Museum of Magnetic Sound Recording

preserving the history of sound recording

Museum of Magnetic Sound Recording

©2022 Museum of Magnetic Sound Recording and David Bockholt

Ampex professional photos donated to MOMSR by David Bockholt

David Bockholt's dad Walter Bockholt worked at Ampex from 1958 to 1987. He passed in 1996.



One of the 1962 newsletters from AMPEX in Redwood city where my dad worked listed Ken Patton as the company photographer. He would be the judge for employee photo contests.





Of note, I included a US PATENT invented by my father Walter Bockholt. It has to do with testing and controlling the distortion levels in magnetic recording.

I do not know what some of the equipment in the stack of photos are, but some to have labels on the edge of the photo or you can make out the model number in the photo.

My dad Walter on the far right above







Ampex Pro Photos donated to MOMSR by David Bockholt


AMPEX FR-600

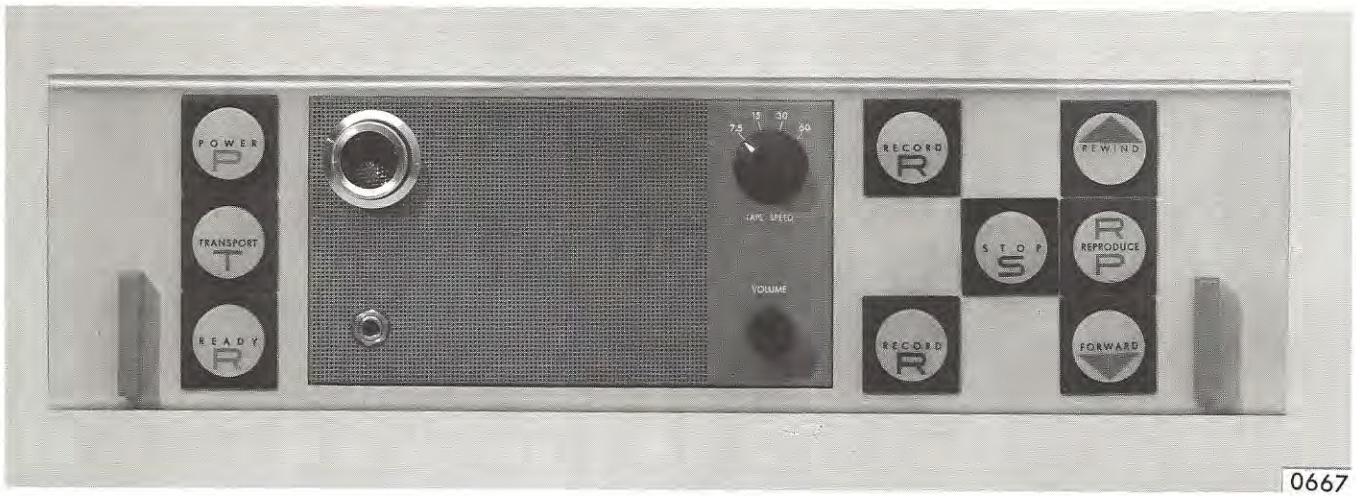


Fig. 6-3
Front Control Panel

control knob (R4) which determines the playback level of recorded information, a phone jack (J216) which permits the information to be heard through a headset rather than the loudspeaker, and a pull-out microphone with a push-to-talk record switch.

The TAPE SPEED selector switch (S4) selects the operating speed of the Tape Transport Mechanism; at the same time, this switch selects the appropriate speed sensitive elements in all electronics assemblies.

At the right-hand side of the Front Control Panel are the normal mode selection buttons. Momentary contact pushswitches labelled RECORD (S12 - S13) when depressed simultaneously, place the system in the RECORD mode; lamps within the buttons indicate that the tape has reached operating speed and that the system has begun recording. STOP pushswitch (S11) stops tape motion from any operating mode. The REPRODUCE pushswitch (S8) places the system in the REPRODUCE mode; a lamp within the button indicates that the tape has reached operating speed and that the system is reproducing data. FORWARD pushswitch (S9) and REWIND pushswitch (S10) move the tape at high speed from reel to reel. (Tape will be moved at either a controlled search speed or at a full speed, depending on the setting of the REWIND - FORWARD SPEED switch on the Inside Control Panel.)

Inside Control Panel (Fig. 6-4)

All special operating modes are controlled from the Inside Control Panel, which becomes visible as the drawer is opened. In addition to the special controls, a circuit breaker (S1), a running time meter, Fuse F1 to protect the System D-c Supply, Fuse F2 to protect the Lamp and Oven supply, and Fuse F3 to protect the Exciter Lamp supply are mounted on the panel.

At the extreme left of the Inside Control Panel is the circuit breaker (S1) through which all system power flows. To the right of the circuit breaker and the tube which protects the microphone cord is the Tape Transport Mechanism running time meter. Three fuseholders for the fuses listed above are located to the right of the meter. Further right is the BIAS DISABLE switch (S14) which disables the Master Bias Oscillator during record level adjustment, and the RECORD TEST switch (S15) which activates all record relays. Both of these switches are connected so as to disable the Tape Transport Mechanism when not in the NORMAL position. A two-position EQUALIZATION switch

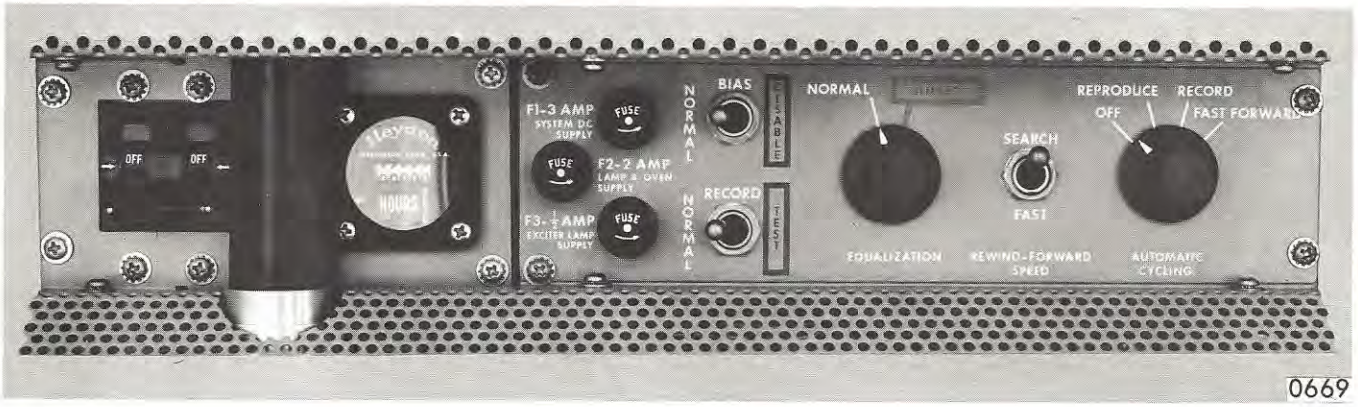


Fig. 6-4
Inside Control Panel

(S5) provides compatibility between FR-600 equipment and earlier magnetic recording systems by halving FM center carrier frequencies and switching filters and equalizers one octave down. The REWIND-FORWARD SPEED switch (S7) determines whether the transport will operate at a full speed fast forward and rewind or at a controlled variable search speed with the heads in contact with the tape. The four-position AUTOMATIC CYCLING switch (S6) operates in conjunction with the footage counter on the Tape Transport Mechanism to permit shuttling of the tape between two pre-selected points in either the REPRODUCE, RECORD, or FAST FORWARD mode. The cycling feature is disabled by leaving the switch in the OFF position.

Electrical Components

Two relays are located on the left side of the System Control Bay; that nearest the front panel is the main power relay (K1) actuated by the POWER switch on the front panel. The second is the transport relay (K2) actuated by the TRANSPORT pushswitch on the front panel. In the left rear corner of the bay is transformer T3, which supplies voltage for the exciter lamps in the Tape Transport Mechanism and for the TRANSPORT and READY indicator lamps. To the right of T3 is T2, which supplies 28 volts a-c for the ovens in the FM Reproduce System and for the remaining indicator lamps. At the right rear of the bay is transformer T1, supplying voltage for the system d-c supply. Transformer T1 and the four capacitors on the right hand side of the bay (C1, C2, C3, and C4) are associated with the vertically mounted circuit card located in front of the transformers. This card contains an 18 volt d-c supply for operation of the Voice Monitor and Master Bias Oscillator modules. Located between the transformers and the four capacitors is a vertically-mounted printed circuit board and relay (K4) associated with the broken tape circuitry which disables transport power when tape is not contacting the inner guides on the Tape Transport Mechanism.

System D-c Power Supply

The System D-c Power Supply produces 28 volts d-c for the operation of remaining system relays and solenoids. Transformer T1 feeds diodes CR1 and CR2, functioning as a full wave rectifier, the output of which is filtered by electrolytic capacitors C1, C2, C3, and C4. The regulated 18 volts d-c for operation of the Voice Monitor and Master Bias Oscillator modules is provided by Q1, operating as a common collector stage whose base voltage is set by CR3. The output of Q1 is applied to the Voice Monitor Module at all times, and to the Master Bias Oscillator through record relay K3 when the system is in the RECORD mode.

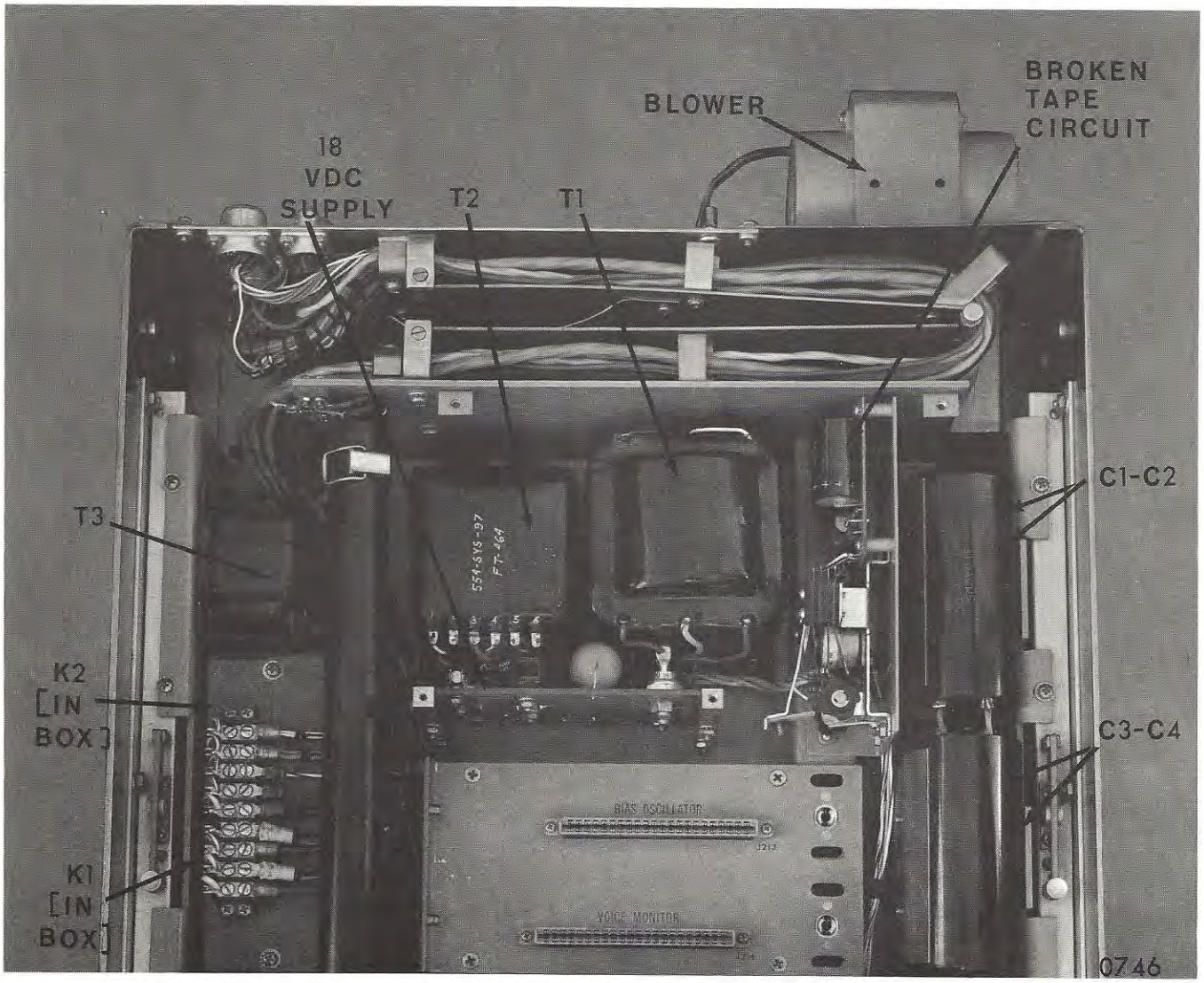


Fig. 6-5
Component Location, System Control Bay

Broken Tape Circuitry

When tape is not properly positioned on the inner tape guides of the Tape Transport Mechanism, the loss of air pressure in the guides causes a switch to trip and apply -28 volts d-c system control power through connecting cables to terminal 23 of the Broken Tape Assembly. Capacitor C6 begins to charge, drawing base current in Q2 which keeps the collector of this transistor at a small negative voltage. While C6 continues to charge this condition will persist, but as C6 nears its fully-charged state, Q2 ceases to conduct and the base of Q3 is pulled negative by R9. This causes current flow in the collector of Q3 to operate K4, a ratchet-impulse two-position relay. This relay is connected with the TRANSPORT switch S3 in the "two-way" circuit; when K4 operates it switches the "active" contact of S3 and, when transport power has been ON, switches it off. TRANSPORT switch S3 must be depressed to restore Tape Transport Mechanism power once K4 has operated. Relay K4 operates only momentarily, since -28 volt power is not present in the transport after K2 is de-energized.

MASTER BIAS OSCILLATOR

Description

The Master Bias Oscillator is used to supply a 1.0 mc bias signal in all systems using Direct Record Modules. This bias signal is subsequently amplified in each of the individual Direct Record Modules before being mixed with the data signal and presented to the record head.

The Master Bias Oscillator (Fig. 6-6) is contained in a silver colored module which mounts in the rear module connector in the System Control Bay. The unit is held in place by a lock fastener. Clockwise rotation of the fastener holds the unit in place; counter-clockwise rotation frees the unit for removal. Two stainless steel panels form a box with the module frame; these side panels may be removed to expose components.

