 200-watt resistors plus the necessary plugs and sockets.

2. CHECKING THE AMPLIFIERS

a.) Airpressure

The pressure in the pressure chamber shall be approximately 1/4 inch water column. The screw in the mid-right hand side of the pressure chamber can be removed and the pressure gauge connected here.

b.) AC-Balancing

Adjust plate currents on front panel to "0" on the VU-meters and make sure the line voltage is 117V. As the procedure is the same in lateral (upper) and vertical (lower) amplifier, only the lateral AC balancing will be described here.

Disconnect the cable between the Beta Amplifier and the Power Amplifier at the Beta Amplifier end, and plug it into the dummy load (Fairchild Model). Connect an AC meter and a distortion meter across it. Set VERTICAL ROLLOFF switch to 10 CPS and PRE-EMPHASIS to FLAT. Different meters can be used, harmonic distortion or intermodulation meters or a wave analyzer. Feed 1 kc into the input of the system and adjust the level until the voltage across the load is 15V.

Adjust the A.C. BAL control at the rear of the amplifier to minimum distortion (second harmonic).

Δ Pomona Electronics Co., Pomona California

If no distortion measuring set or dummy loads are available, here is an alternate but less accurate way of A.C. balance adjustment.

Remove the cover from 643 Beta Amplifier. With two clip leads, short pin 1 to pin 2 and pin 9 to pin 10 on the sixteen-terminal cable socket and remove the vertical and lateral fuses.

Feed a 1 kc signal to the left channel and set the generator level until the plate currents on the front panel meters increase to +2 db.

Adjust the appropriate A.C. BAL controls until same reading is obtained when switching between V104 and V105 (lateral channel) or V204 and V205 (vertical channel).

Restore the system, reinsert the fuses and connect the cutterhead.

c.) Feedback Setting

This adjustment requires use of the Fairchild Test Box Model which shall be inserted between the 643 and 644. Switch the feedback off on the box and connect an AC Voltmeter to it.

Connect a generator to pin 7 on V102 Fig. 9a, using a Tube Socket Test adapter if necessary.

Set generator to 1 kc and adjust level until the AC meter connected to the Test Box reads .8 volts.

Switch feedback in and vary frequency to maximum reading in 2 to 5 kc range.

Adjust LAT FB control at that frequency until meter reads 1 volt. if it continues to rise, check by switching the feedback in and out that there is no more than 3.5 db difference in readings.

Repeat procedure with vertical channel (Pin 7 on V202). AC BAL and FEEDBACK controls are now set and shall not be readjusted unless the Cutterhead is replaced

The system is now ready for final adjustments.

3. ADJUSTMENT OF FREQUENCY RESPONSE AND SEPARATION EMPLOYING LIGHT-PATTERN METHOD

a.) General

Since the frequency response and separation of stereophonic and monophonic cartridges depend somewhat on the so-called plastic resonance between the record material and the effective stylus mass reflected to the stylus tip, it has been found unreliable to use acetate disk playback as a method to determine frequency response and separation on records. The acetate coating is considerably softer as compared to vinyl or polystyrene. Until definite relationships between pressings and acetate playback of given cartridges can be established, we suggest the light-pattern method as the only acceptable method to determine frequency response and separation of a disk cutting system. This method of checking frequency response has been in use for lateral records for many years, and its usefulness for stereo has also been described.

b.) Theory

As the grooves on a stereo record are cut with a cutting stylus with exactly 90° included angle, both groove walls should be at 45° to the record surface. If, therefore, parallel light is projected down on the record at an angle of 45°, the highly polished groove wall (burnishing facets) will reflect the light back in the same direction. See Fig. 12.

If the reflected light is dull, it may be time to clean or exchange the cutting stylus. As the width of the light pattern is proportional to the velocity of ONE GROOVE WALL, lateral or vertical velocity shall be 3 db higher than the velocity in one stereo channel to produce identical light pattern as shown in Fig.12, Fig. 13 shows the Light-Pattern Geometry.

For narrow light pattern, u° is near zero and we have

$$x = \frac{v}{\pi n}$$

where x is width of light pattern in cm, v = velocity in cm/sec., and n = ~~rpm~~ RPS of cutting lathe.

In practice, however, it is often difficult to read the width of the light-pattern from infinite distance. An arm's length is easier, and will still give quite accurate results.

c.) Cutterhead Positioning

Place the light source (slide projector, flashlight or Buchmann-Meyer light) so that the light will hit the record surface at an angle of exactly 45°. If the light is not collimated, keep the light source approximately 5 to 10 feet or more away from the record. If it is collimated, any distance will do. This angle can be set accurately by using a simple 45° - 45° triangle and adjusting the light until the shadow does not show. See Fig. 14.

The first test is to determine whether the cutting stylus is cutting 45° groove walls (no modulation). Project and look at 45° to the record surface. Looking under different angles may reveal that the maximum light reflection is not at 45°, which indicates that the groove walls are not at 45° to the surface.

Repeat the procedure on the other half of the record. If both groove walls give maximum reflection at 45°, the stylus is O.K. and the Cutterhead mounting is right. To give an impression of which angle discrepancies may be tolerated if the playback equipment is properly aligned;

Desired maximum separation:	10db	20db	30db
Maximum allowable angle deviation:	±35°	±12°	±3°

Because of the approximately 20° vertical cutting angle, the light-pattern will not be symmetrical with respect to the reflection from an unmodulated groove at high vertical velocities. If, however, it is not symmetrical at low levels, it indicates that the cutting stylus is not traveling across the record in a line through the center pin which means that the Cutterhead should be moved either forward or back.

d.) Checking Frequency Response and Separation

Turn the EQUALIZATION switch to FLAT position. Record the desired frequencies on the record at a level of maximum -5db on the front VU-Meters. Switch a generator between the two input channels at each frequency (by switch or patch cord, and spiral in between). The light pattern will now show the frequency response if looking and projecting light at 45° angle to the record, as described above. In between the frequency response bands will be seen the crosstalk. Since the width is proportional to velocity in cm/sec. and db, a conversion is necessary.

Frequency Response:

Within ±1 db or a total of 2 db means that the widest part of the pattern shall not exceed 1.26 times the narrowest pattern.

Within ±2 db or a total of 4 db means that the widest part of the pattern shall not exceed 1.6 times the narrowest part.

Within ±3 db or a total of 6 db means that the widest part of the pattern shall not be less than twice as wide as the narrowest part.

Separation:

The ratio between the widths of two adjacent bands will be an indication of the separation. The curve in Fig. 15 shows the relationship between ratio and db.

It may be difficult to read the pattern width at high frequencies because of poor definition of the contour. At low frequencies, because of the coarse modulation, it is advantageous to let the turntable spin while making the measurements.

e.) Readjusting Frequency Response and Separation - General

If light pattern frequency response and separation are not satisfactory, or if the Cutterhead, Beta Amplifier, or one of the input tubes has been replaced, it may be necessary to readjust the system for maximum separation and best frequency response. The procedure is as follows:

First, set the VERT FB and LAT FB controls as described in Section IV, 2,b, then remove the gray front cover plate. Remove the screw at the top of the black front panel. This panel is hinged at the bottom and will fold down. Two transformers are located inside near the bottom of the panel. They matrix the two stereo channels into lateral and vertical components. The secondary of the left transformer supplies the lateral information, the secondary of the right the vertical information.

In order to obtain the best separation, the lateral and vertical frequency and phase responses shall be similar.

As the system also cuts lateral records, it is most important that the lateral response be flat.

f.) Adjustment of Lateral Frequency Response

Set PRE-EMPHASIS knob on front panel to FLAT, VERTICAL ROLL-OFF to 10 CPS, and feed 5 kc into one channel of the system at a level of -5db on the VU-Meter on the front panel.

Short circuit pins 6 and 7 on the right-hand transformer with a clip lead. The lower VU-Meter showing the vertical component should not read now.

Cut the 5 kc on a blank and observe the width of the light pattern in the manner described in the previous section dealing with light-pattern measurements.

Spiral and change the frequency to 2 kc. Adjust the LAT 2 KC control inside the amplifier until the width of the light pattern is identical to that at 5 kc. Spiral and repeat the procedure, this time comparing 10 kc to 5 kc while adjusting the LAT 10 KC control at the rear of the amplifier. As the controls may interact slightly, repeat the entire procedure and the lateral frequency response will be flat within a few db.

g.) Adjustment of Vertical Frequency Response

Move the clip lead to the left-hand transformer (short pin 6 to pin 7). Repeat above procedure, comparing 2 kc and 10 kc to 5 kc by observing the widths of the light pattern, also here projecting the light and looking at an angle of 45° to the record surface, as described in the previous section.

Remove the clip lead, feed 1 kc into one of the stereo channels at a level of +7 dbm (+3 on the meter, VERTICAL and LATERAL METERING knobs at +4), and observe the light pattern. If it is wide (1" or more), feed the other channel instead and then adjust the REC CAL control at the rear of the amplifier to minimum width of the light pattern, indicating maximum separation. If the light-bands are approximately of equal width at 1 kc, no matter which channel is fed, either the lateral or vertical coil is not energized. Check fuses in Beta-Amplifier.

h.) Checking Separation with Microscope

Another way of determining separation is through a microscope. Record a frequency between 200 cps and 1 kc where the wave length is convenient in size at a high level, such as +7 (see above) for a very short duration of time (half a second), and a silent groove next to it. It is advisable to cut a deeper groove than normally since it will make it easier to judge the separation.

In the microscope the modulation of one stereo channel will look as shown in Fig. 16, top.

If there is crosstalk, the microscope will show whether this is because of too much lateral or too much vertical component. Fig. 16 center shows too much lateral component in the stereo channel. Remedy: Turn up the REC CAL control, which is actually a vertical level control, until the increased vertical component will cancel out unwanted lateral modulation.

Fig. 16, bottom shows too much vertical component. Remedy: Turn down the REC CAL control until the left wall is unmodulated. Having an unmodulated groove next to the wall containing the crosstalk makes it easier to determine minimum modulation of this wall.

If the microscope is calibrated, it is possible to determine the separation in db. Measure the peak-to-peak amplitude of each groove wall, find the ratio and enter it in Fig. 15.

Example:

Peak-to-peak amplitude of one groove wall: 8 lines in the microscope.

Peak-to-peak amplitude of other groove wall: 1 line in the microscope.

Separation:

$$\frac{8}{1} = 8 \text{ times or } 18 \text{ db.}$$

1.) Adjustment of Monitor Separation

With the separation now set to maximum while cutting 1 kc, only the Monitor Amplifier remains to be adjusted.

Terminate the monitor outputs (600Ω) and connect a VTVM across the rejected (lowest reading) channel.

Feed 1 kc into LEFT CHANNEL, and adjust MON CAL to minimum reading at RIGHT monitor output.

4.) SETTING OF VU-METERS

a. Theory

If only one groove wall is modulated, the lateral and vertical components of this modulation will be a factor of $\sqrt{2}$ or 3 db lower in level than the 45^{o} modulation.

As lateral modulation will occur if the sound source were right between the microphones in the recording, the VU-Meters should be adjusted so that "0" corresponds to standard lateral or vertical recording level.

There are several different ways of calibrating the VU-Meters:

Playback of a stereophonic test record with monophonic cartridge.
Playback of a stereophonic test record with stereo cartridge.
Playback of a monophonic test record with monophonic cartridge.
Playback of a monophonic test record with stereo cartridge.
Light pattern of stereophonic record.
Light pattern of a monophonic record,
and recording either stereo or monophonically.

That totals 12 different possible ways of adjustment. The easiest is to use the RCA monophonic Test Record 12-5-49. Its level is widely used as standard recording level on monophonic records.