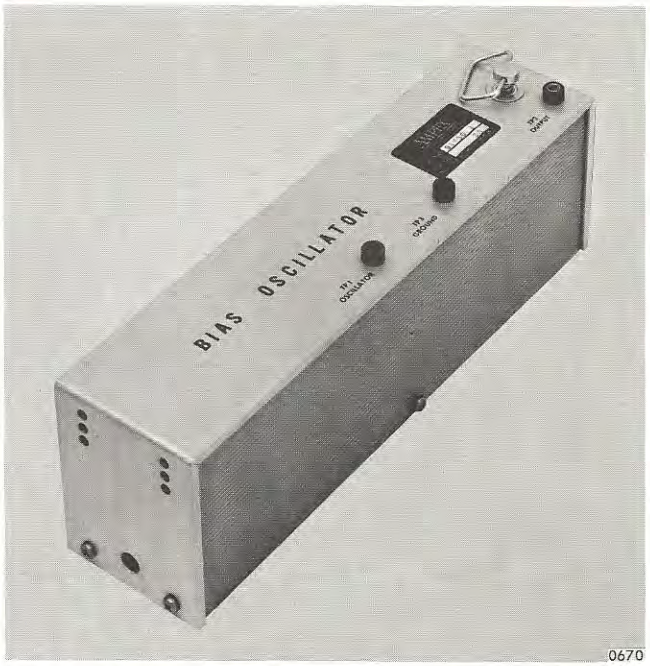


Fig. 6-6
Master Bias Oscillator

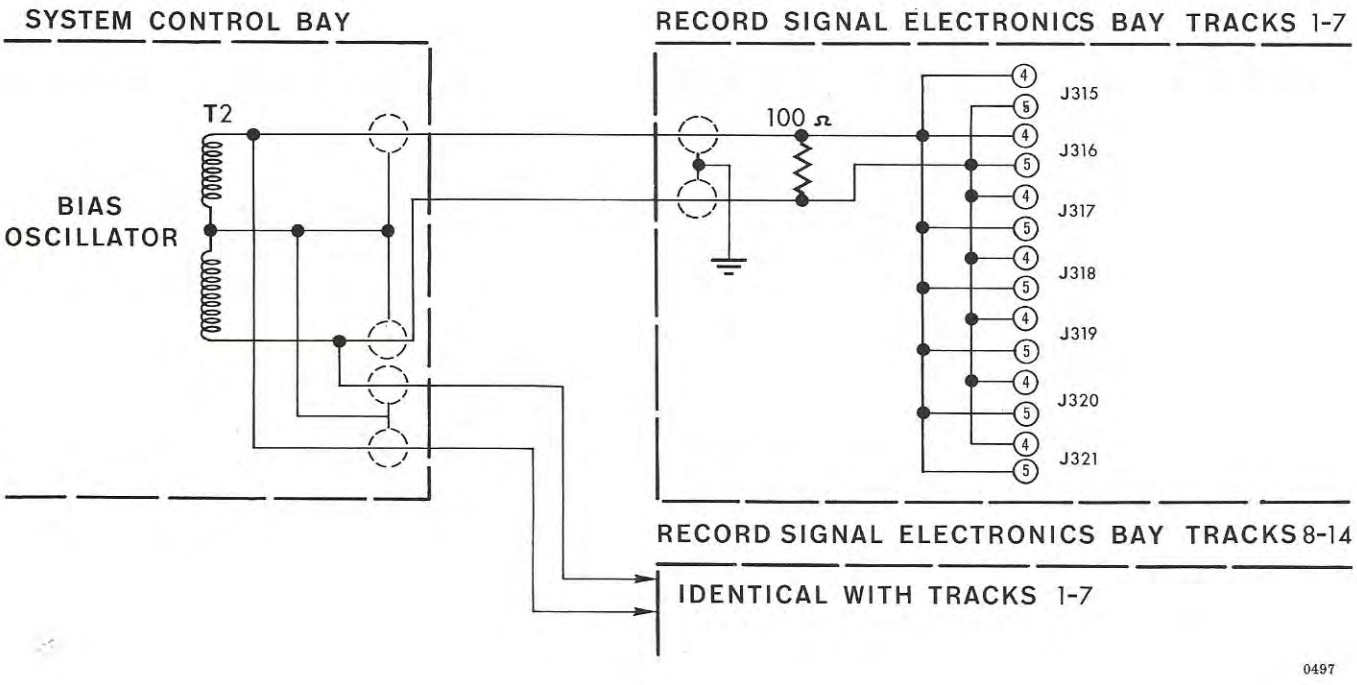


Fig. 6-7
Simplified Schematic, Bias
Distribution System

MASTER BIAS OSCILLATOR

Description

The Master Bias Oscillator is used to supply a 1.0 mc bias signal in all systems using Direct Record Modules. This bias signal is subsequently amplified in each of the individual Direct Record Modules before being mixed with the data signal and presented to the record head.

The Master Bias Oscillator (Fig. 6-6) is contained in a silver colored module which mounts in the rear module connector in the System Control Bay. The unit is held in place by a lock fastener. Clockwise rotation of the fastener holds the unit in place; counter-clockwise rotation frees the unit for removal. Two stainless steel panels form a box with the module frame; these side panels may be removed to expose components.

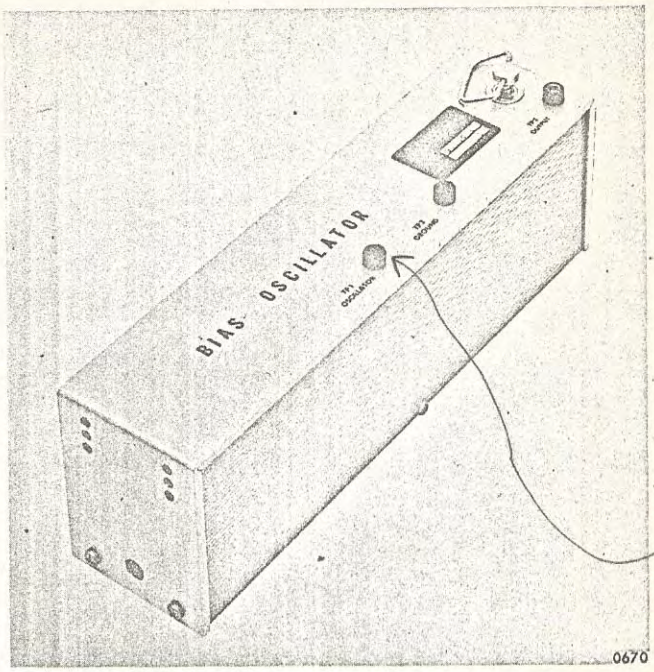


Fig. 6-6
Master Bias Oscillator

INSERT TEST PROBE HERE

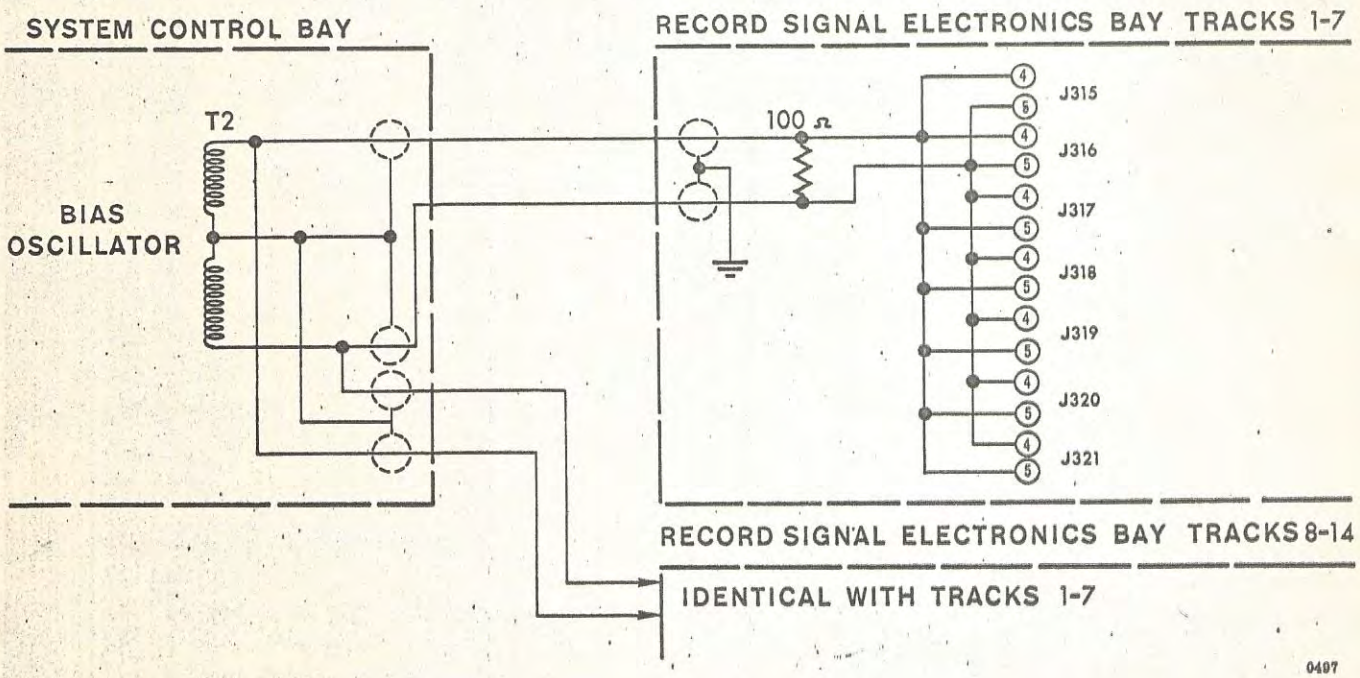


Fig. 6-7
Simplified Schematic, Bias Distribution System



7923-1





KODAK-SAFETY FILM

7923-6







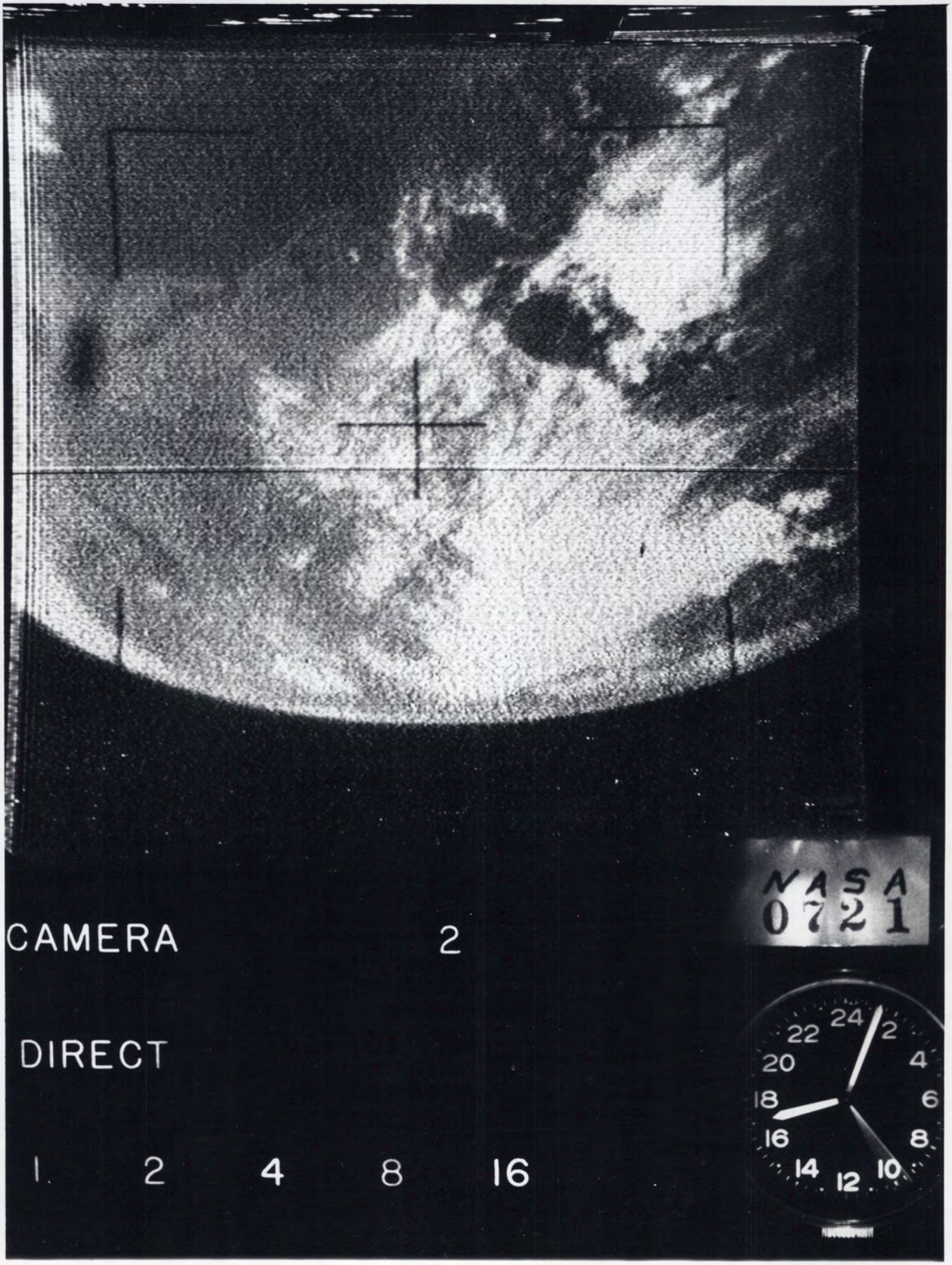


8-5888




PHOTO CURRENT
MOTOR VOLTAGE
MODEL TU-20
AMPEX


HIGH
OUT
LOW
IN
RANGE
PHOTO CURRENT
CURRENT
ADJUST
MAX
MOTOR VOLTAGE
+15V
-15V
SUPPLY
-30V
TAKE-UP
AIR PRESSURE
P.S.I.
AMPEX
MODEL TU-20



TIROS I

Space Navy System


AMPEX
CALIBRATE
VOLTS
POWER
OFF
ON
CALIBRATE
OUTPUT
ZERO ADJ
METER
DIRECT
LEVEL
INPUT
OUTPUT
RECORD
SPEED



FIELD SERVICE MEMO

DATE: APRIL 20, 1961
MODEL: FR-600
MEMO NO: 45

COMMON MODE REJECTION AND THE LOW LEVEL OSC. MODULE (VCO)

1. What is common mode voltage? (CMV)

The difference in potential that may exist between the source or transducer ground and the VCO (or any DC amplifier) ground. (See Figure 1)

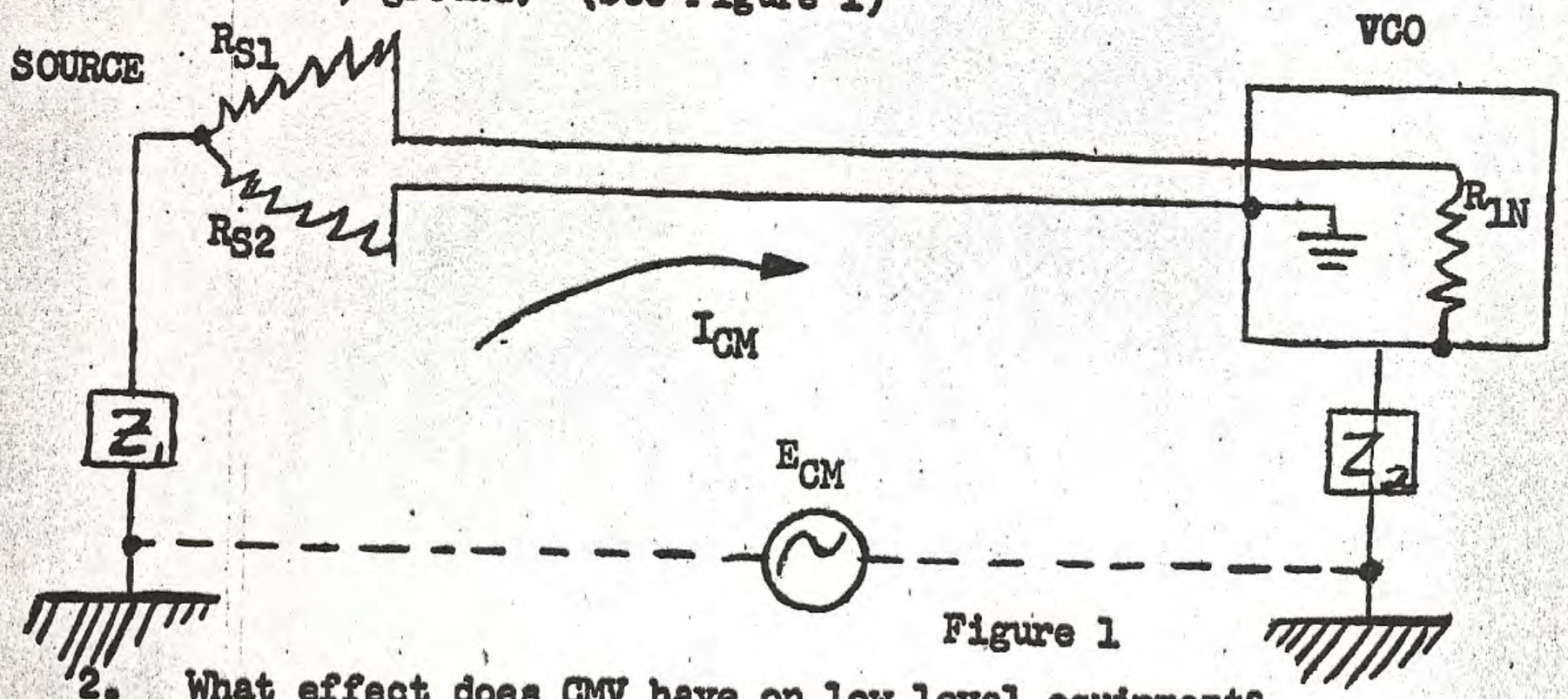


Figure 1

2. What effect does CMV have on low level equipment?

From Figure 1 it is clear that if any common mode current flows through R_{S2} a voltage will be developed across this resistance that will give an unwanted signal at the input of the VCO.

(a) How serious is this?

That depends on many things. For example: magnitude of E_{CM}, Z_1, Z_2, R_{S2}, and the output voltage of the source. In most low level systems it is <u>very</u> serious. Let us look at a possible case where the VCO might be used. Imagine the customer has a strain gage bridge grounded to a common power supply. In this configuration $Z_1 \simeq 0$ and a floating VCO is needed. (See Figure 2)

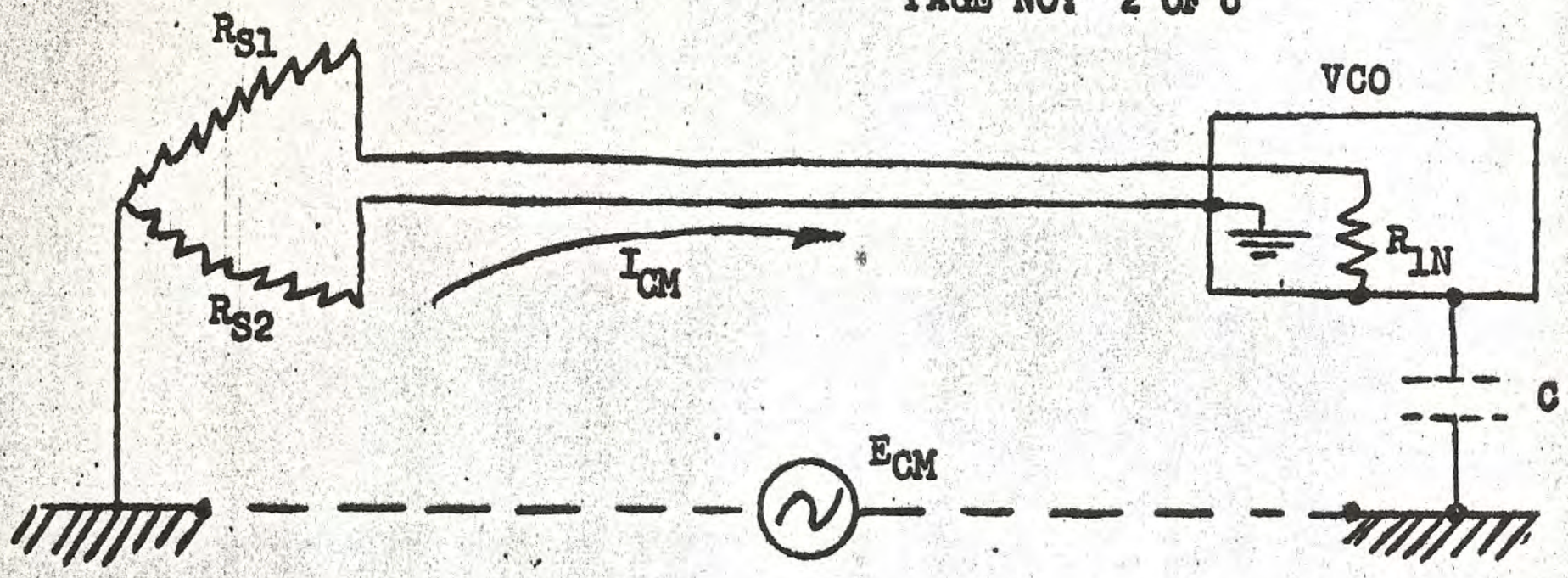


Figure 2

Let: E_{CM} = 4 v rms, 60 cps (It is not unusual to find this high in actual installations.)

R_{S2} = 500 Ω

C = 100 uuf

Then: $I_{CM} = \frac{4}{500 \angle Z_C} \sim \frac{4}{Z_C}$

$= \frac{4}{26.5 \text{ meg.}} = .151 \text{ uA}$

This would produce an unwanted signal voltage of:

$E_{S2} = I_{CM} R_{S2} = 0.151 (10)^{-6} (500)$

$+ \underline{75.5 \text{ uV}}$

If we operate the VCO in the 2 mv position and we say that no one source of system error should contribute more than 0.1%, then 0.1% of 2 mv is 2 uV. Clearly, 75.5 uV will not do.

3. How can CMV problems be solved? (How can common mode rejection be achieved?)

(a) Float the source. This increases the impedance of the ground loop and reduces common mode current. Unfortunately this cannot always be done. As pointed out earlier, several strain gages are often powered from a common supply. Then too, very often thermocouples are welded to the test frame, which is grounded.

(b) Run a buss bar between source and VCO ground. This doesn't work too well for two reasons:

(1) If the impedance of the earth path is low, then the additional strapping doesn't give much improvement.

(2) Even a perfect buss bar cannot prevent a CMV caused by AC magnetic fields in the loop comprised of the buss bar and the source to VCO signal wiring.

(c) Balanced input to a differential amplifier. (See Figure 3)

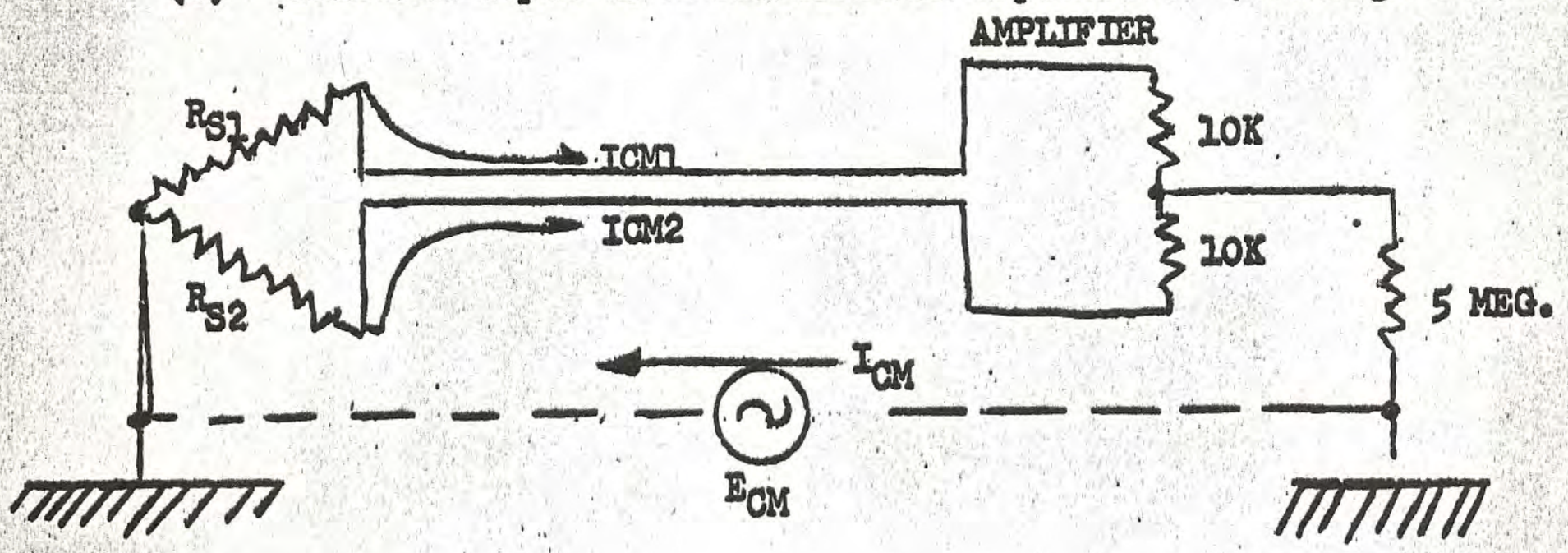


Figure 3

In this type of arangement R_{S1} must equal R_{S2} so $\frac{1}{2}$ of the common mode current will go through each of the source resistors and thus produce unwanted voltages that are equal. (I_{CM1} must equal I_{CM2}) This has no effect on the amplifier input.

But what if the source resistors are not equal? Then you are in trouble, as the amplifier will see an unwanted signal. Thus there is always great concern in this type of equipment with how much unbalance to ground exists in the source. (In our equipment, the amount of source unbalance does not matter. THE LOWEST RESISTANCE, HOWEVER, SHOULD GO TO THE VCO GROUND.) (See Figure 2)

(d) Float the amplifier. This requires tranformer coupling and is expensive. It is, never-the-less, widely used and is a big step in the right direction.

(e) Guard Shield around floating amplifier. Our VCO uses this approach.

4. What does the guard shield do for us.? (See Figure 4)

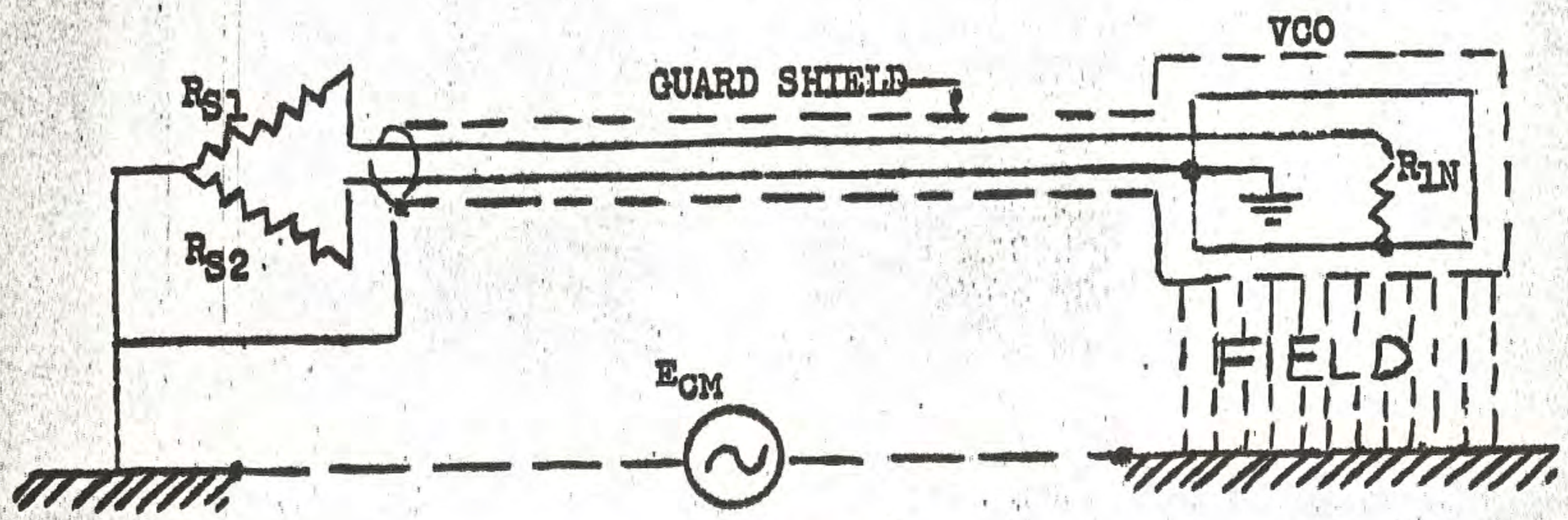


Figure 4

With this arrangement the AC field that formerly went to the VCO case now terminates on the guard shield. The CMV is still on the VCO, but there is no current flow through the source resistor.

In the real life case this looks like Figure 5.

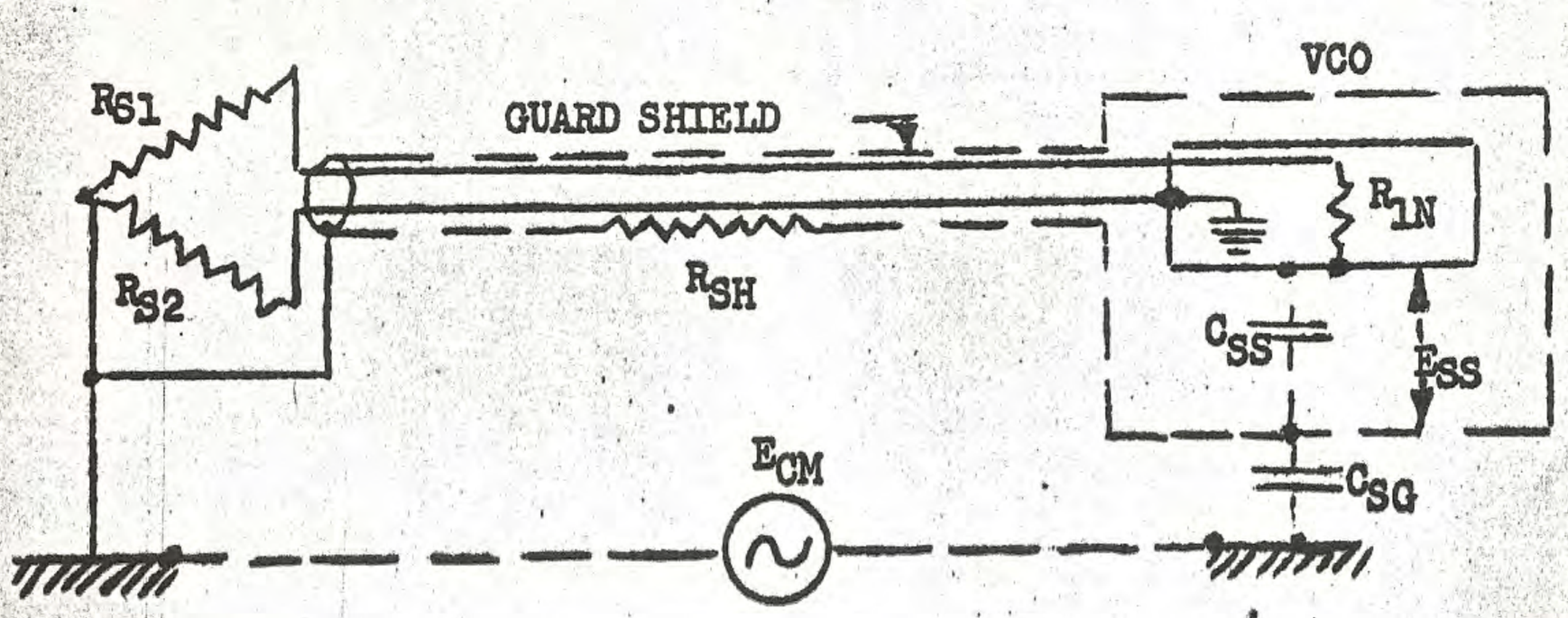


Figure 5

If this were an ideal shield, then there would be no drop in the cable shield and no E_{CM} between guard shield and inner shield (or amplifier case). This, of course, is not the case and so a voltage e_{SS} must exist between shields. How harmful is this voltage?