Set the VERTICAL ROLL-OFF switch in position LAT ONLY and cut laterally, feeding one stereo channel. Vary the generator level until mono or stereo playback or light pattern indicate same level as the RCA Test record.

Adjust LAT VU CAL control at the rear of the amplifier to "0" on the upper front panel meter with LATERAL METERING switch to 0 db.

Switch VERTICAL ROLL-OFF to 10 CPS still feeding the same channel the same level.

Both meters will read now. Adjust VERT VU CAL control to same indication on the two meters (approximately -5db). Connect the 641 system to the program busses, feed one channel at a time and adjust the input attenuators LEFT CHANNEL and RIGHT CHANNEL until "-5" on both front panel meters corresponds to the level fed into the system (+4 VU or +8 VU).

Are both channels fed the same signal simultaneously a vertical or lateral cut will result and one of the front panel meters will read "0", the other much less.

If a stereo signal is fed into the system "0" on the front panel VU Meters means 6.2 cm/sec. velocity (RCA Test Record) of lateral or vertical component respectively. 641 systems with serial number 6 or below have a different calibration.

In LAT ONLY position they are similar but in the 4 stereo positions the indication is 6 db lower on the front panel meters.

"0" on lateral and vertical meters here means 3.1 cm/sec. velocity of vertical and lateral components.

5. EQUALIZATION ADJUSTMENTS:

This can be done without cutting.

Adjust the level of a 10 kc input signal until approximately 0.5 volt appears across the lateral cutterhead coil (649 test box) with equalization switch in pos. "Flat". Switch to "RIAA" and adjust "RIAA" screwdriver control in front panel until the reading is 13.75 db above the "Flat" reading.

Repeat with vertical channel. ✓ 2,3 ✓

Still feeding 10 kc into the amplifier, switch to "Pop" and adjust to center electrically. (Full variation approximately 4 db)

SECTION V

MAINTENANCE

1. PREVENTIVE MAINTENANCE

Make sure that the Cutterhead does not come in contact with iron dust, or filings. Magnetic particles in the gaps will upset the performance.

Inspect the cutting stylus at regular intervals, and remove with caution eventual burned chips. Excessive heat may cause a solid crust of burned chips to build up on the stylus. This will increase the groove noise, attenuate high frequencies, cause distortion and reduce separation.

Clean output tubes with compressed air or vacuum if excessively dusty, making sure that the proper amount of cooling air can pass through them.

If tubes are removed from the amplifier, mark them so they will not be switched when put back.

Adjust plate currents at regular intervals, and check line voltage.

2. TROUBLE SHOOTING

TROUBLE SHOOTING CHART

SYMPTOM	REMEDY
Unit inoperative No pilot light	Check main fuse (12A) and inter-connecting cable between 644 Amplifier and 645 Power Supply.
Unit inoperative, but pilot light lighted.	Check plate currents on front panel. If no plate current, check 1/2amp screen grid fuse in the rear of the 644, and plate supply voltage. See schematic diagram.
Insufficient plate current.	Check line voltage. Replace output tube, 4CX250B, if only occurring in one tube. If consistent with all four tubes, check V-R tube, OA2 and bias voltage.
Excessive plate current.	Check line voltage. Replace output tube, 4CX250B, if only occurring in one tube. Check V-R tube, OA2 and bias voltage. If a tube fails after only a few hours of operation, it should be returned to us for credit. Make sure that the fan is operating and the tubes not clogged up with dust.
Blows 1/2 amp fuse.	If unit continues to blow this fuse, observe the plate currents on the front panel meters during warmup to determine which tube is defective.

NOTE: When replacing this fuse, make sure that the Cutterhead fuses located in the 643 Amplifier are not blown!

SYMPTOM	REMEDY
No Separation.	Check Cutterhead fuses in the 643 Amplifier. Check Vertical roll-off position. Check connections to Cutterhead.
Poor Separation.	Dirty or defective stylus.
Poor frequency response, peak around 1 kc, tinny sound.	Check feedback circuit, check tubes and voltages in the 643 Beta Amplifier.
Lack of bass in playback.	Check phasing. Feed same signal to both channels. Result should be lateral groove modulation. Can be checked by playing a full track monaural tape on the Stereo tape machine.
Instability.	Possible dirt in Cutterhead or damaged armature. Return Cutterhead and Beta Amplifier to factory for cleaning.
Distortion at low levels.	Listen to monitor output while moving the cutting stylus with a finger. If rubbing or crackling noise result, iron filings may have found their way into the gaps. Return Cutterhead and Beta Amplifier to factory for cleaning and remagnetizing.
Noise in monitor when Cutter is lowered.	Loose or defective stylus.
Whistling noise at monitor output when cutting.	Turn adjustment screw in the side of 643 slightly.
Crackling noise.	Remove Cutterhead fuses. If noise continues, replace diode CR501, CR502, CR601 or CR602 in Beta Amplifier.

THE END

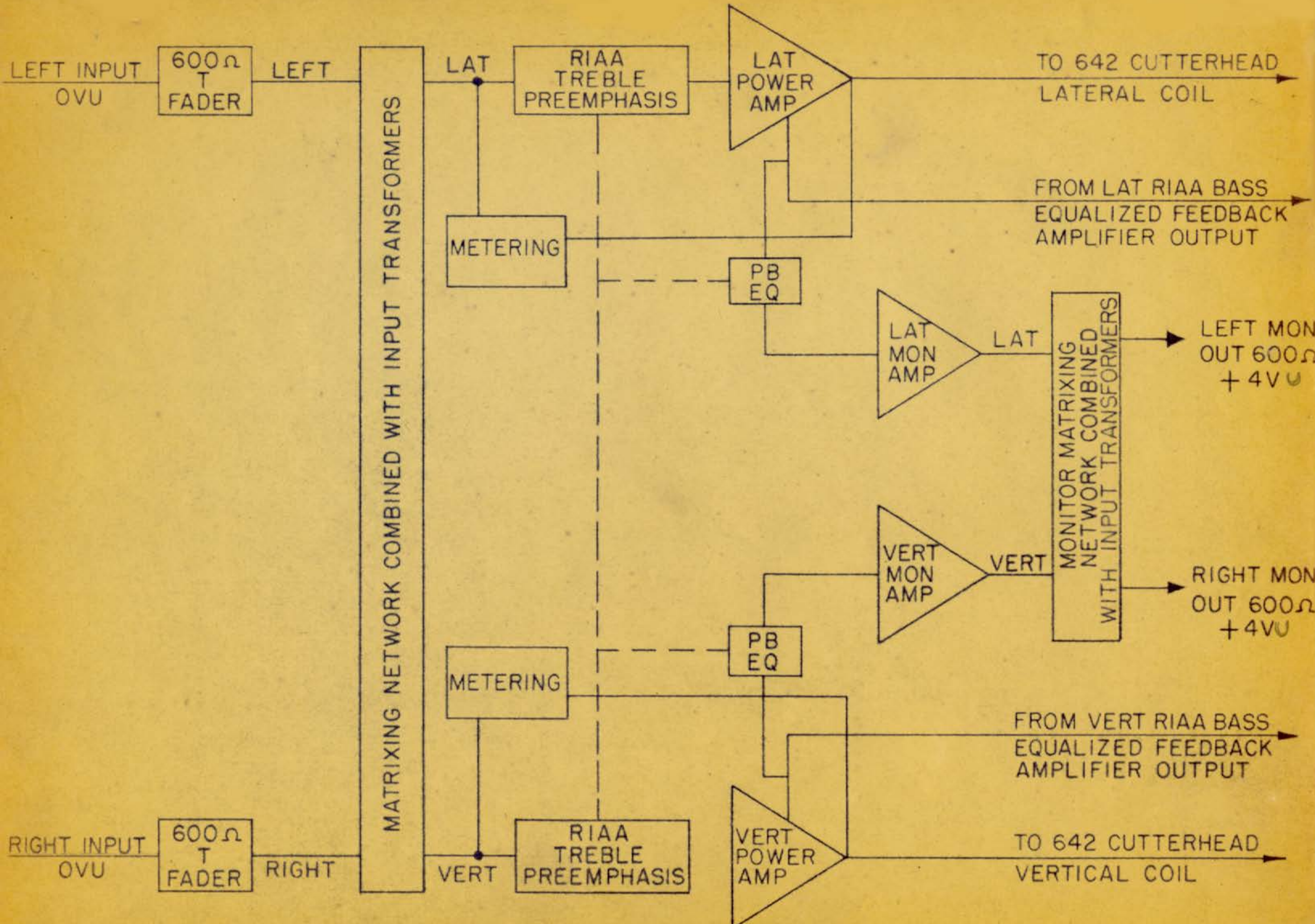
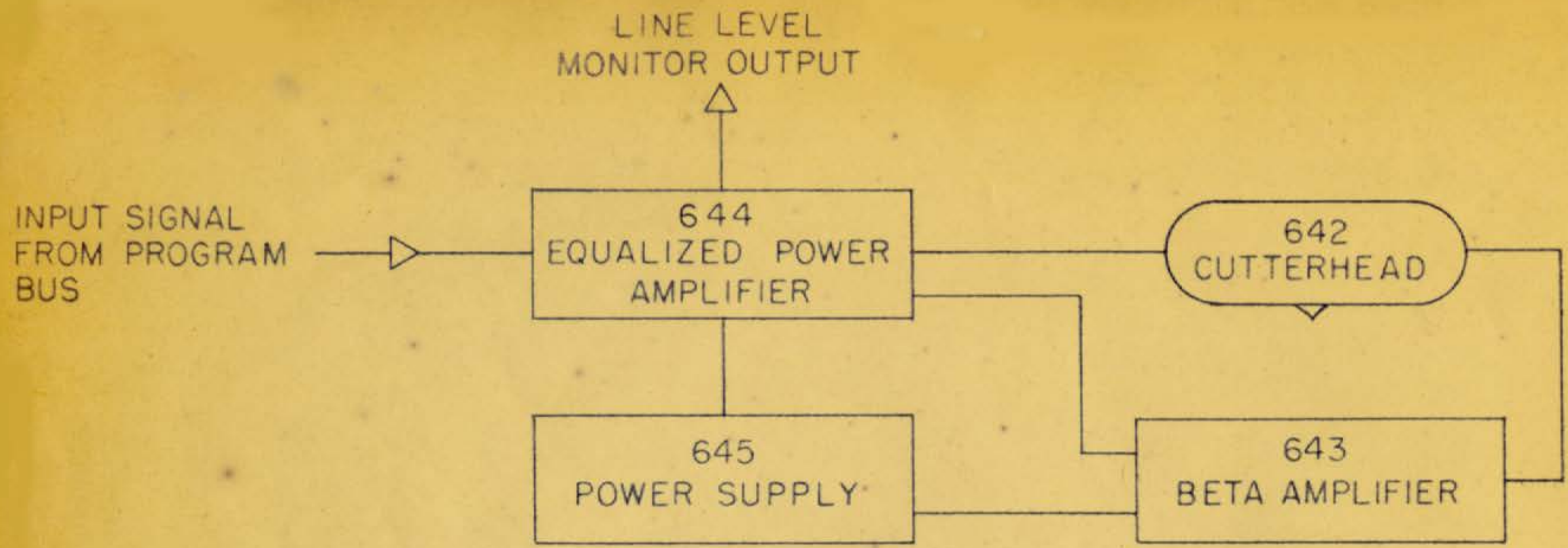