That is because of the imperfect nature of the shield how much current will flow in the source resistance and what error voltage will be produced?

Let: C_{SS} = 3000 uuf

C_{SG} = 100 uuf

R_{S2} = 500

E_{CM} = 4 v rms, 60 cps

R_{SH} = 5 Ω (probably much less)

Then $e_{SS} = I_{SS} R_{SH}$

$$= \frac{E_{CM}}{Z_{SG} \not / R_{SH}} R_{SH} \approx \frac{E_{CM} R_{SH}}{Z_{SG}}$$

$$= \frac{(4)(5)}{26.5\,(10)^6} = \frac{.755 \text{ uV} = e_{SS}}{}$$

We can now see that high resistance in the wire shield (5 Ω) and capacitance on the order of 3000 uuf between guard shield and inner shield produces only a very small voltage between shields, even with 4 V or CMV. This small voltage (0.75 uV) will of course cause some current to flow in the source resistor R_{S2} but it is easily shown that this causes only a very small error signal to be sent to the VCO.

EXAMPLE:

$$\text{Error current} = I_E = \frac{e_{SS}}{R_{S2} \not / Zc_{SS}}$$

$$\text{Error Voltage } E_E = (I_E)(R_{S2})$$

$$= \frac{e_{SS}}{R_{S2} \not / Zc_{SS}} (R_{S2})$$

$$E_E = \frac{0.75(10)^{-6}(500)}{500 \not / 26.5(10)^6} \approx \frac{.75(500)(10)^{-12}}{26.5}$$

$$\approx \underline{14.1 \text{ uuV} = E_E}$$

This is about 100 times smaller than necessary so all is well as far as capacitance between shields or resistances in the cable shield causing common mode error signals. To be complete, however, it must be noted that the transducer must drive any capacitance that exists between shields. How serious is 3000 uuf on the transducer source? In the examples we have used, if the transducer were 500 Ω then at what frequency would the 300 uuf look like 500 Ω.

This would be the 3 db point and we would like it to be well above the 20 kc bandwidth of the V.C.O.

$$Z_C = \frac{1}{WC} = \frac{1}{2\pi fc} = 500\,\Omega$$

$$500 = \frac{(10)^{12}}{2\pi\,(3000)(f)}$$

$$f = \frac{(10)^{12}}{500\,(2\pi\,)(3000)} = .111(10)^6$$

$$= \underline{111 \text{ kc} = f}$$

Common Mode rejection in our VCO is based on the concept of a guard shield and no doubt should exist at this time as to its necessity. Why an inner shield? (See Figure 6)

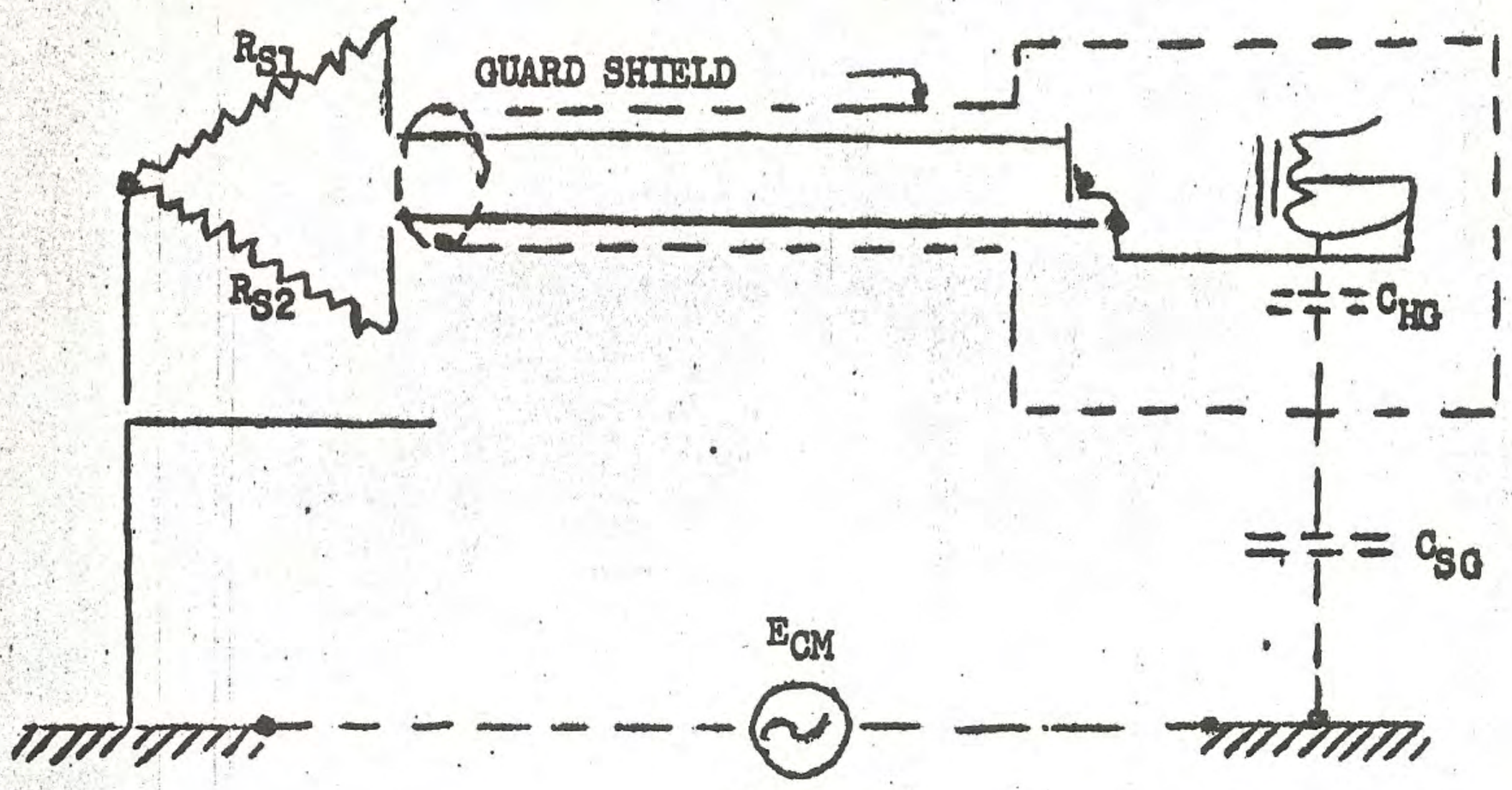


Figure 6

Inspection of Figure 6 will show that any capacitance between the guard shield and points within the electronics on which appear sizeable AC voltages will result in capacitive current through R_{S2} giving an unwanted signal. Thus, the sole purpose of the inner shield is to contain electric fields due to AC voltages within the electronic circuitry.

In Review:

(1) Common mode voltage (CMV) is the voltage difference between transducer ground and amplifier or VCO ground.

(2) Common mode rejection (CMR) is the ability of the equipment to reject this voltage and not produce an output proportional to the CMV.

(3) CMR is achieved in our equipment through the use of a floating VCO enclosed within a guard shield. This is not the only possible method, but it appears to be the best.

(4) The VCO guard enables any current caused by CMV to flow without passing through the source resistance.

(5) The VCO inner shield is to protect the guard from the AC voltages of the electronics, so as to prevent capacitive currents from flowing in the source resistance.

SUPPLY AND PAPER COSTS:

METHOD	MASTER	+ SUPPLIES & PAPER
Mimeograph	.16	2.60/1000 copies
Ditto	.027	2.45/1000 copies
Multilith	.015	2.45/1000 copies
Xerox	--	50.00/1000 copies

OFFSET MASTERS CAN BE MADE:

By typing

Xerox copying

Thermofax copying

Verifax copying

Photography

Pencil Drawing

Pen Drawing

Rubber stamping

ADVANTAGES:

Easier to correct

Lower Cost

New dry masters can be printed

Higher quality print - Professional looking

Time savings

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75
PAGE NO.: 1 of 1

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75
PAGE NO.: 1 of 1

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61

FIELD SERVICE MEMO

DATE: June 23, 1961
MODEL: FR 100 SERIES
MEMO NO.: 75

ERASE OSCILLATOR NO. 41080

SCHEMATIC NO. 41081

Sufficient head current for erasure depends on LC resonance in the output stage consisting of transformer T2, the head cables, and the erase head.

The following currents should be obtained for approximately 55 db erasure at 60 IPS. This is measured at TP1 and TP2 and calculating the current across R6, 2.7 ohms.

1 inch head	175 - 225 ma
1/2 inch head	140 - 175 ma
1/4 inch head	120 - 150 ma

Because of variances in component values, cable length and capacity, head resonance, it may be necessary to perform the following steps to achieve proper operation.

1. Tune C8 for maximum output. It should be possible to go through resonance. If not try adding approximately 200 to 300 uufd capacitor across C8.

   If the desired results are not obtained perform Step 2.

2. Connect an oscilloscope from terminal 2 of T2, to ground. Decouple the output circuit by detuning C8. Add capacity in parallel across C6 and C7 in 50 mmfd steps until maximum output is obtained. Usually a total of 1100 to 1200 mmfd for C6 and C7 will suffice.