FIG I
BLOCK DIAGRAM OF 641 CUTTING SYSTEM



SIMPLIFIED BLOCK DIAGRAM OF
641 CUTTING SYSTEM

FIG 2

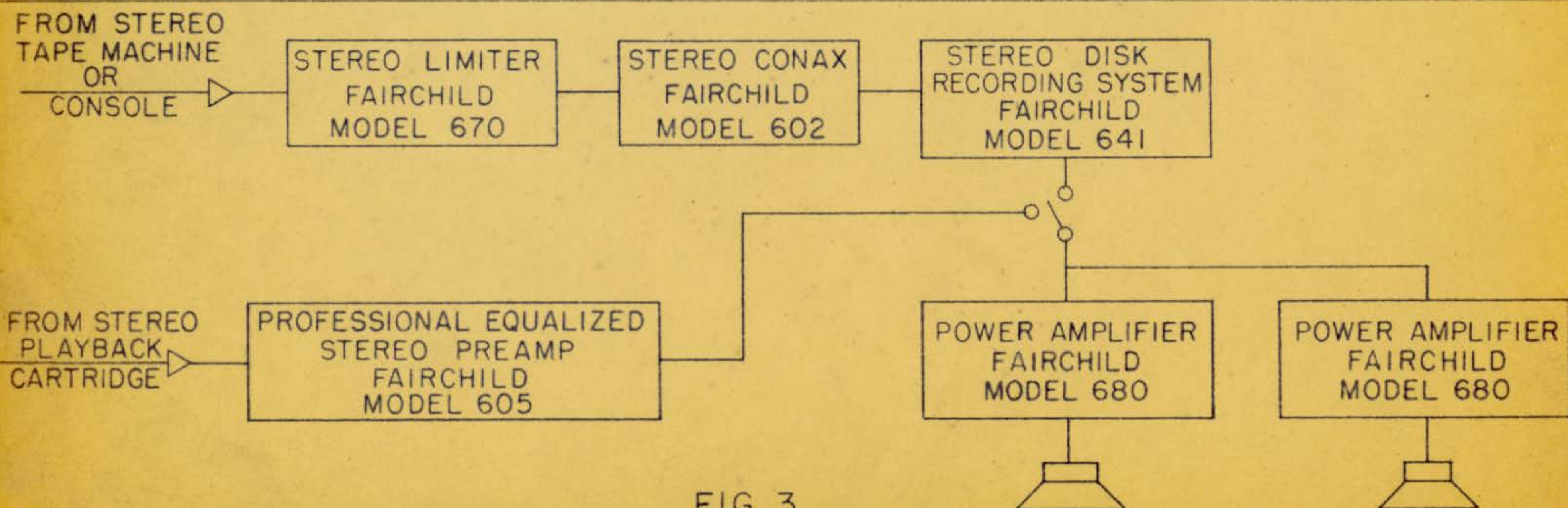


FIG. 3

COMPLETE DISK RECORDING & PLAYBACK SET-UP FOR
HIGH QUALITY, HIGH LEVEL STEREO & MONOPHONIC OPERATION

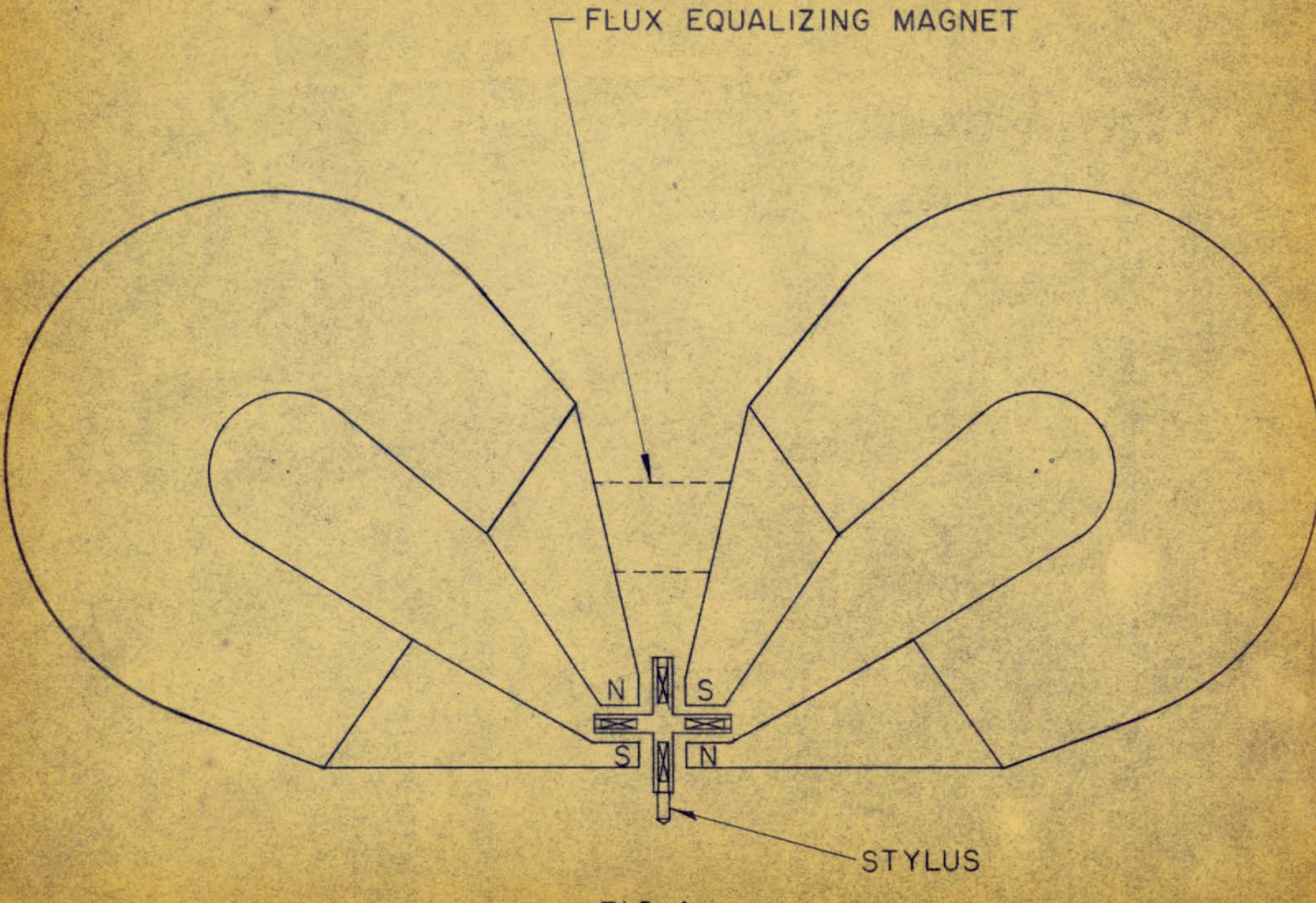
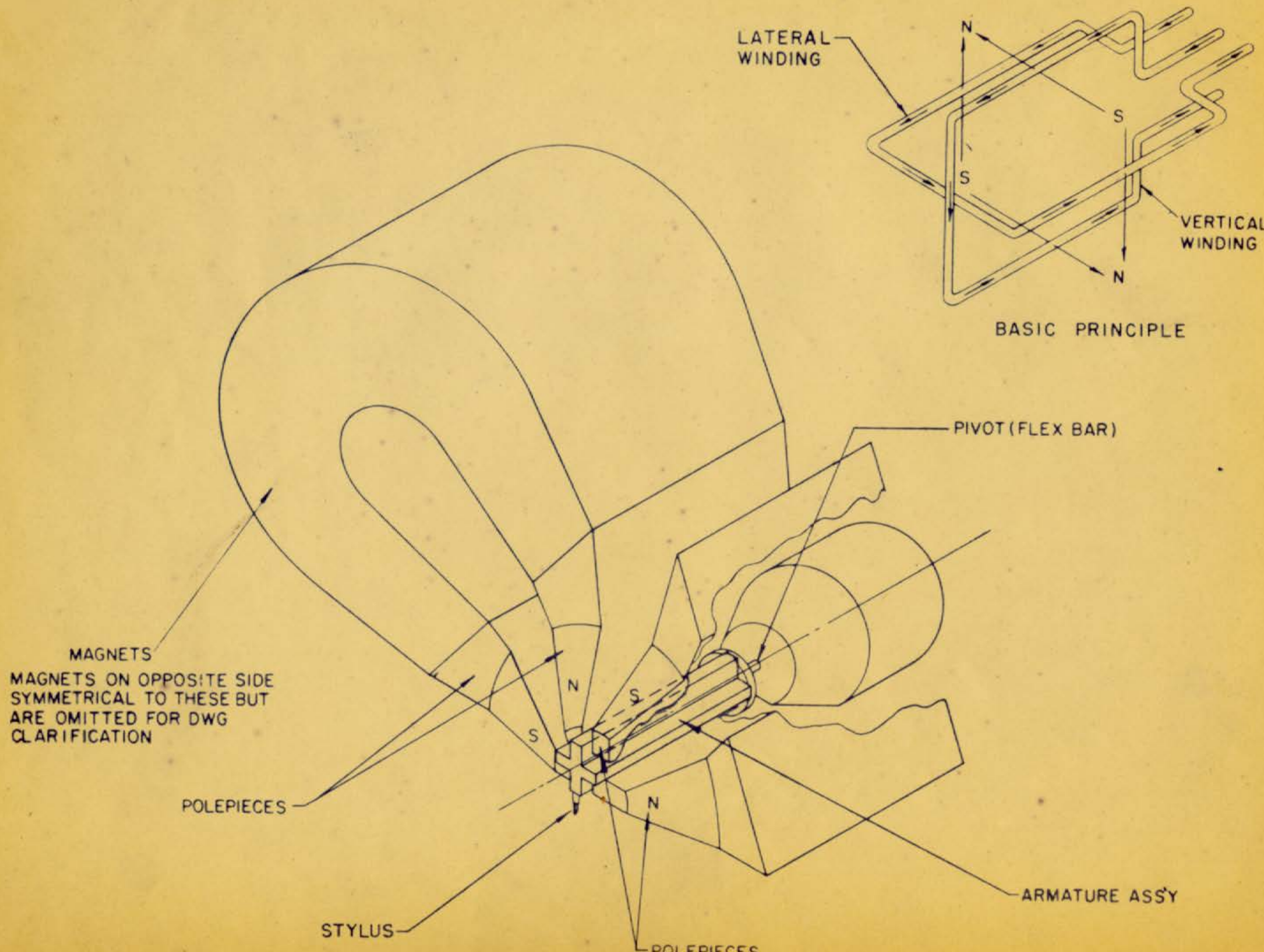


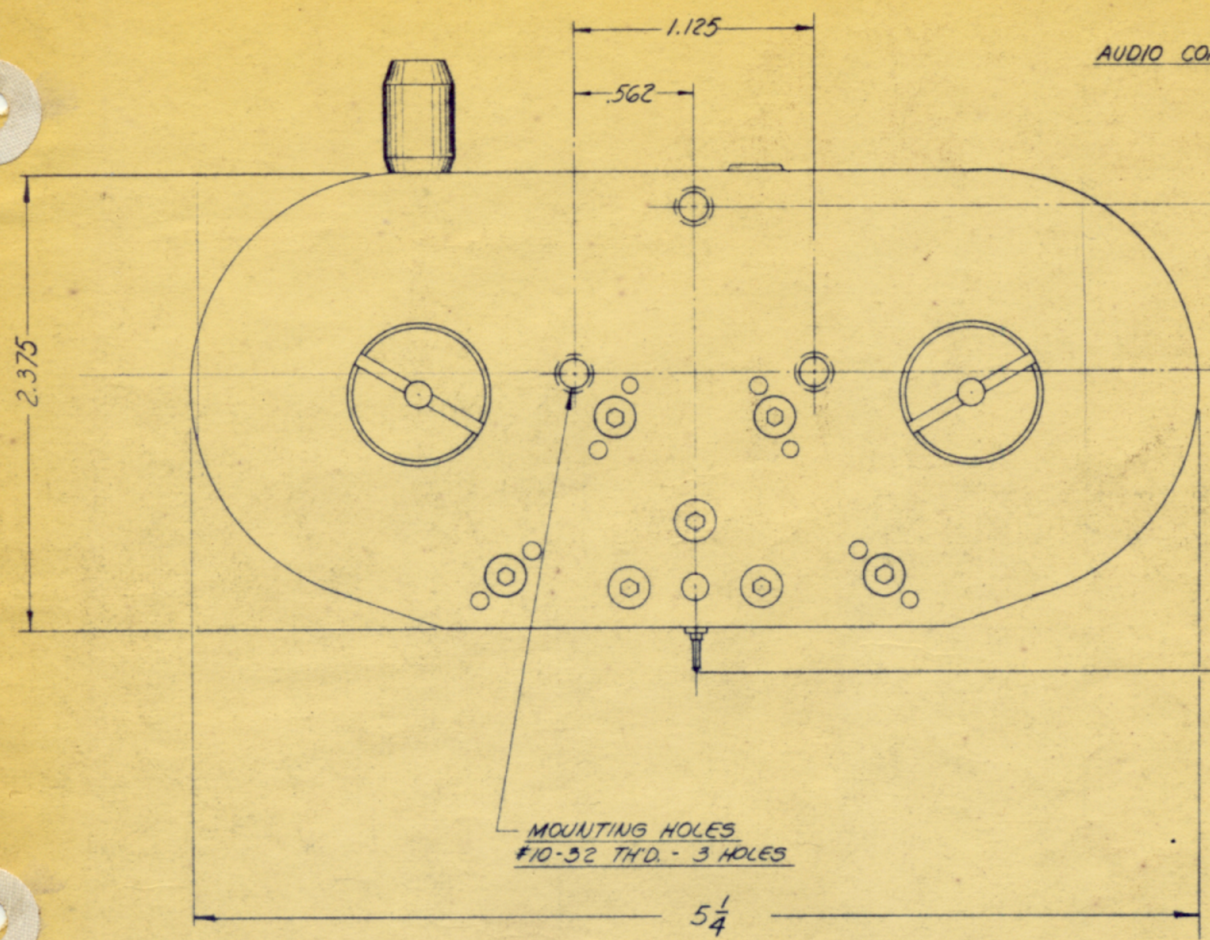
FIG. 4



LATERAL WINDING
N
S
S
N
VERTICAL WINDING
BASIC PRINCIPLE
PIVOT (FLEX BAR)
MAGNETS
MAGNETS ON OPPOSITE SIDE SYMMETRICAL TO THESE BUT ARE OMITTED FOR DWG CLARIFICATION
N
S
S
N
POLEPIECES
STYLUS
POLEPIECES
ARMATURE ASS'Y

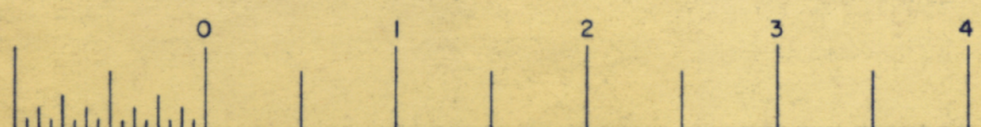
FIG. 5

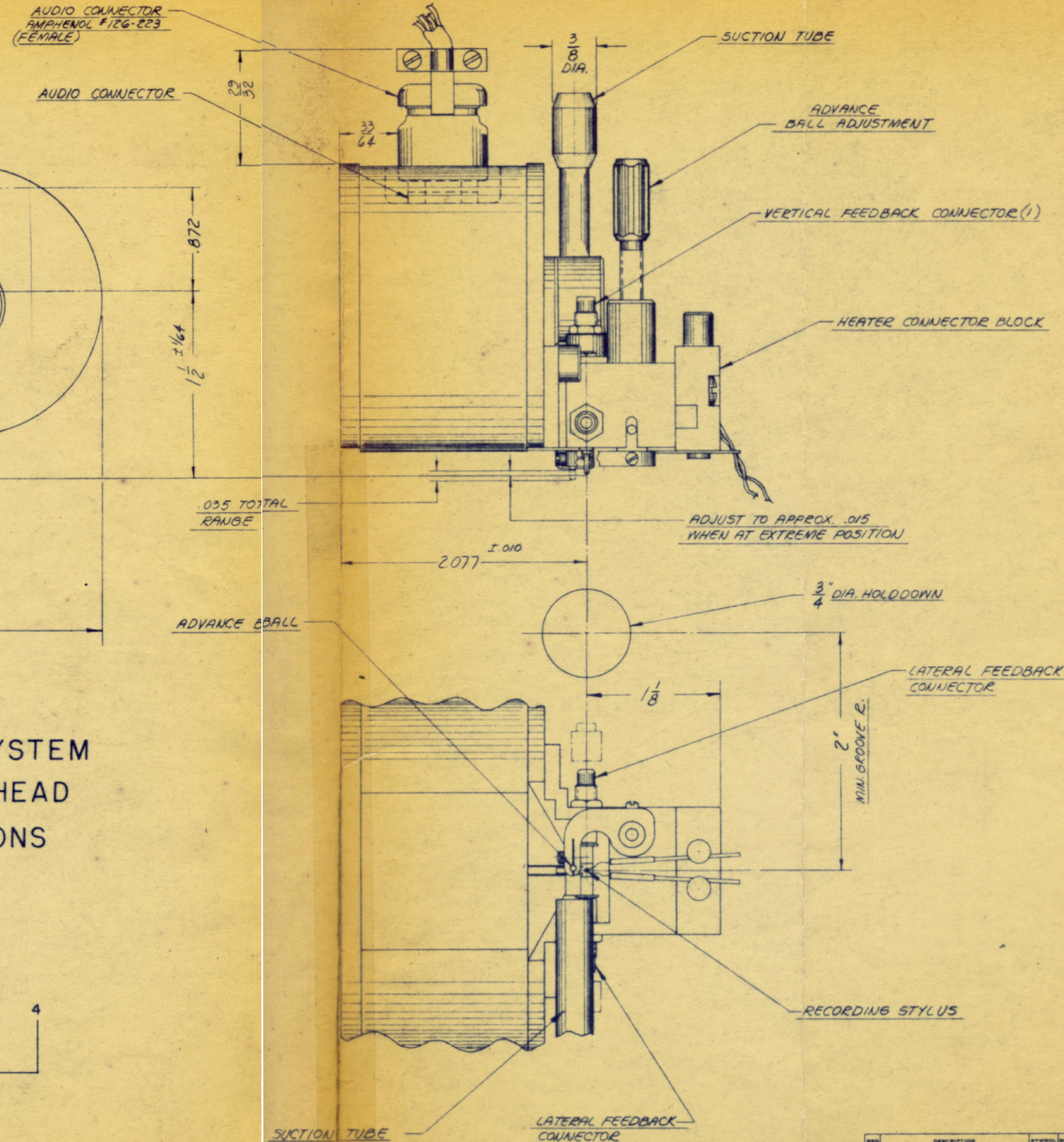
DO NOT SCALE DWG. - WORK TO FIGURES. TOLERANCES - UNLESS OTHERWISE SPECIFIED DEC. DIMS. ± FRAC. DIMS. ± ANGULAR DIMS. ±	DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS' TOLERANCES ARE NOT INCLUDED.	REMOVE ALL BURRS AND SHARP EDGES



FAIRCHILD
641 STEREO CUTTER SYSTEM
MODEL 642 CUTTERHEAD
MOUNTING DIMENSIONS

SCALE OF INCHES:





REQ	DESCRIPTION	SYMBOL	NOTE	DWG NUMBER	ITEM	NEXT ASSEMBLY

MATERIAL ~	NAME	641 CUTTERHEAD OUTLINE DIMENSIONS
HEAT TREATMENT ~		
FINISH ~	FAIRCHILD RECORDING EQUIPMENT CORPORATION 154 ST. & 7 AVE. WHITESTONE, L.I., N.Y.	
DRAWN BY R.E.J.	CHKD BY	DRFTG APP
ENG	PROJECT ENG	ENG APP
SCALE 2:1	NUMBER	G-98008