JERRY HERFIELD
6-23-61























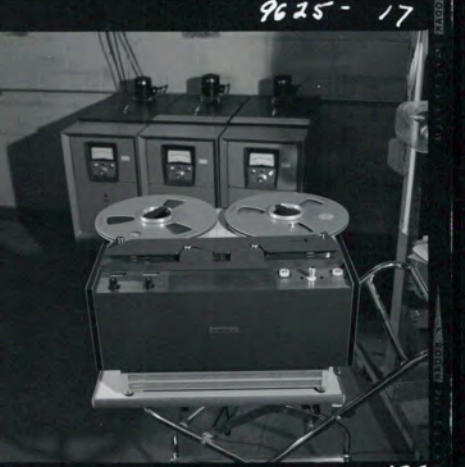


SP-600







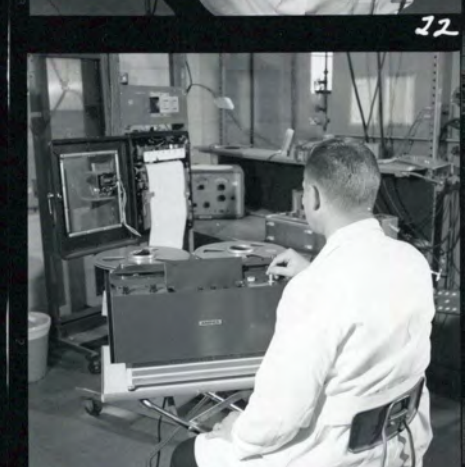






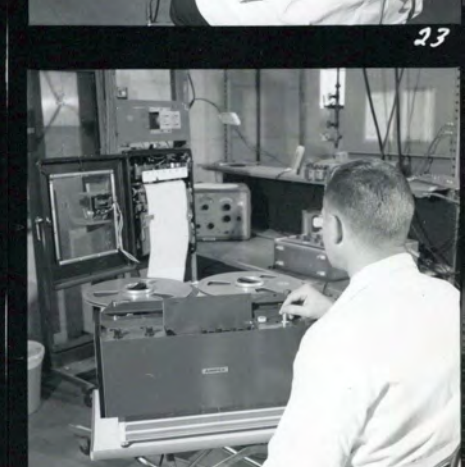












SP-600



9444-5

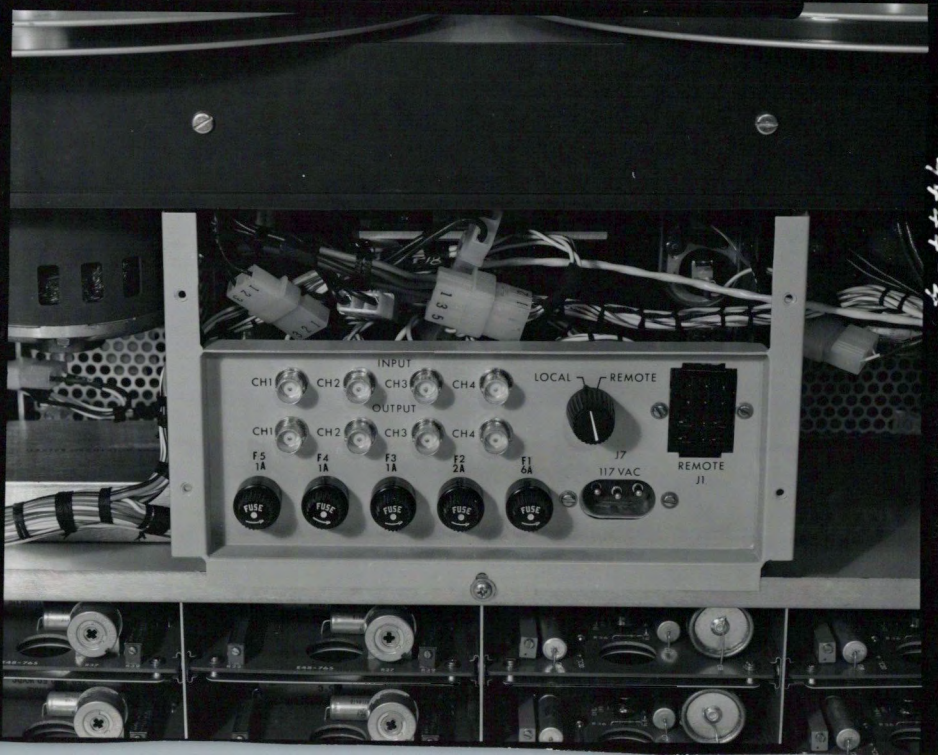
SP60e
11-4-65



9444-3



9444-1



9444-4



9444-2

SP600
11-4-65

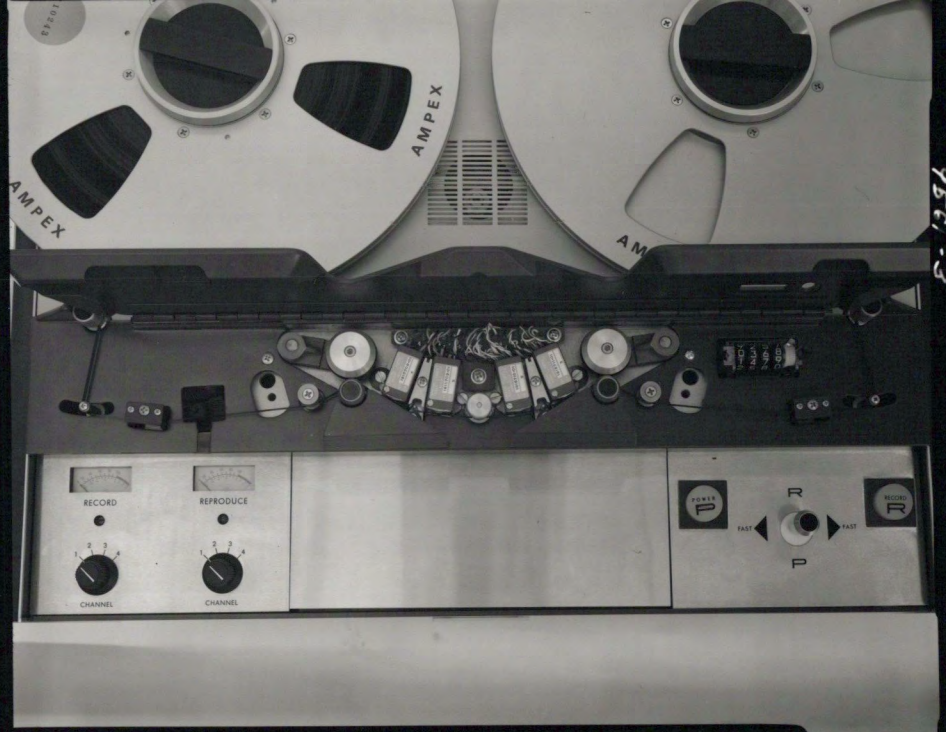
9518-1

9518-2

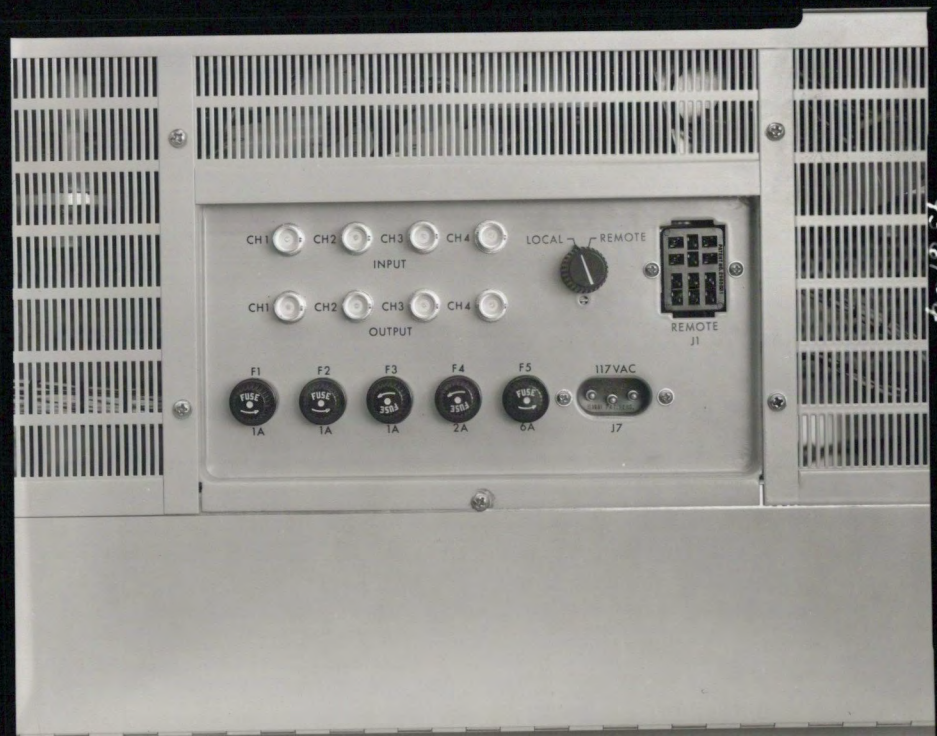
9518-3

9518-4

SP 600 3-11-66

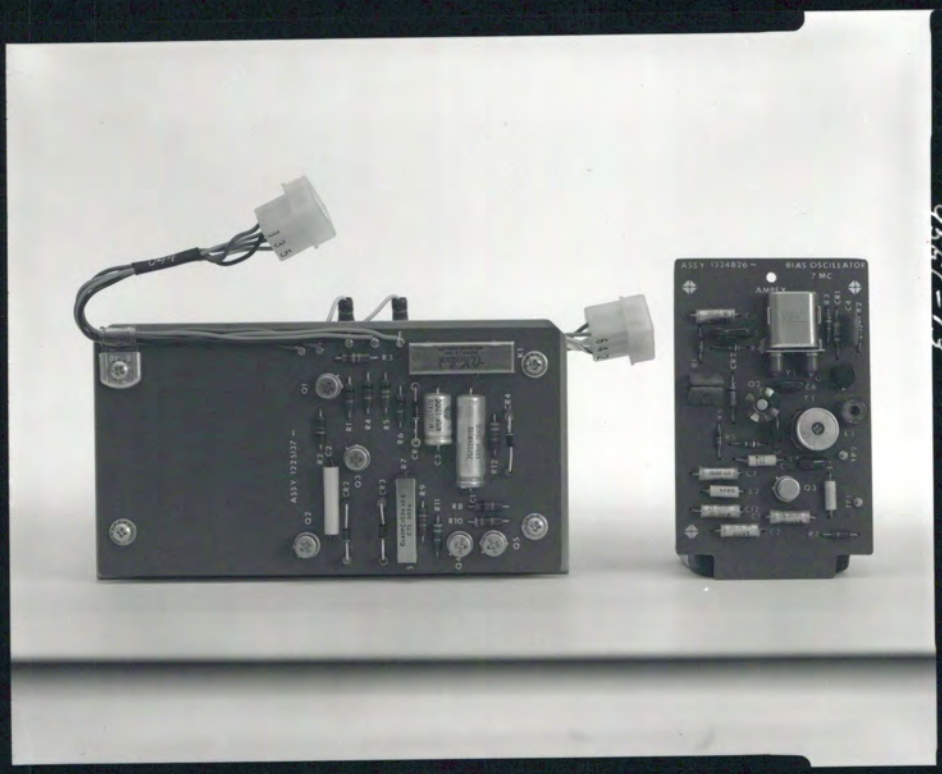








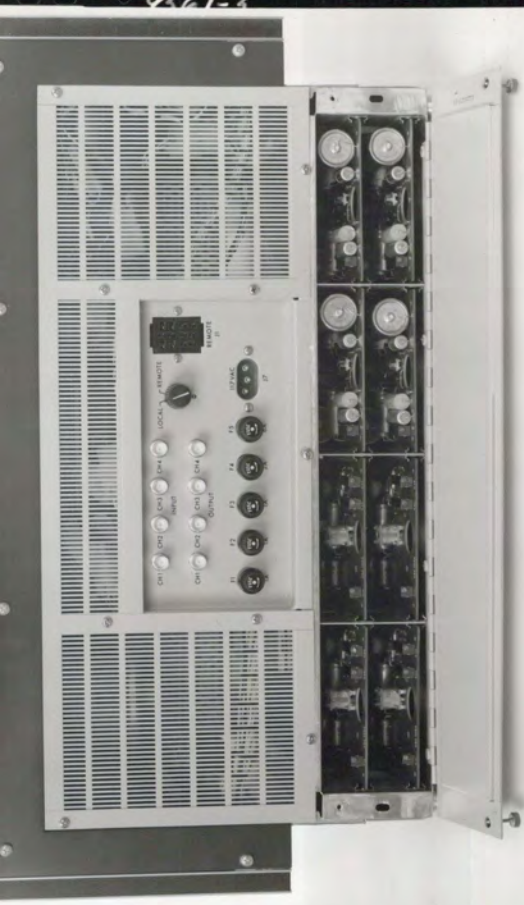
SP600 – March '66



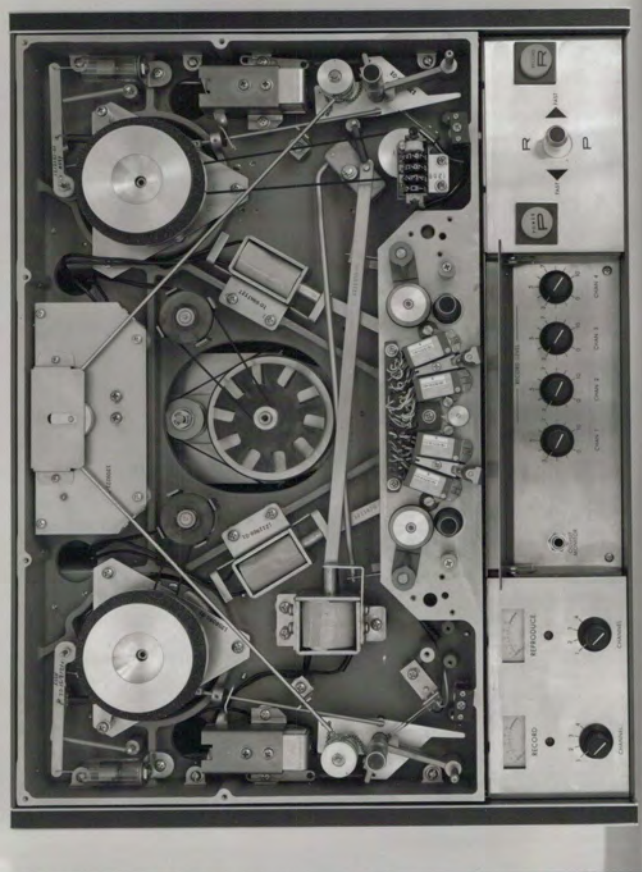
ET-15516