643 BETA AMPLIFIER BLOCK DIAGRAM

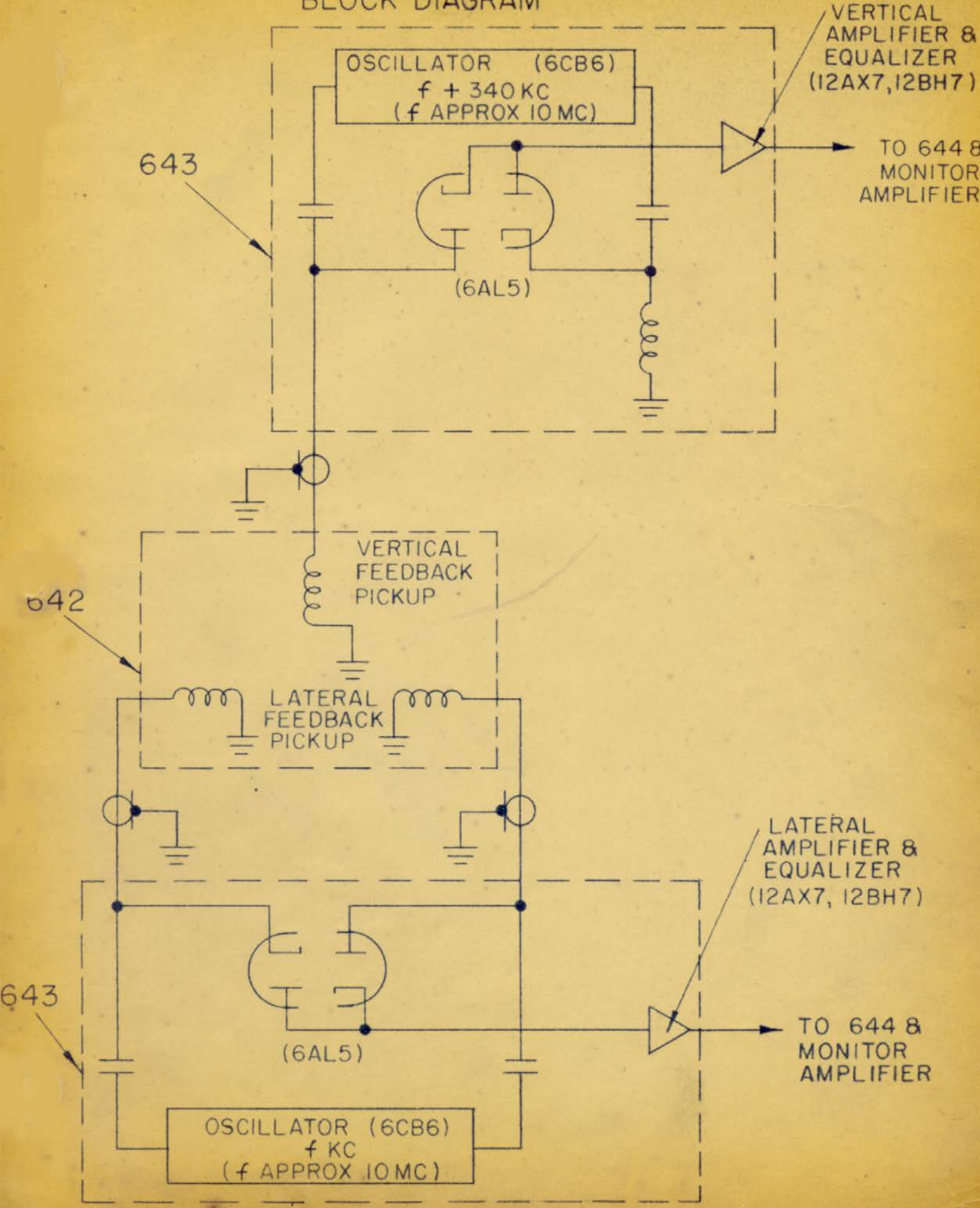


FIG. 7

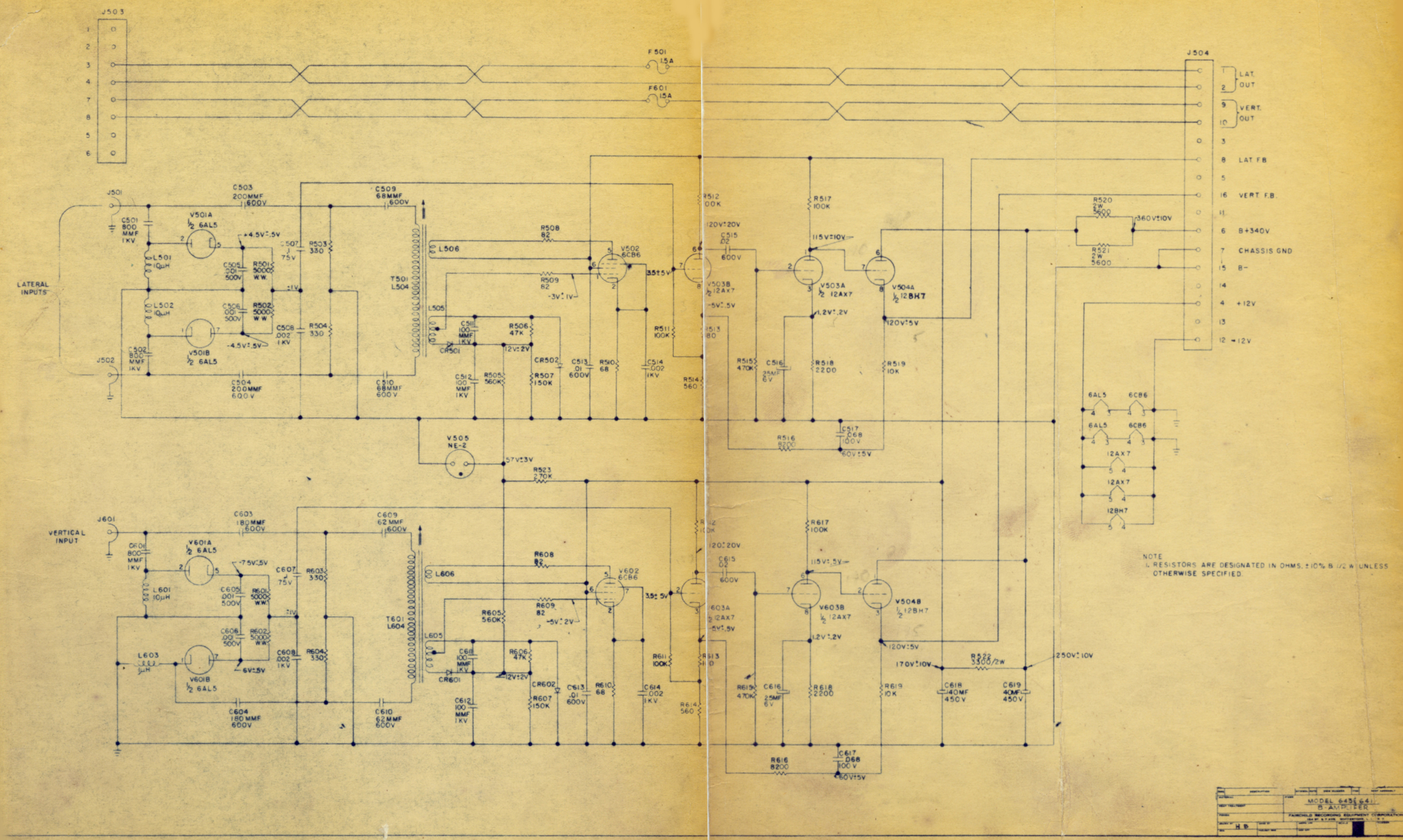

J503
J504
LAT. OUT
VERT. OUT
LAT F.B
VERT F.B.
B+340V
CHASSIS GND
B-
+12V
-12V
LATERAL INPUTS
VERTICAL INPUT
V501A ½ 6AL5
V501B ½ 6AL5
V502 6CB6
V503A ½ 12AX7
V503B ½ 12AX7
V504A ½ 12BH7
V504B ½ 12BH7
V505 NE-2
V601A ½ 6AL5
V601B ½ 6AL5
V602 6CB6
V603A ½ 12AX7
V603B ½ 12AX7
T501 L504
T601 L604
NOTE
1. RESISTORS ARE DESIGNATED IN OHMS, ±10% & 1/2 W UNLESS OTHERWISE SPECIFIED.
MODEL 643 & 641
B-AMPLIFIER
FAIRCHILD RECORDING EQUIPMENT CORPORATION

FIG. 8

DO NOT SCALE DWG. - WORK TO FIGURES.
TOLERANCES - UNLESS OTHERWISE SPECIFIED
DEC. DIMS. ± ~ FRAC. DIMS. ± ~ ANGULAR DIMS. ± ~

DRILL. PUNCH. COMMERCIAL STOCK SIZES AND MANUFACTURERS' TOLERANCES ARE NOT INCLUDED.

REMOVE ALL BURRS AND SHARP EDGES

NUMBER B-98010

ISSUE: / 2-9-60

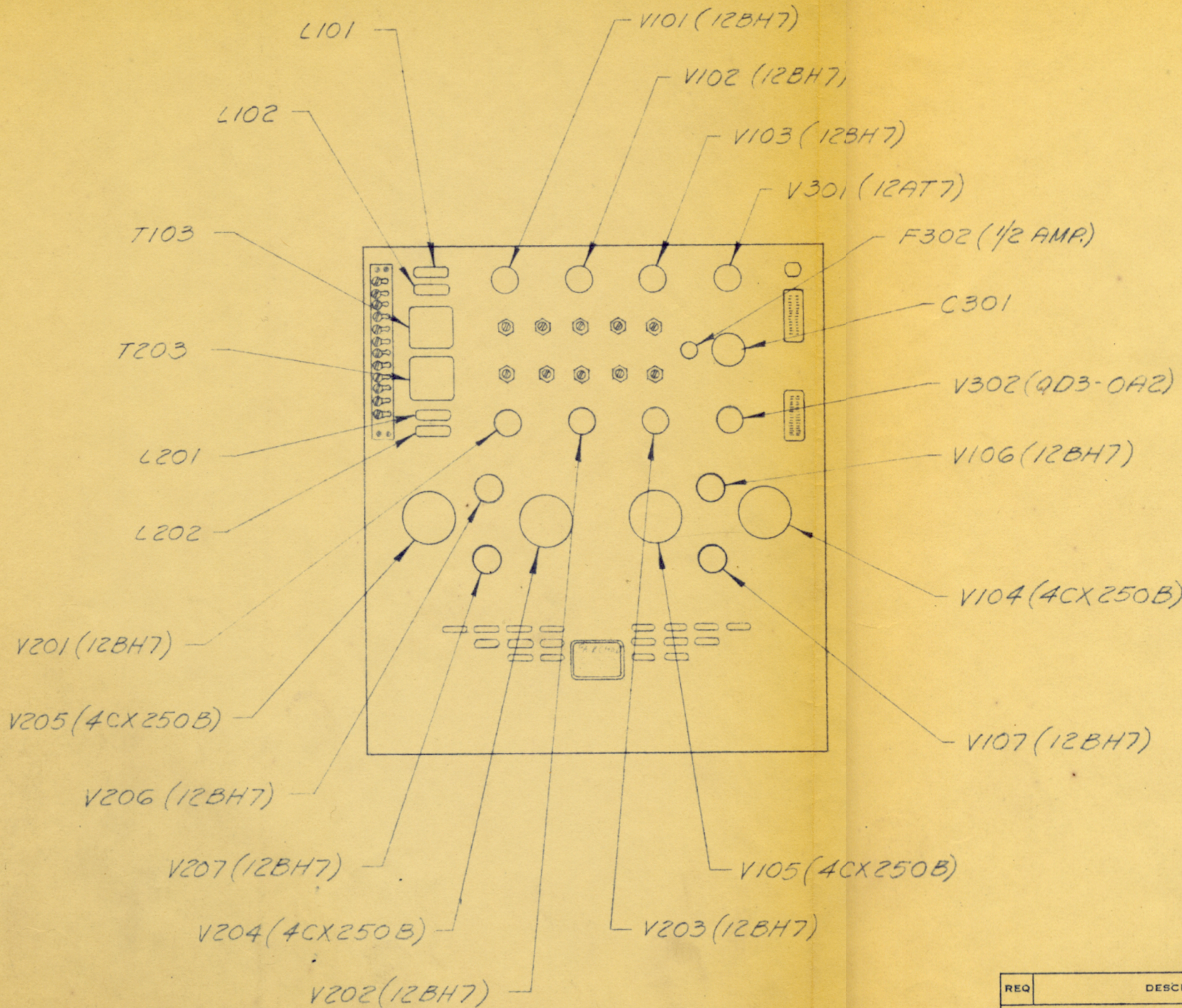


FIG. 9a

REQ	DESCRIPTION	SYMBOL	NOTE	DWG NUMBER	ITEM	NEXT ASSEMBLY

MATERIAL ~

HEAT TREATMENT ~

FINISH ~

NAME: 644 POWER AMPLIFIER COMPONENT LAYOUT (REAR VIEW)

FAIRCHILD RECORDING EQUIPMENT CORPORATION
154 ST. & 7 AVE. WHITESTONE, L.I., N.Y.