SP600 – MARCH '66

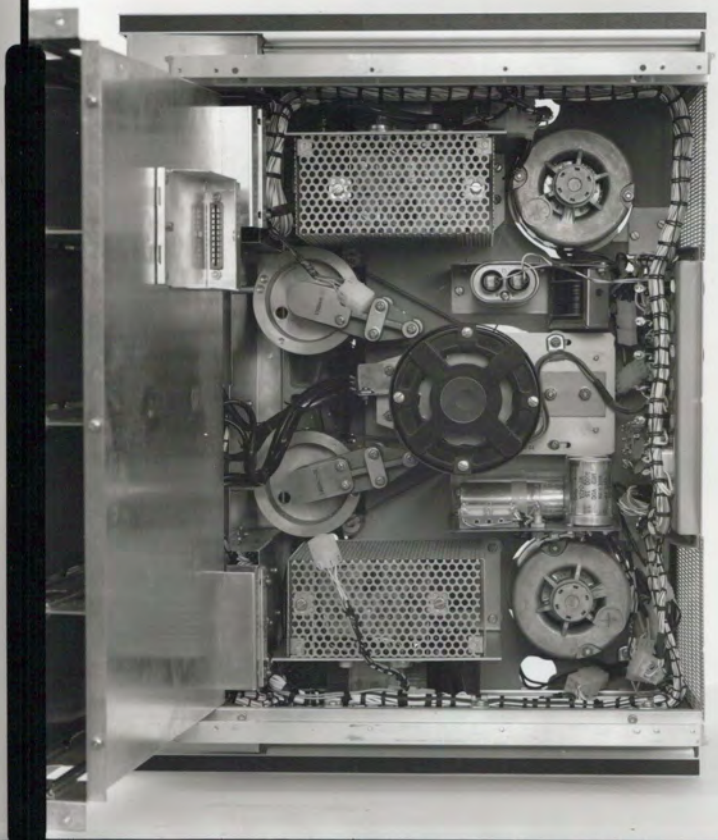
9561-6



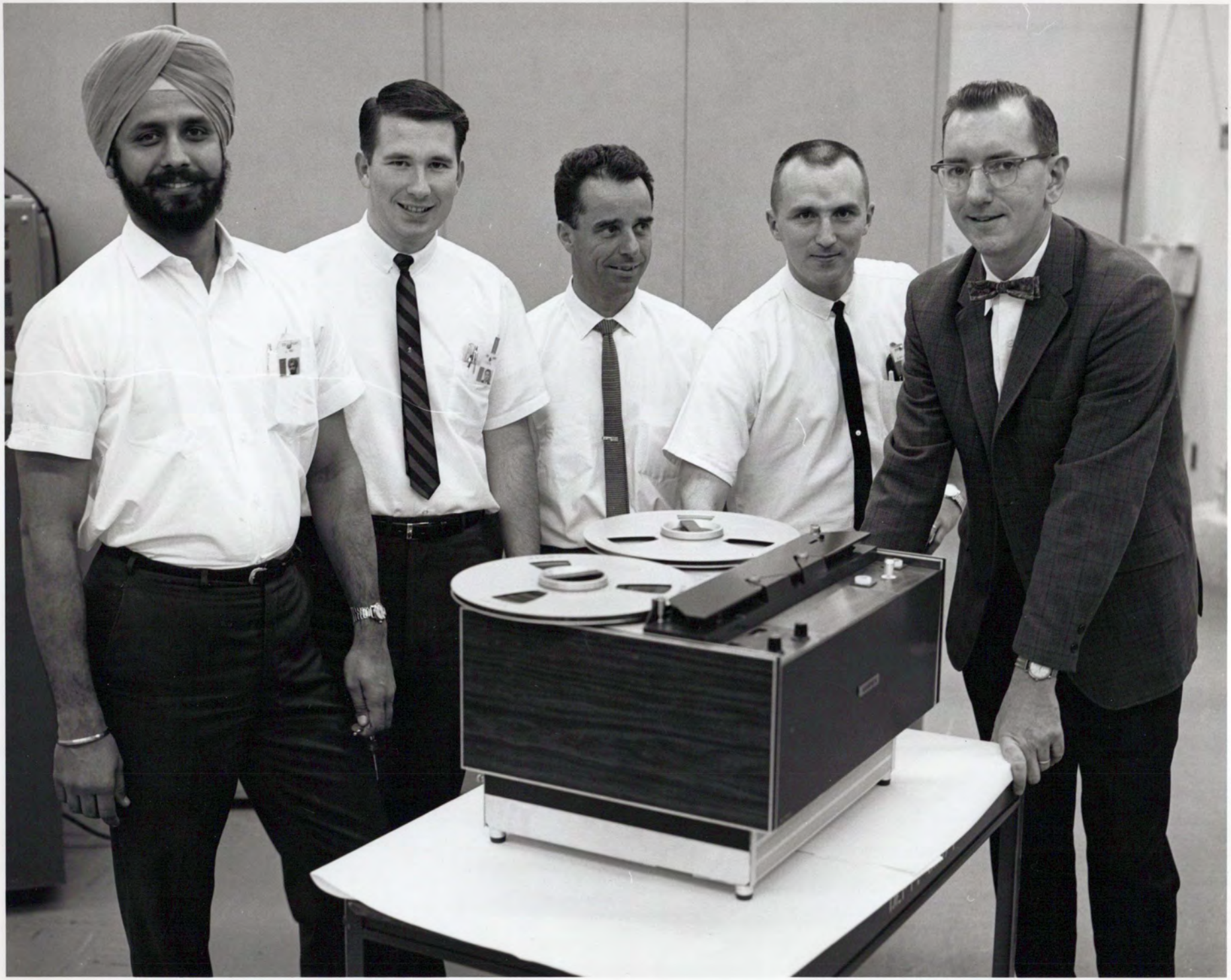
9561-7



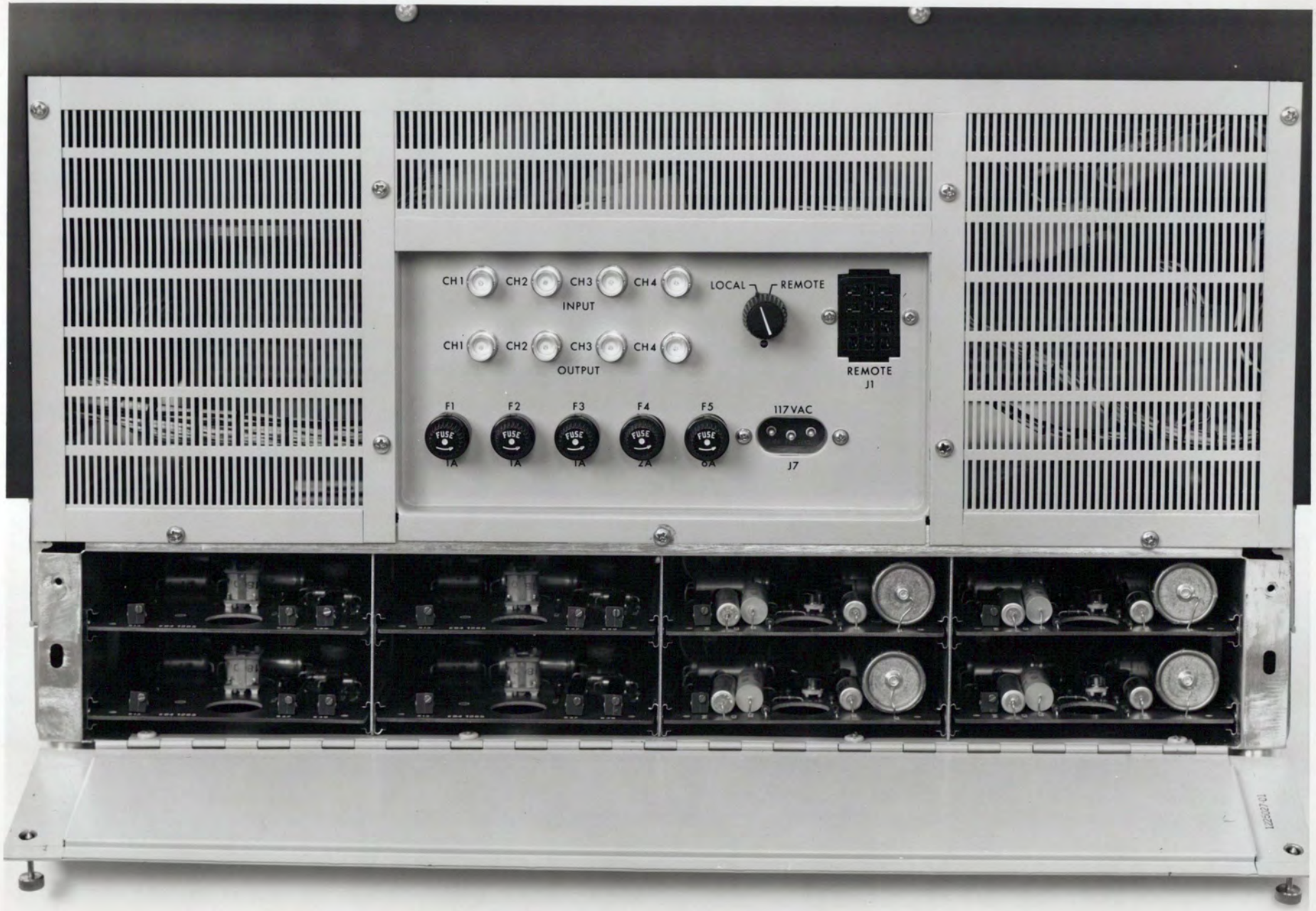
9561-8

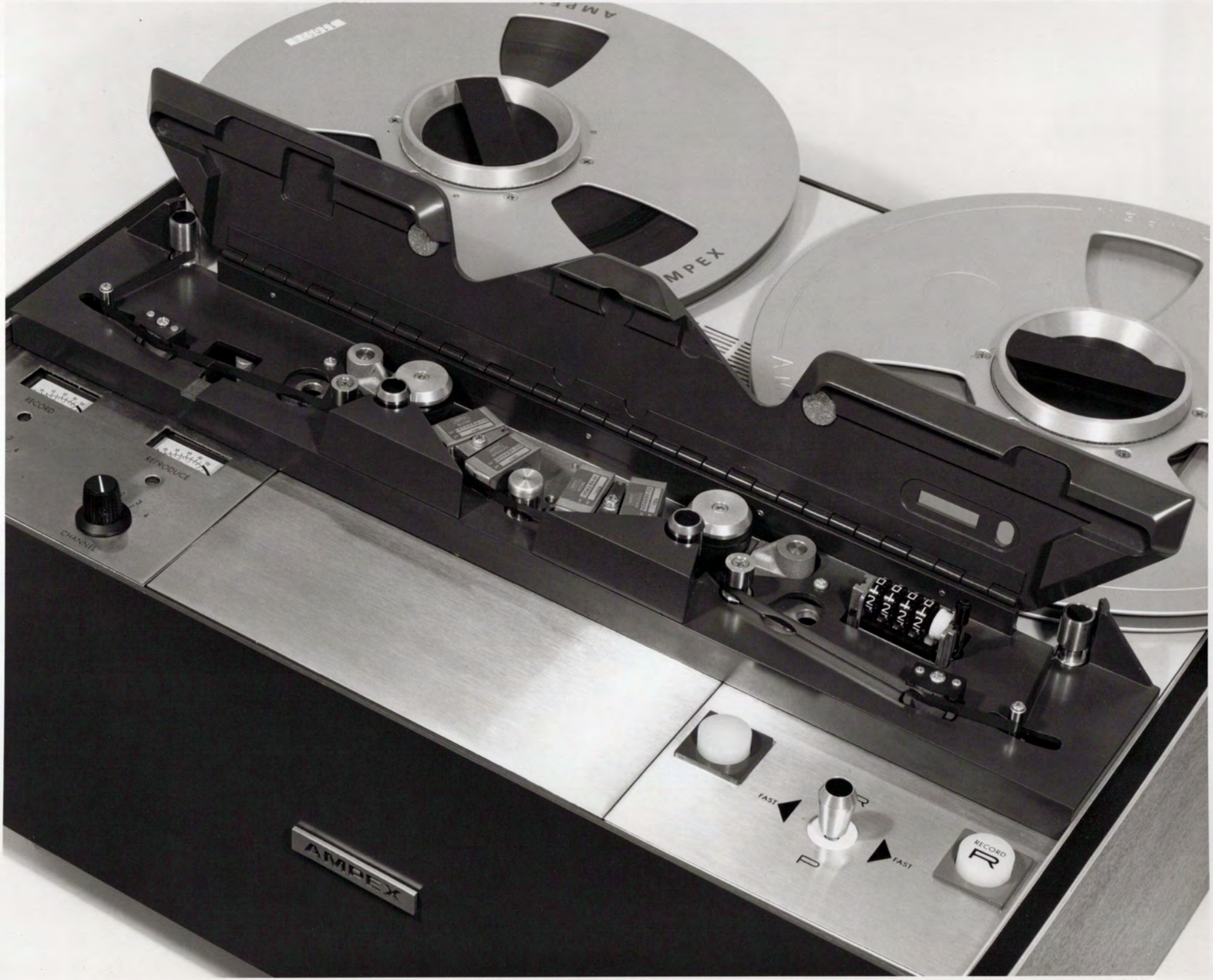


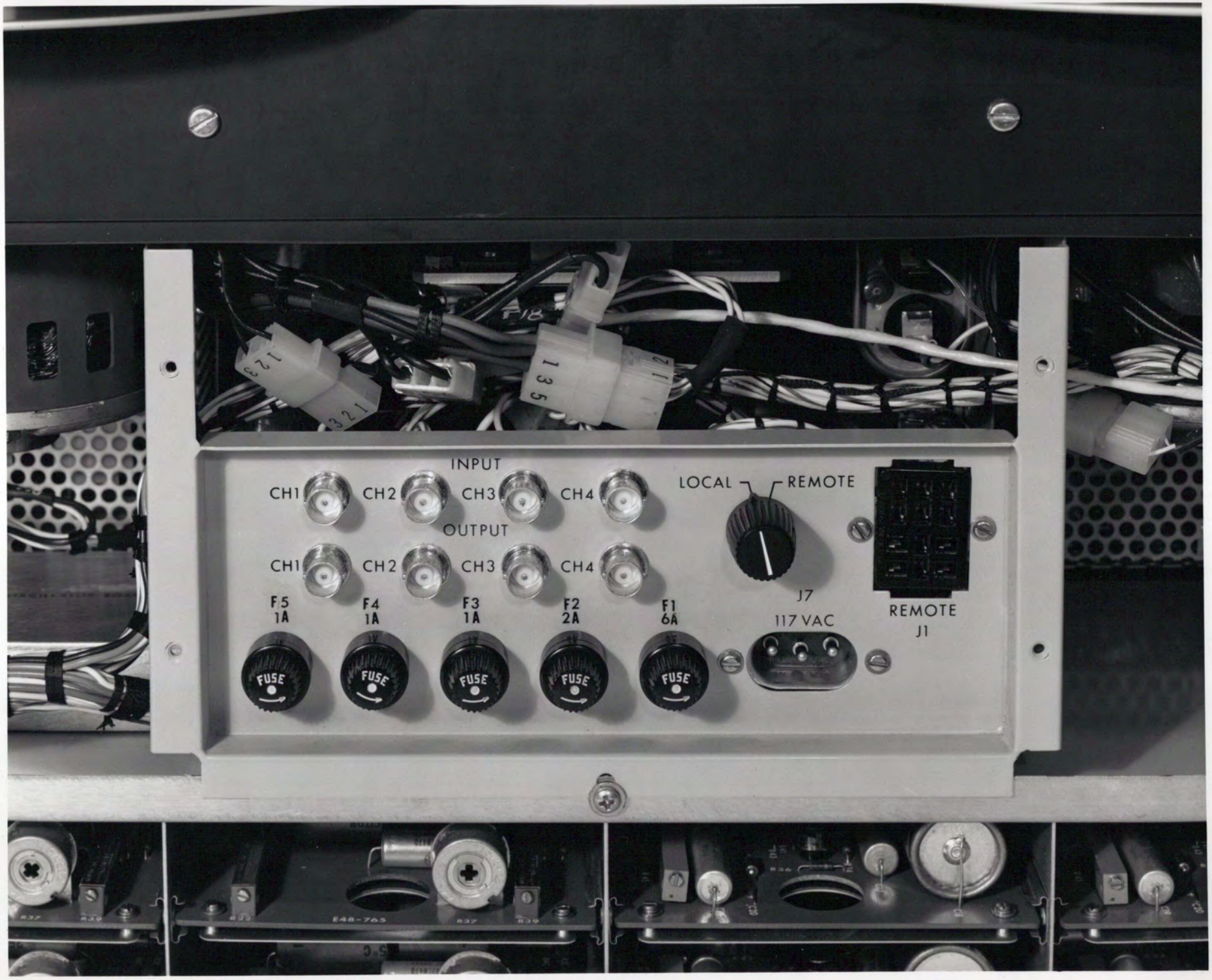
SP600 – MARCH '66




AMPEX
AMPEX
AMPEX


CH1
CH2
CH3
CH4
INPUT
CH1
CH2
CH3
CH4
OUTPUT
LOCAL
REMOTE
REMOTE
J1
F1
F2
F3
F4
F5
FUSE
1A
1A
1A
2A
6A
117VAC
J7


RECORD
REPRODUCE
CHANNEL
FAST
FAST
RECORD
AMPEX

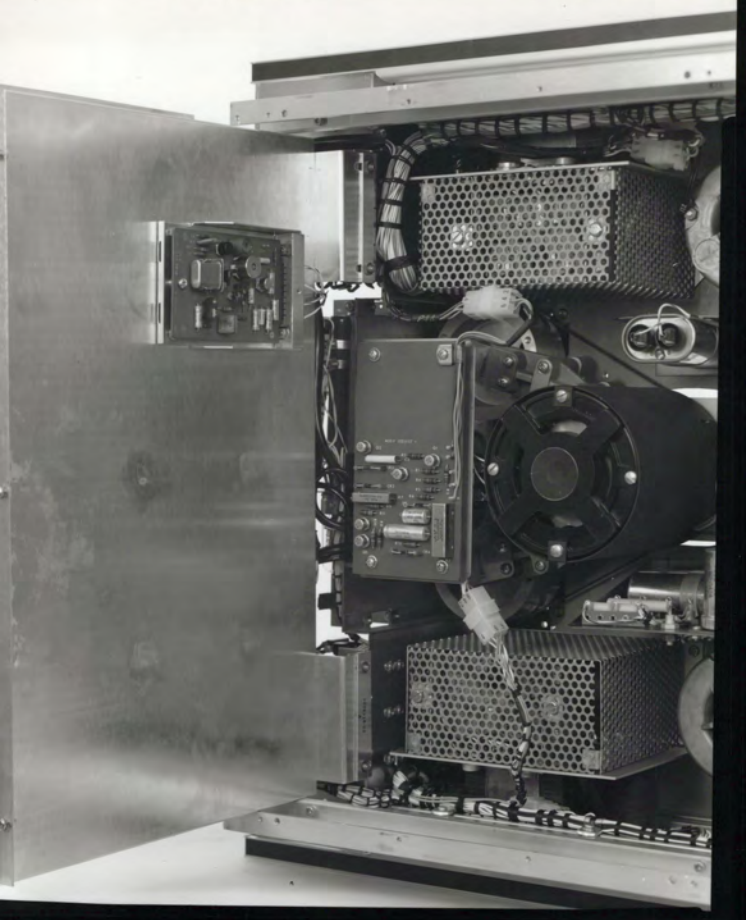

INPUT
CH1
CH2
CH3
CH4
OUTPUT
CH1
CH2
CH3
CH4
LOCAL
REMOTE
J7
117 VAC
REMOTE
J1
F5
1A
F4
1A
F3
1A
F2
2A
F1
6A
FUSE
FUSE
FUSE
FUSE
FUSE