DRAWN BY R.E.J. | CHKD BY | DRFTG APP | SCALE ~ | NUMBER B-98010

ENG | PROJECT ENG | ENG APP

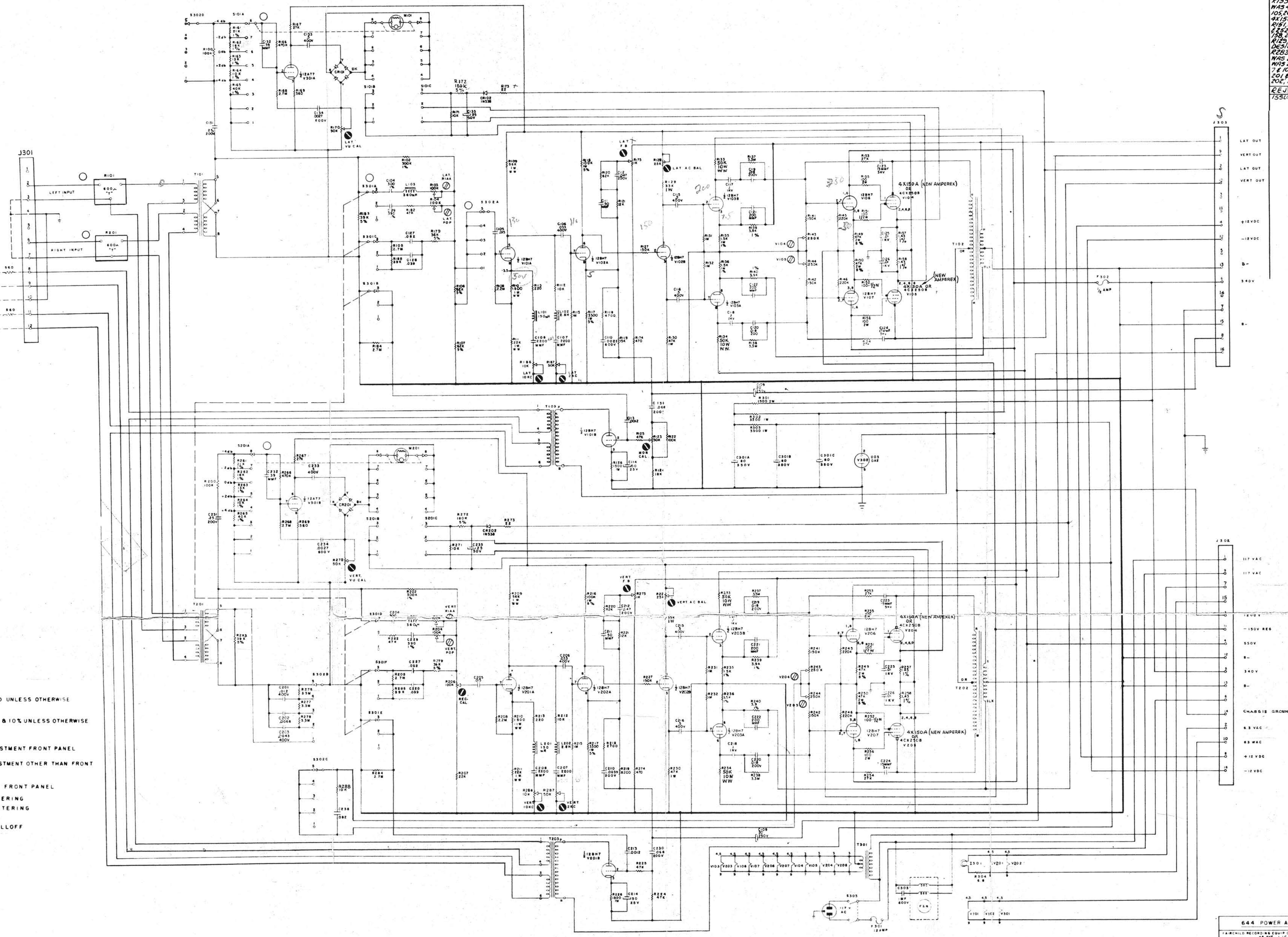
FRE 53B

ISSUE: 1-

R133, 134, 233 & 234 WAS 47K, 2W-5%. V104, 105, 204 & 205 ADDED 4X150A (NEW AMPEREX) R151, 251 WAS 2W. R152 & 252 ADDED 1/2 W. R157, 158, 257 & 258 ADDED 1% R129, 225, 1W ADDED. DESIG. J301 ADDED. R283 WAS 285. R288 WAS 283. IN J302, 7 WAS 2, 15 WAS 10, 2 WAS 7 & 10 WAS 15. V101, 102, 201 & 202 WAS V201, 202, 101, 102, RESP.

R.E.J.		E.G.W.	

ISSUE: 2 9-30-60



NOTE

1 ALL CAPACITORS ARE IN MFD UNLESS OTHERWISE SPECIFIED

2 ALL RESISTORS ARE 1/2 WATT & 10% UNLESS OTHERWISE SPECIFIED

3 SCREWDRIVER ADJUSTMENT FRONT PANEL

4 SCREWDRIVER ADJUSTMENT OTHER THAN FRONT PANEL

5 KNOB ADJUSTMENT FRONT PANEL

6 SWITCH S101 LATERAL METERING
S201 VERTICAL METERING
S301 PREEMPHASIS
S302 VERTICAL ROLLOFF

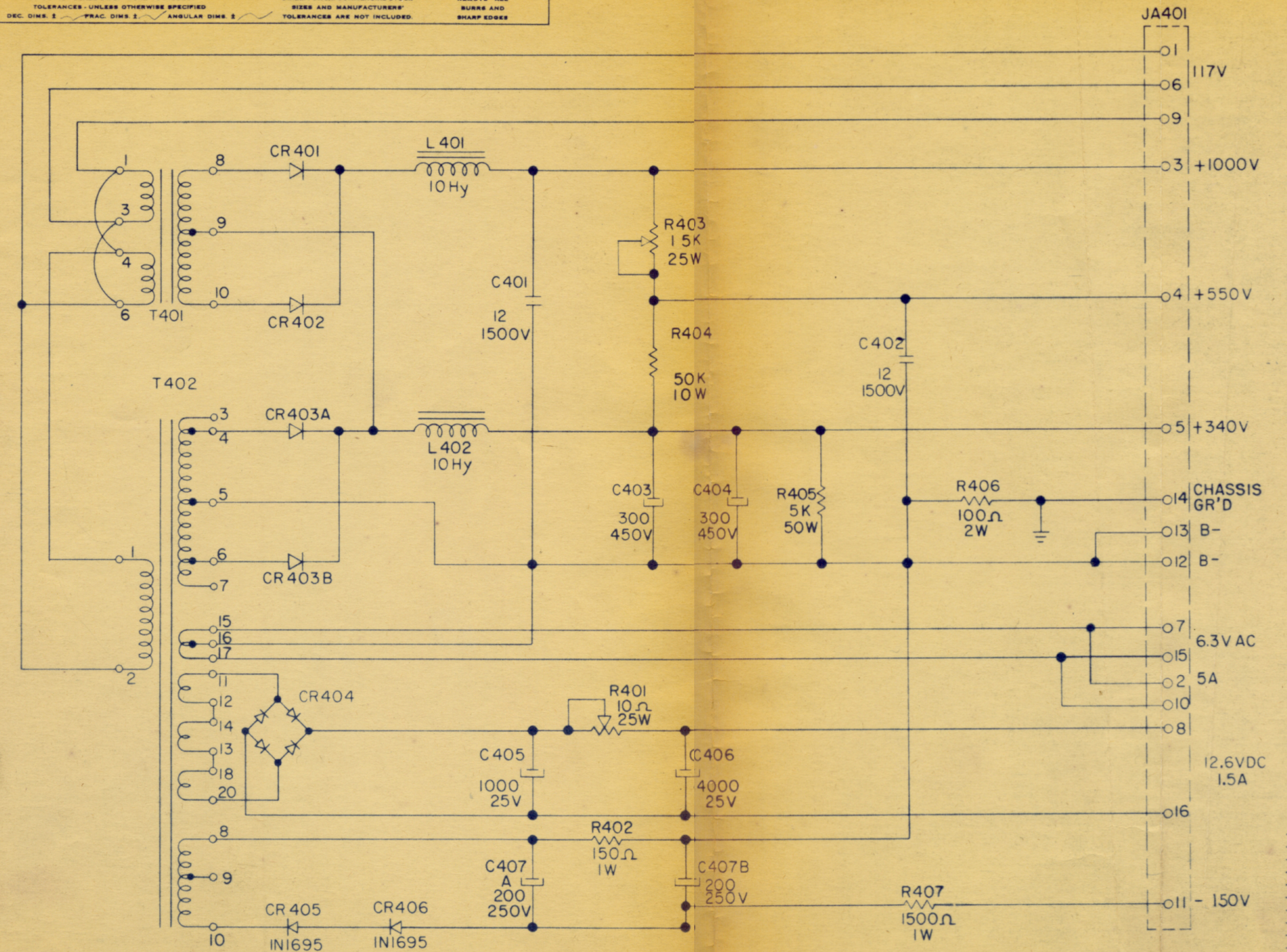
644 POWER AMPLIFIER		
FAIRCHILD RECORDING EQUIP CORPORATION 10-40 45 AVE., L.I.C. 1, N.Y.		
REV / DATE		
DRWN H.B.	DATE 4-1-60	NUMBER R-96052
ENG E.P.S.	DATE	

DO NOT SCALE DWG. - WORK TO FIGURES.
TOLERANCES - UNLESS OTHERWISE SPECIFIED
DEC. DIMS. ± ~ FRAC. DIMS. ± ~ ANGULAR DIMS. ± ~

DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS' TOLERANCES ARE NOT INCLUDED.

REMOVE ALL BURRS AND SHARP EDGES

ISSUE: 1 9-28-59



NOTES
1 FOR 117V AC OPERATION, STRAP 1 TO 4 & 3 TO 6 ON T401. (NORMAL)
2 FOR 220V AC OPERATION STRAP 3 TO 4 ONLY ON T401
3 ALL CONDENSERS MF UNLESS OTHERWISE SPECIFIED

FIG. 10

REQ	DESCRIPTION	SYMBOL	NOTE	DWG NUMBER	ITEM	NEXT ASSEMBLY

MATERIAL ~
HEAT TREATMENT ~
FINISH ~
NAME: 645 POWER SUPPLY SCHEMATIC
FAIRCHILD RECORDING EQUIPMENT CORPORATION
154 ST. & 7 AVE. WHITESTONE, L.I., N.Y.
DRAWN BY R.E.J. | CHKD BY | DRFTG APP | ENG | PROJECT ENG | ENG APP | SCALE ~
NUMBER D-96031

D-96031

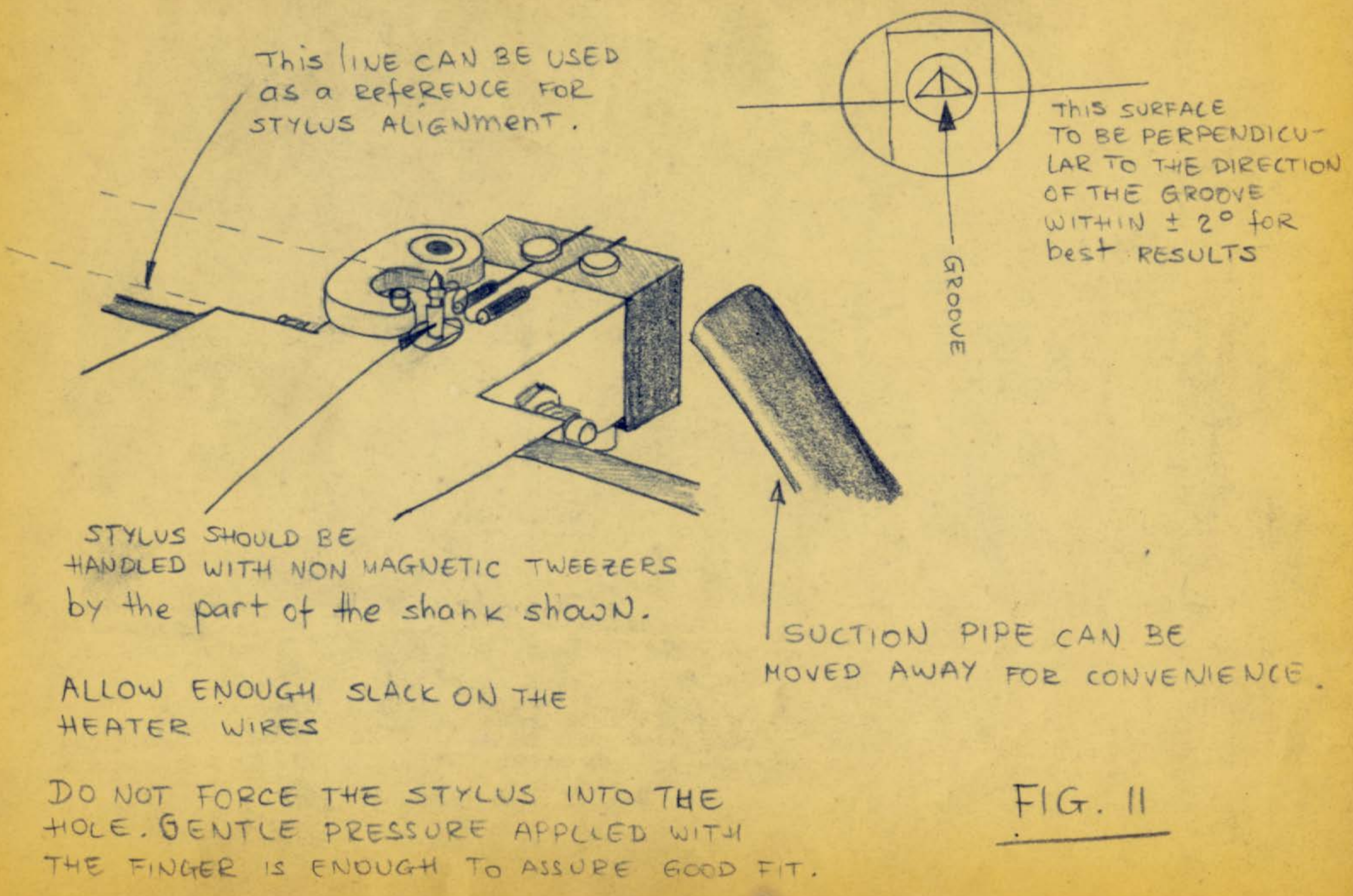
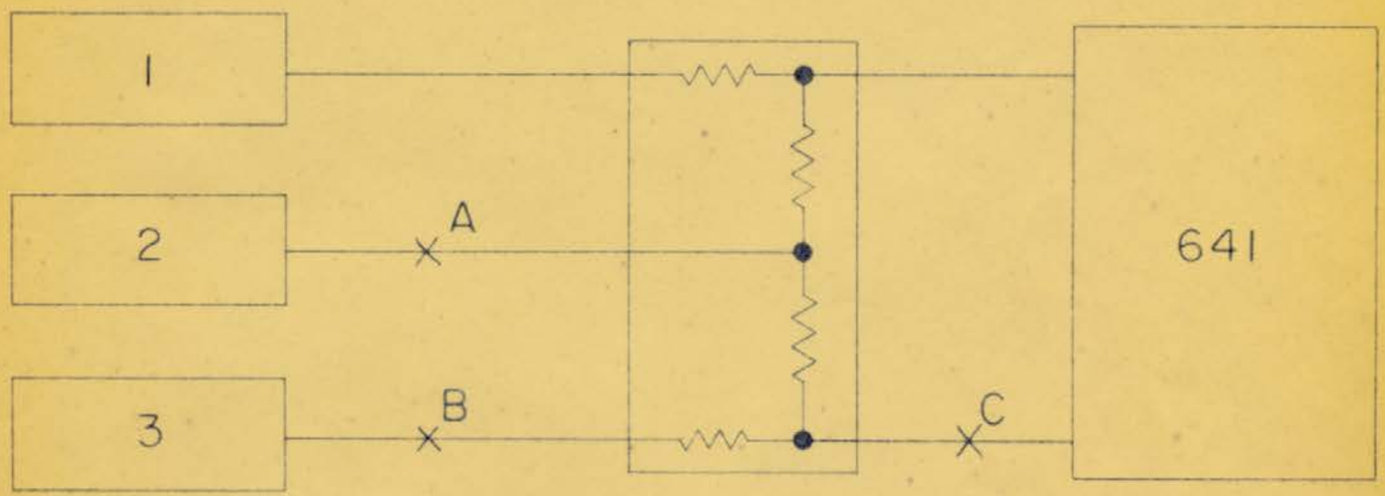

This line CAN BE USED as a reference FOR STYLUS ALIGNment.
THIS SURFACE TO BE PERPENDICULAR TO THE DIRECTION OF THE GROOVE WITHIN ± 2° for best RESULTS
GROOVE
STYLUS SHOULD BE HANDLED WITH NON MAGNETIC TWEEZERS by the part of the shank shown.
SUCTION PIPE CAN BE MOVED AWAY FOR CONVENIENCE.
ALLOW ENOUGH SLACK ON THE HEATER WIRES
DO NOT FORCE THE STYLUS INTO THE HOLE. GENTLE PRESSURE APPLIED WITH THE FINGER IS ENOUGH TO ASSURE GOOD FIT.

FIG. 11



THREE CHANNEL FEED

FIG. 11a

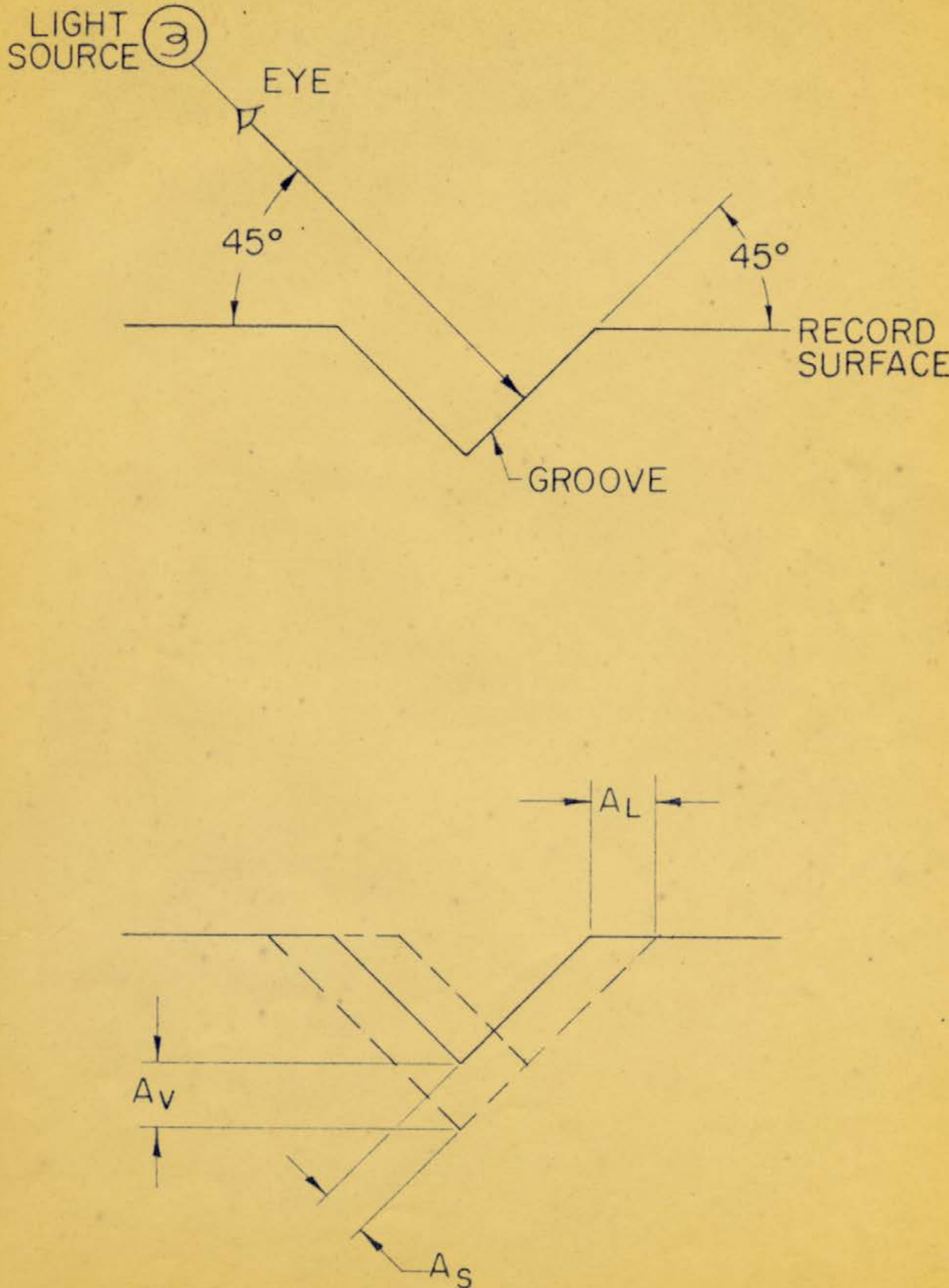
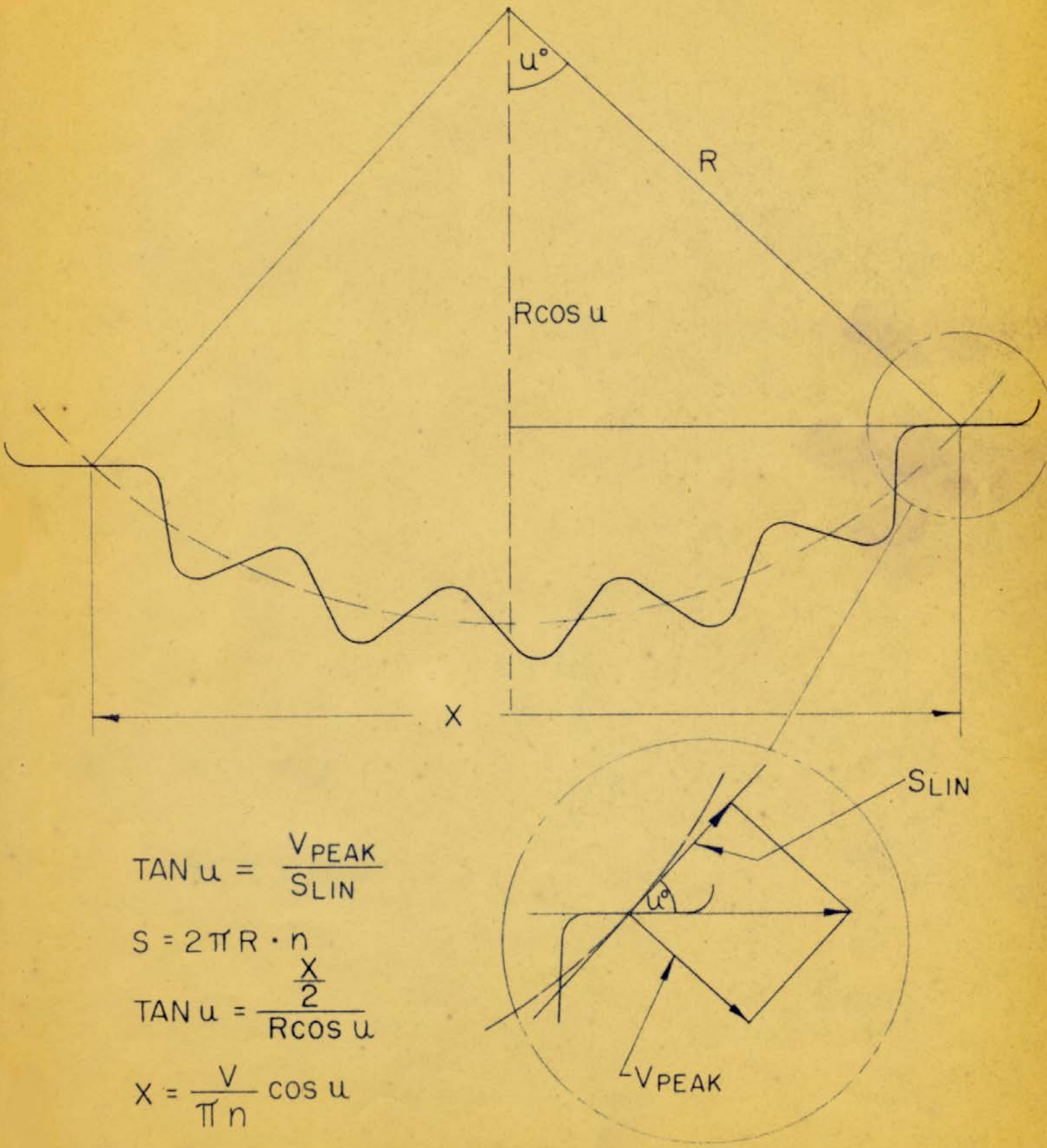