REPRODUCE
OUTPUT MONITOR
RECORD LEVEL
CHAN 1
CHAN 2
CHAN 3
CHAN 4
AMPEX
AMPEX
FAST
FAST

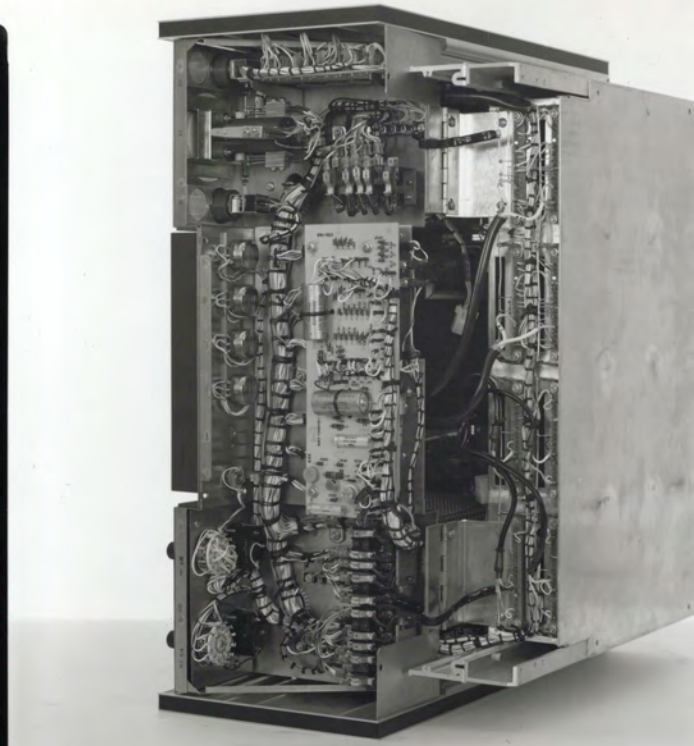

INPUT
CH1
CH2
CH3
CH4
OUTPUT
CH1
CH2
CH3
CH4
LOCAL
REMOTE
F5 1A
F4 1A
F3 1A
F2 2A
F1 4A
J7
117 VAC


AMPEX
AMPEX
AMPEX

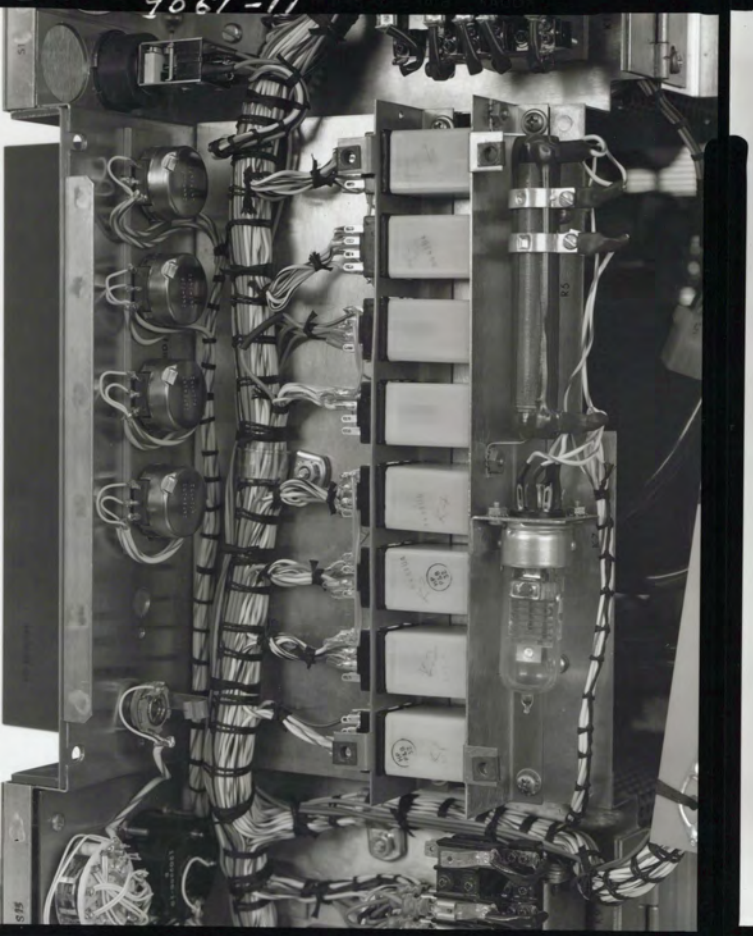
9561-9



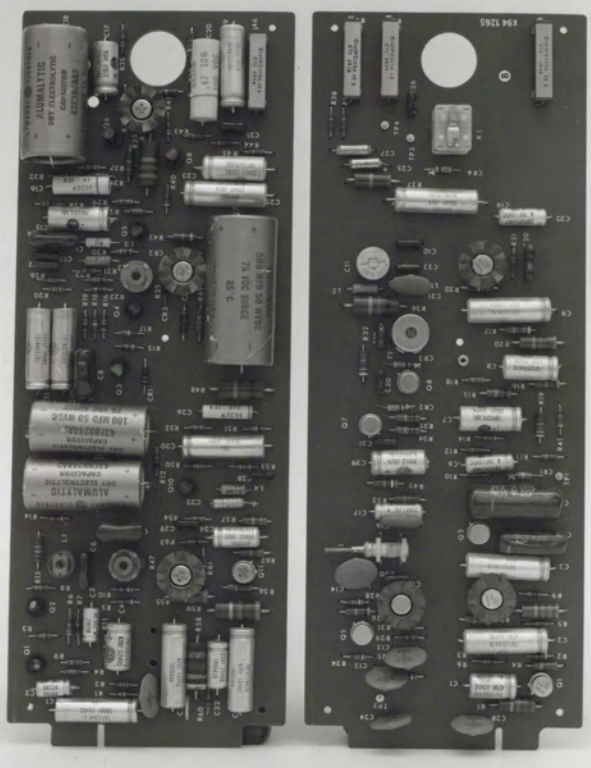
9561-10



9561-11

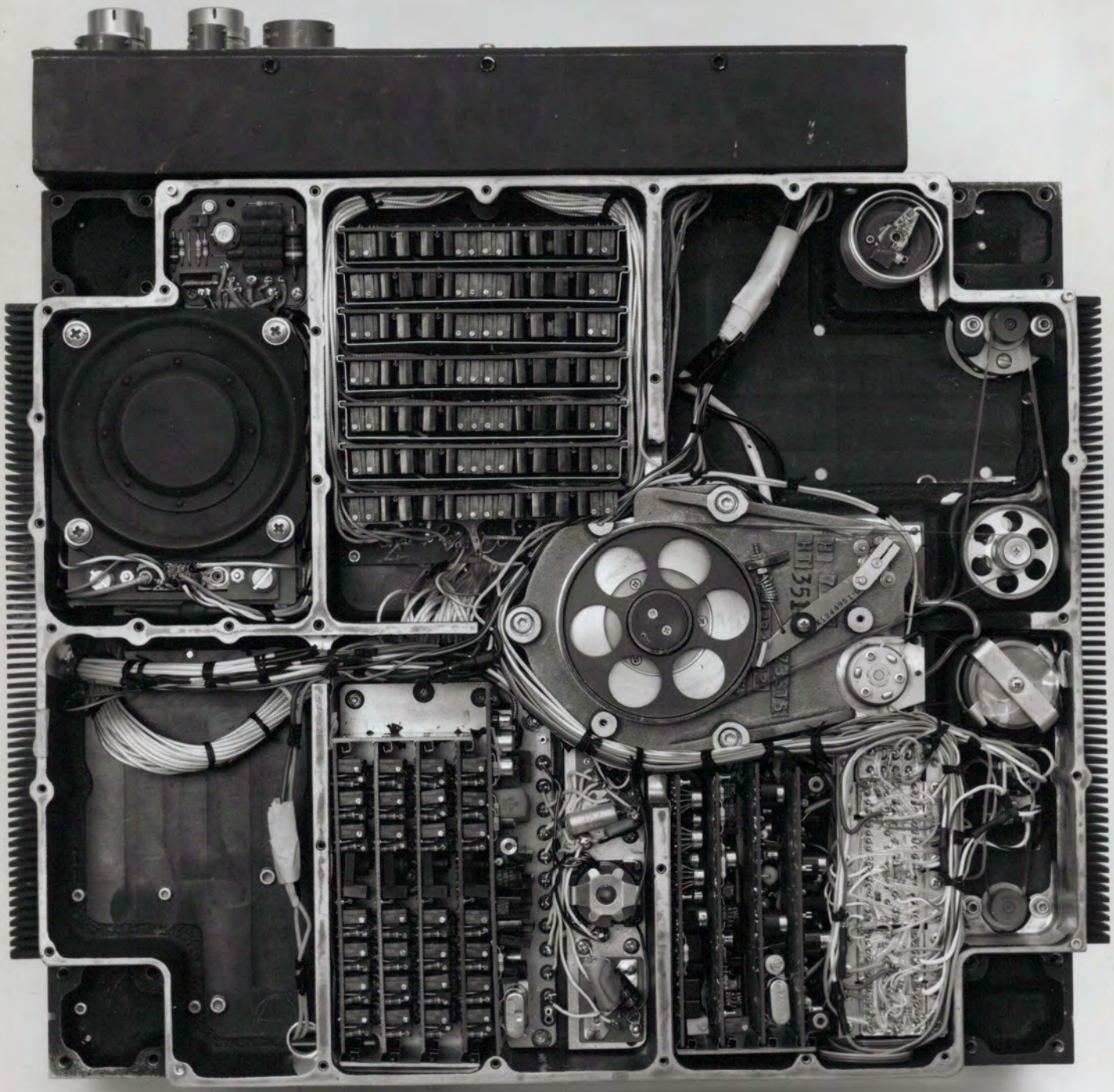


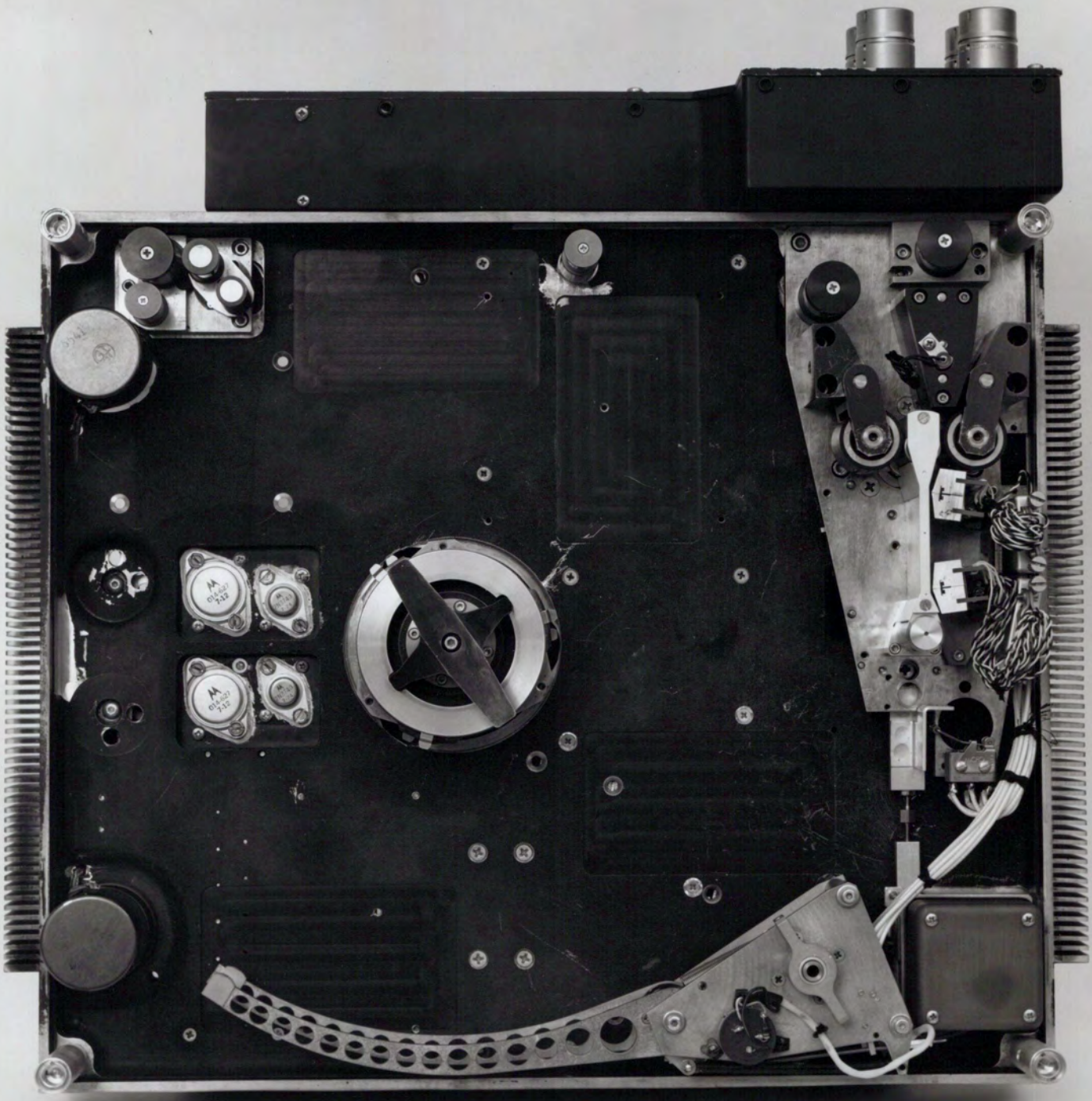
9561-12

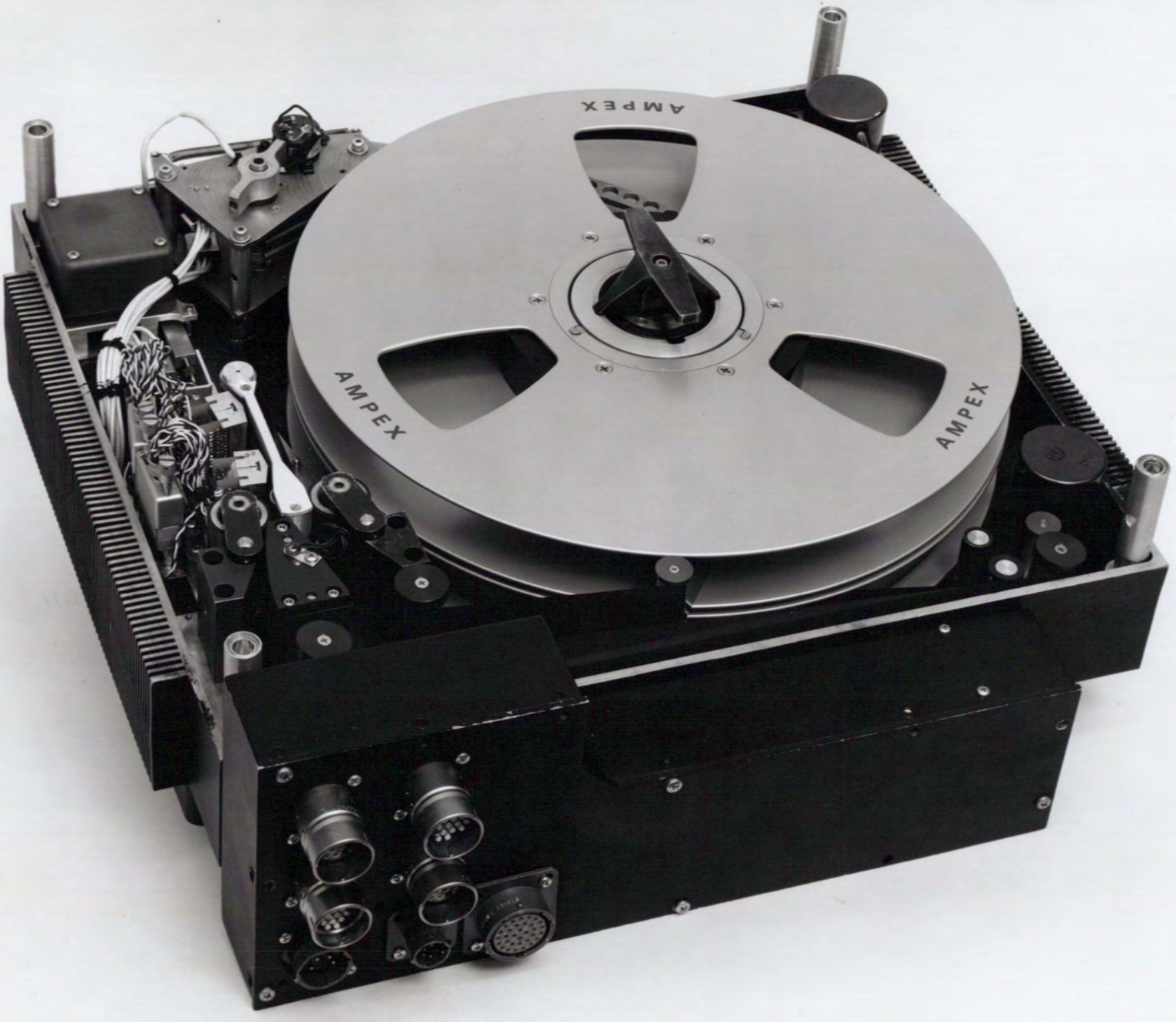


SP600 – MARCH '66

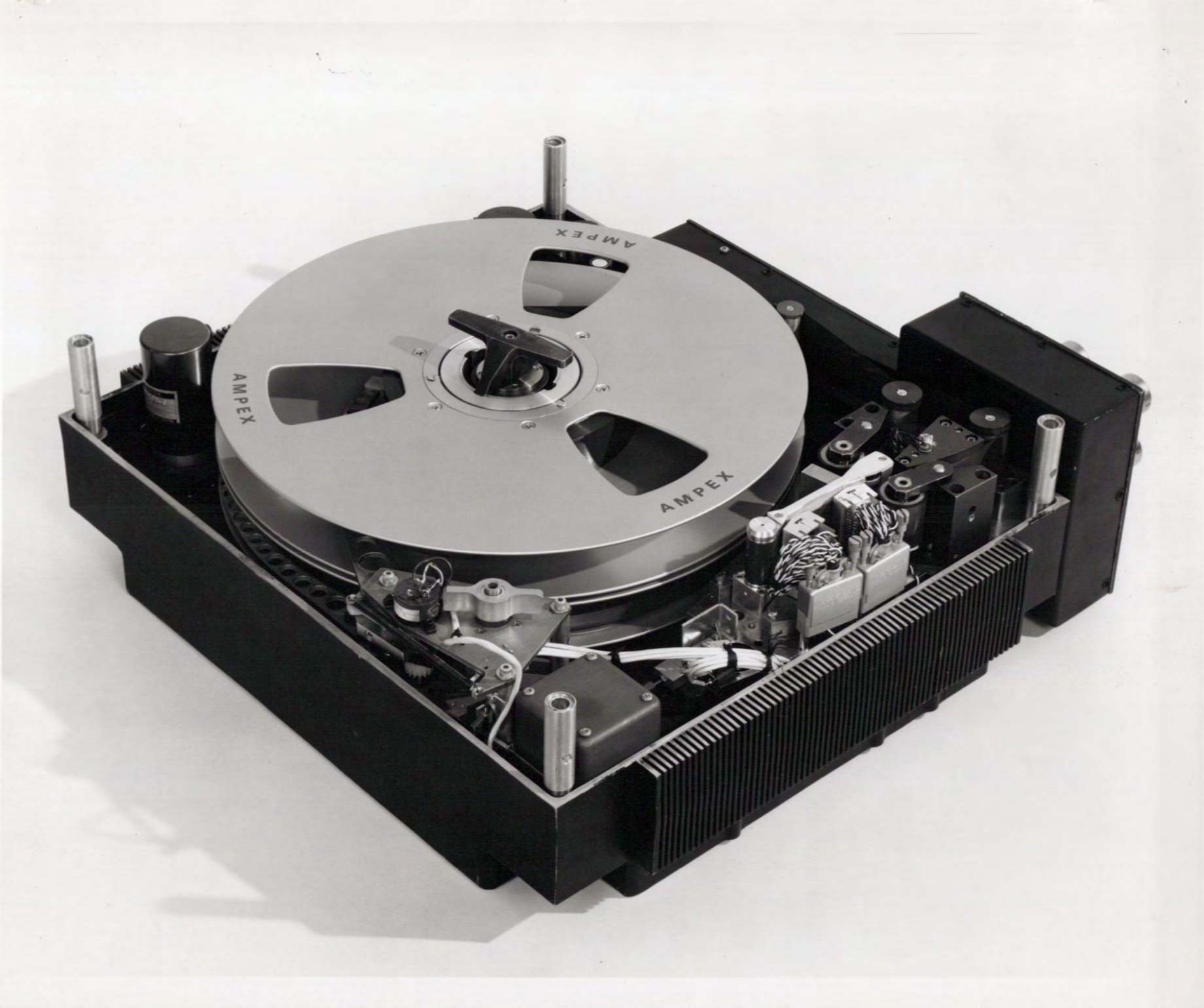