FIG. 12



$$\tan u = \frac{V_{PEAK}}{S_{LIN}}$$

$$S = 2\pi R \cdot n$$

$$\tan u = \frac{\frac{X}{2}}{R\cos u}$$

$$X = \frac{V}{\pi n} \cos u$$

FIG. 13

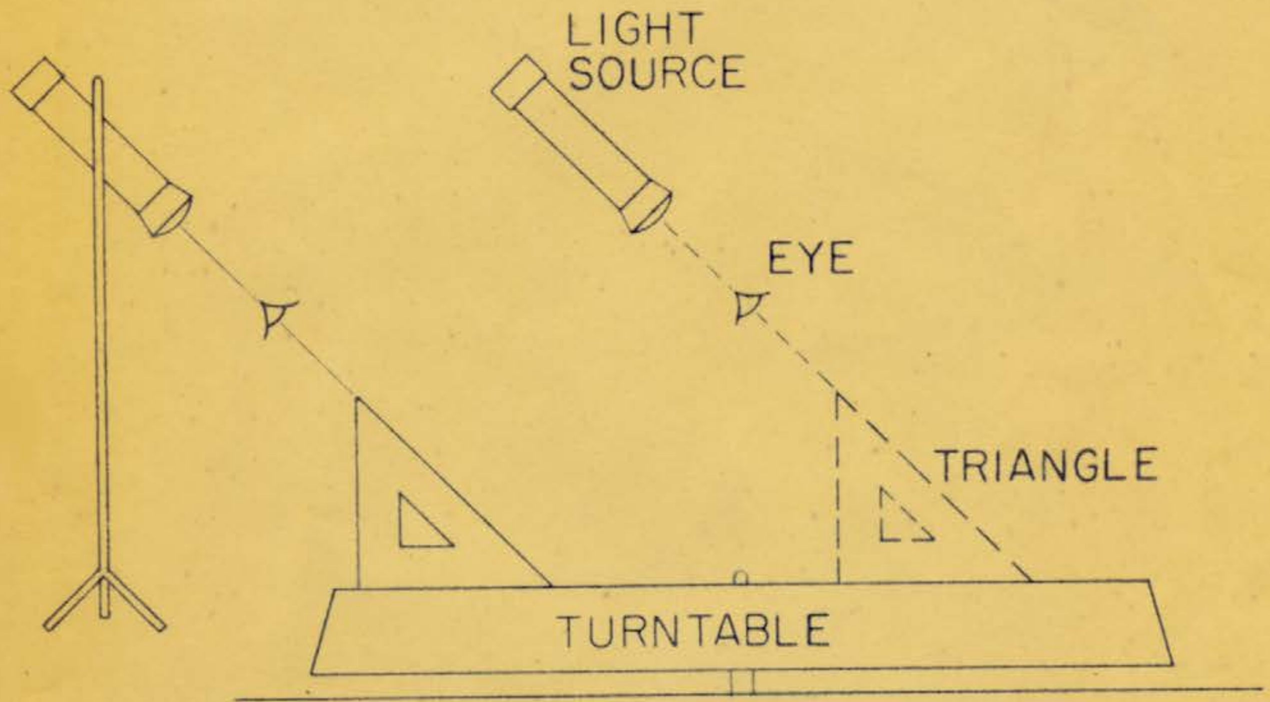


FIG. 14

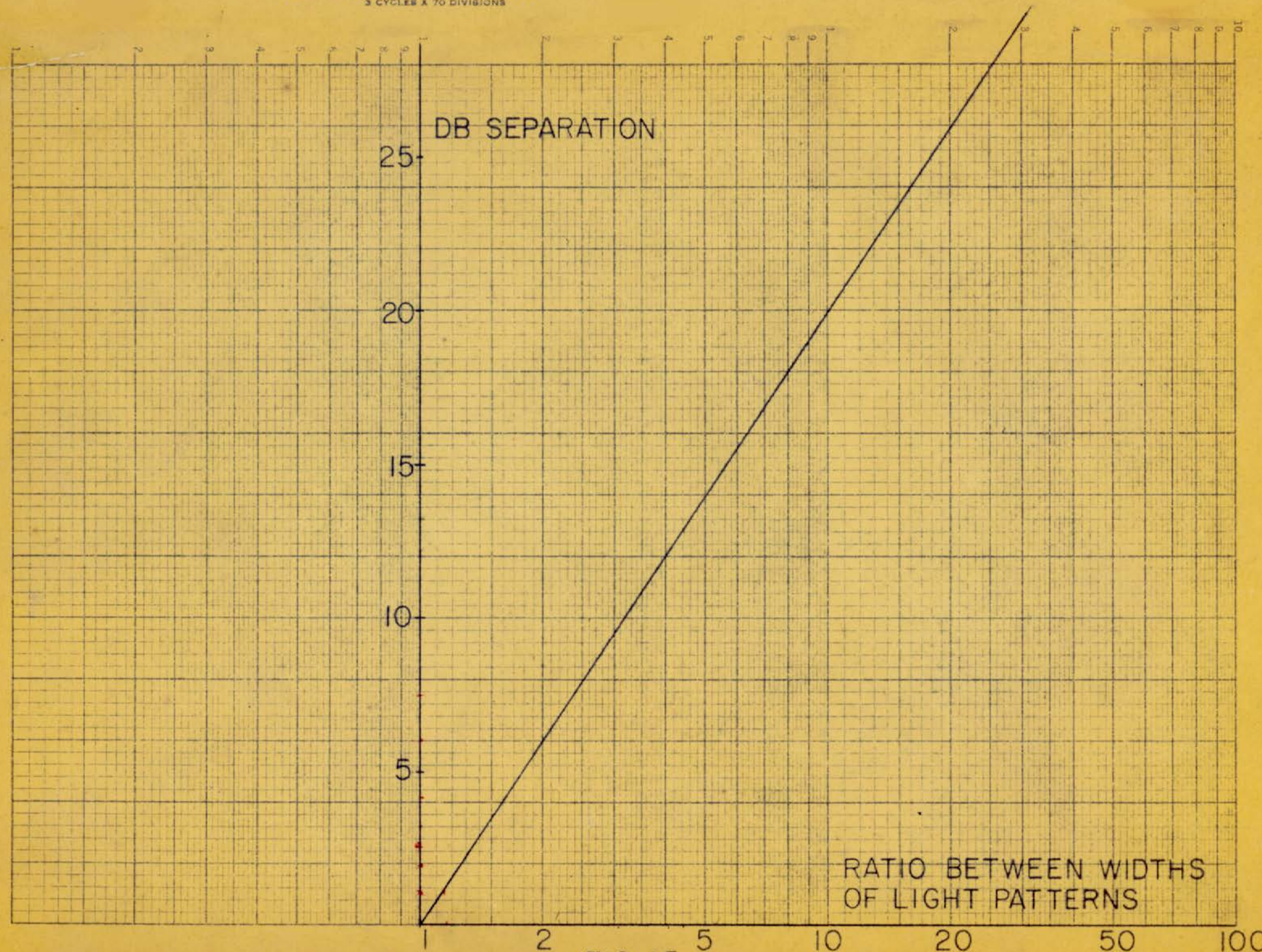

DB SEPARATION
25
20
15
10
5
1
2
5
10
20
50
100
RATIO BETWEEN WIDTHS
OF LIGHT PATTERNS

FIG. 15

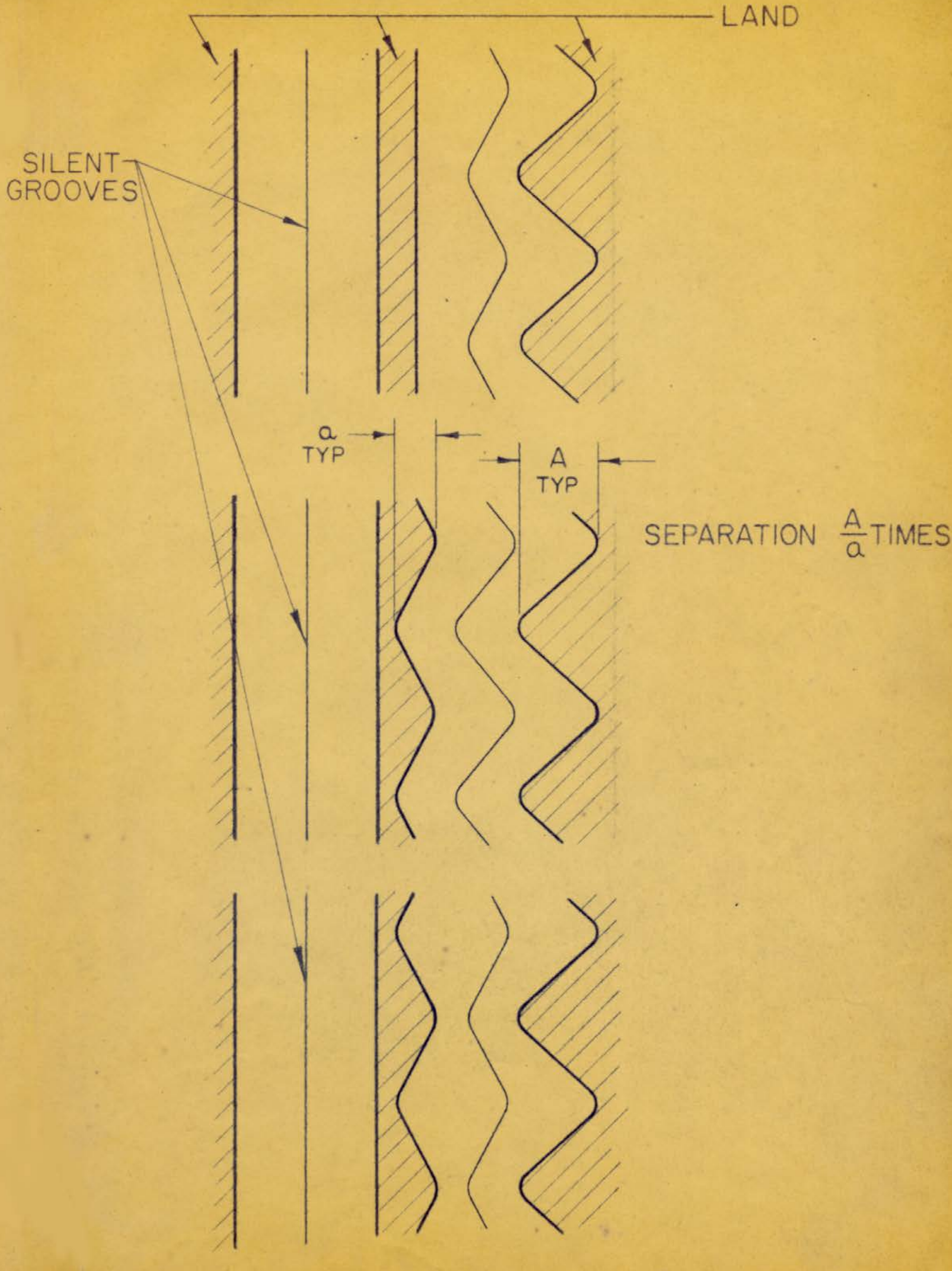


FIG. 16