ACTIVE
STANDBY
SLOW FORWARD
FAST FORWARD
STOP
Western Electric
MANUFACTURED BY
AMPEX CORPORATION


HH351

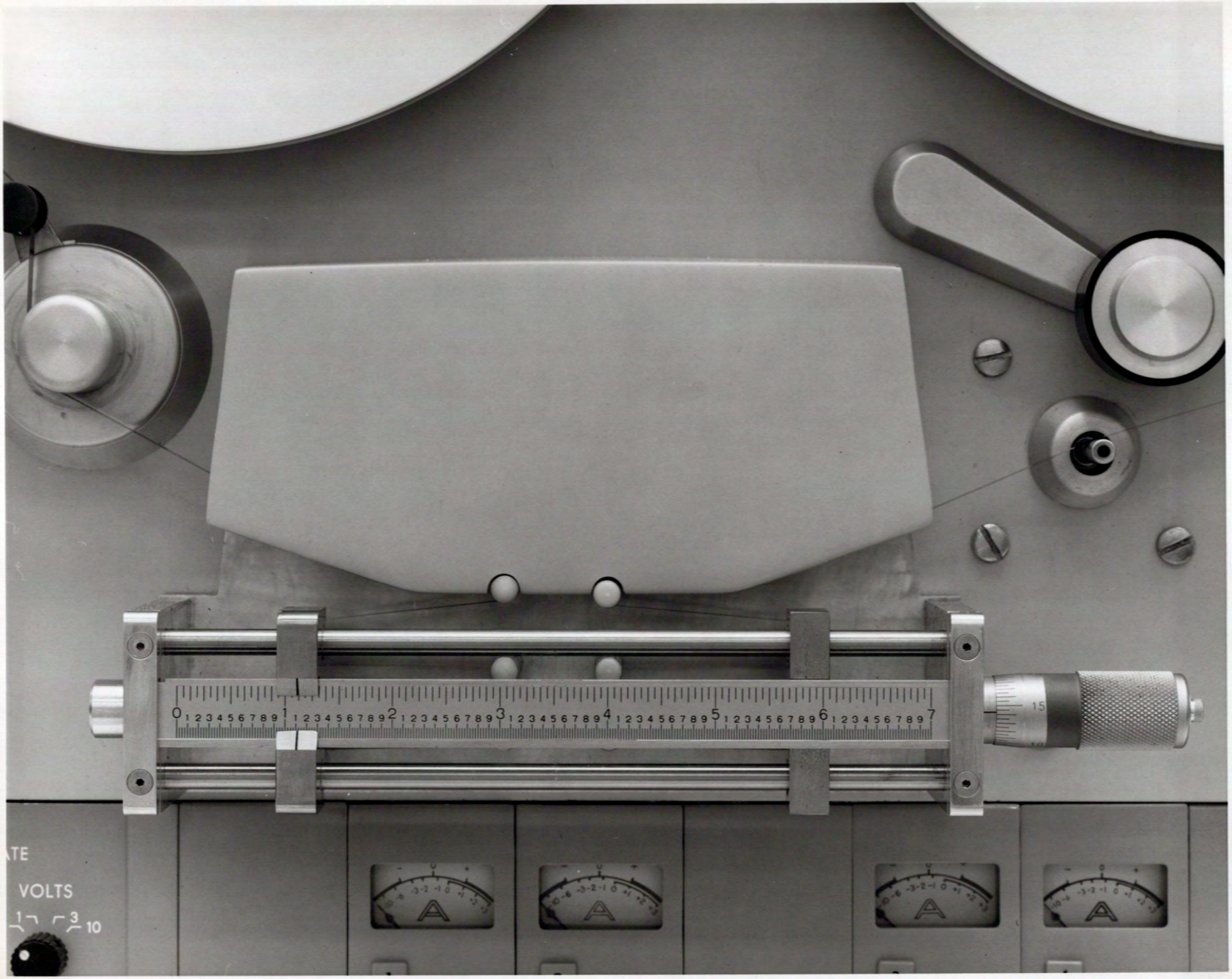


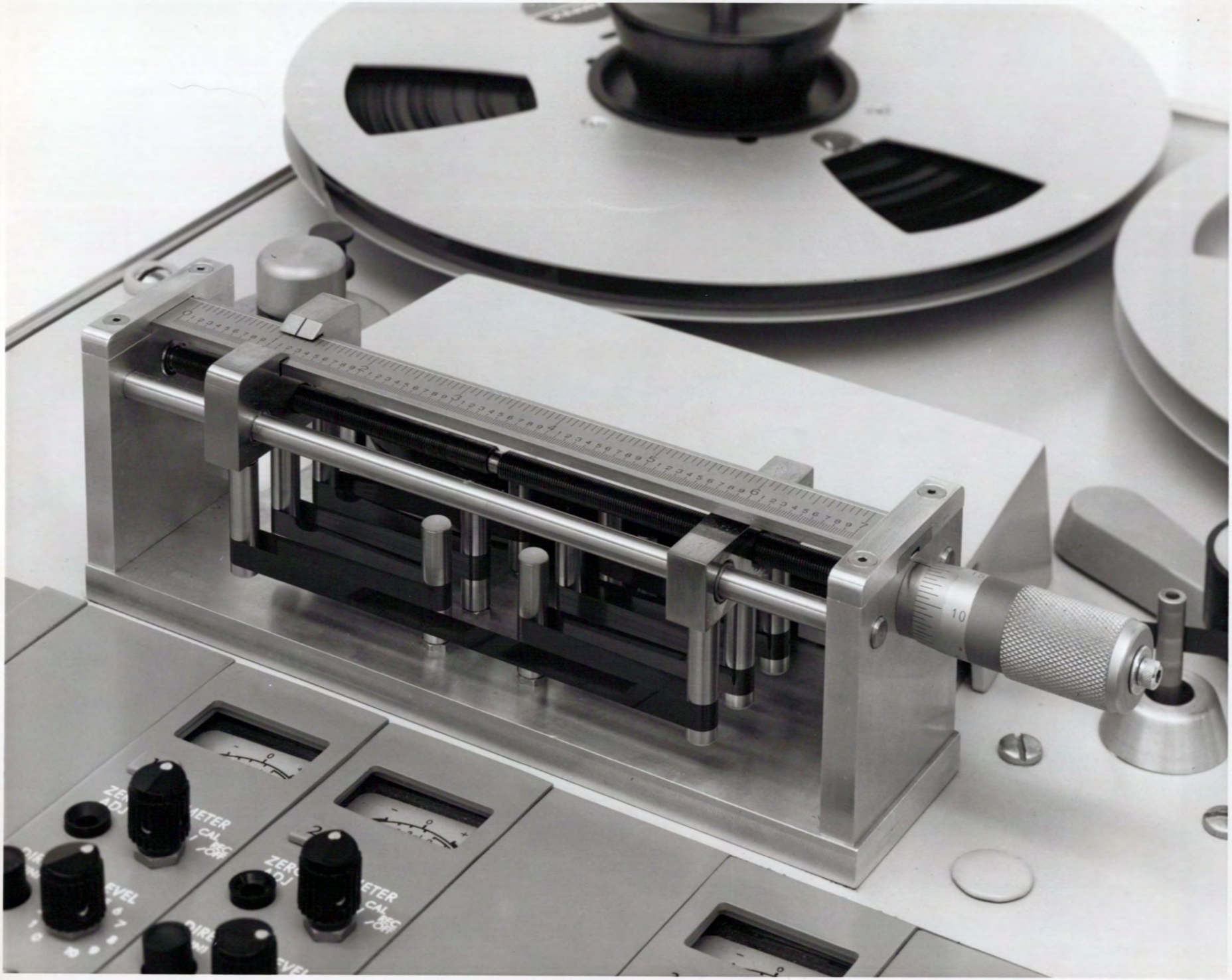

AMPEX
AMPEX
AMPEX

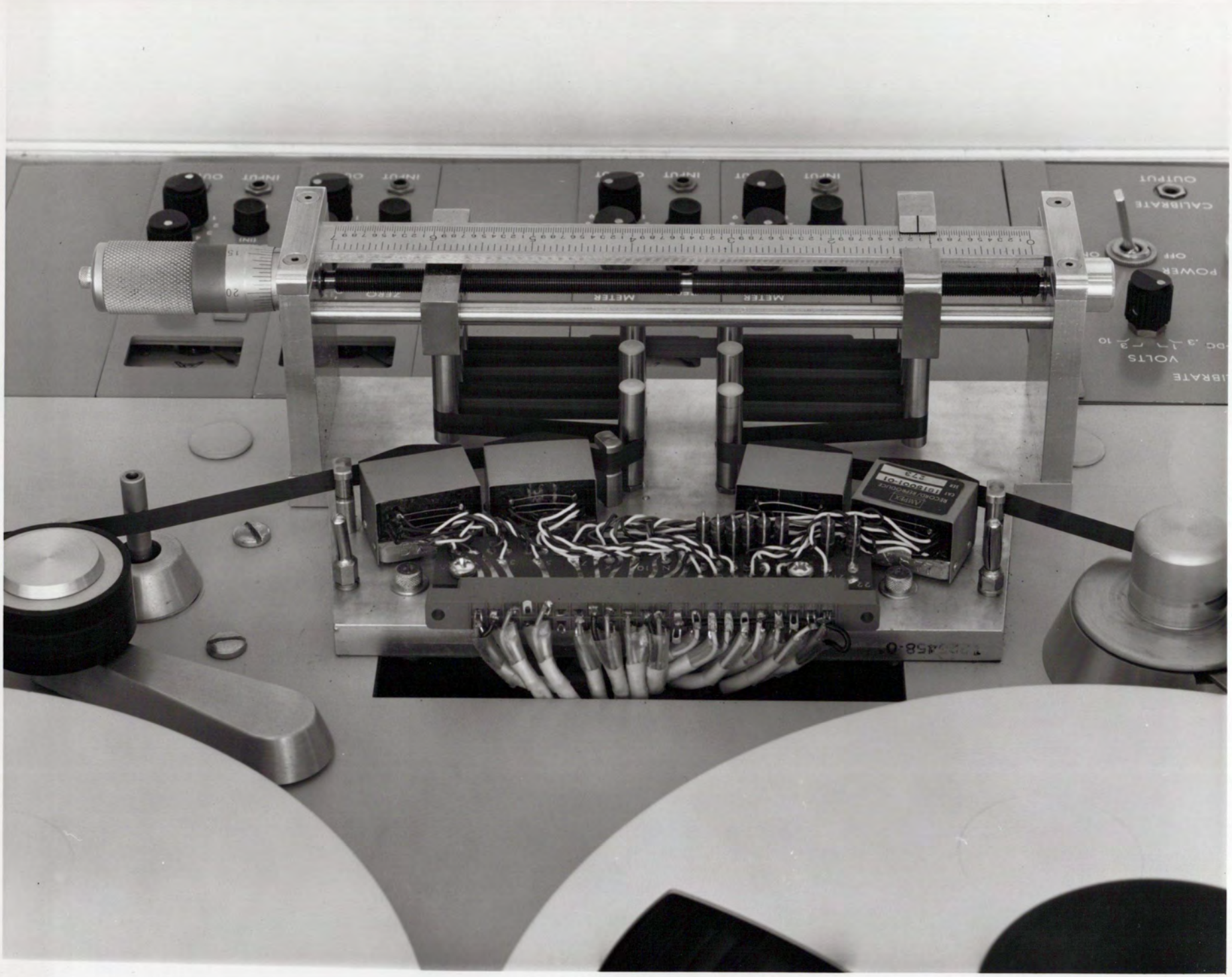

AMPEX


AMPEX
AMPEX
AMPEX


AMPEX
CALIBRATE
VOLTS
POWER
OFF
ON
CALIBRATE
OUTPUT
ZERO ADJ
METER
DIRECT
LEVEL
INPUT
OUTPUT
ERASE
RECORD
SPEED


VOLTS
10




INPUT
METER
CALIBRATE
OUTPUT
POWER
Off
VOLTS

10218-1



10218-3





10218-2

FB500 8-16-67

10348-13



10348-14



10348-15



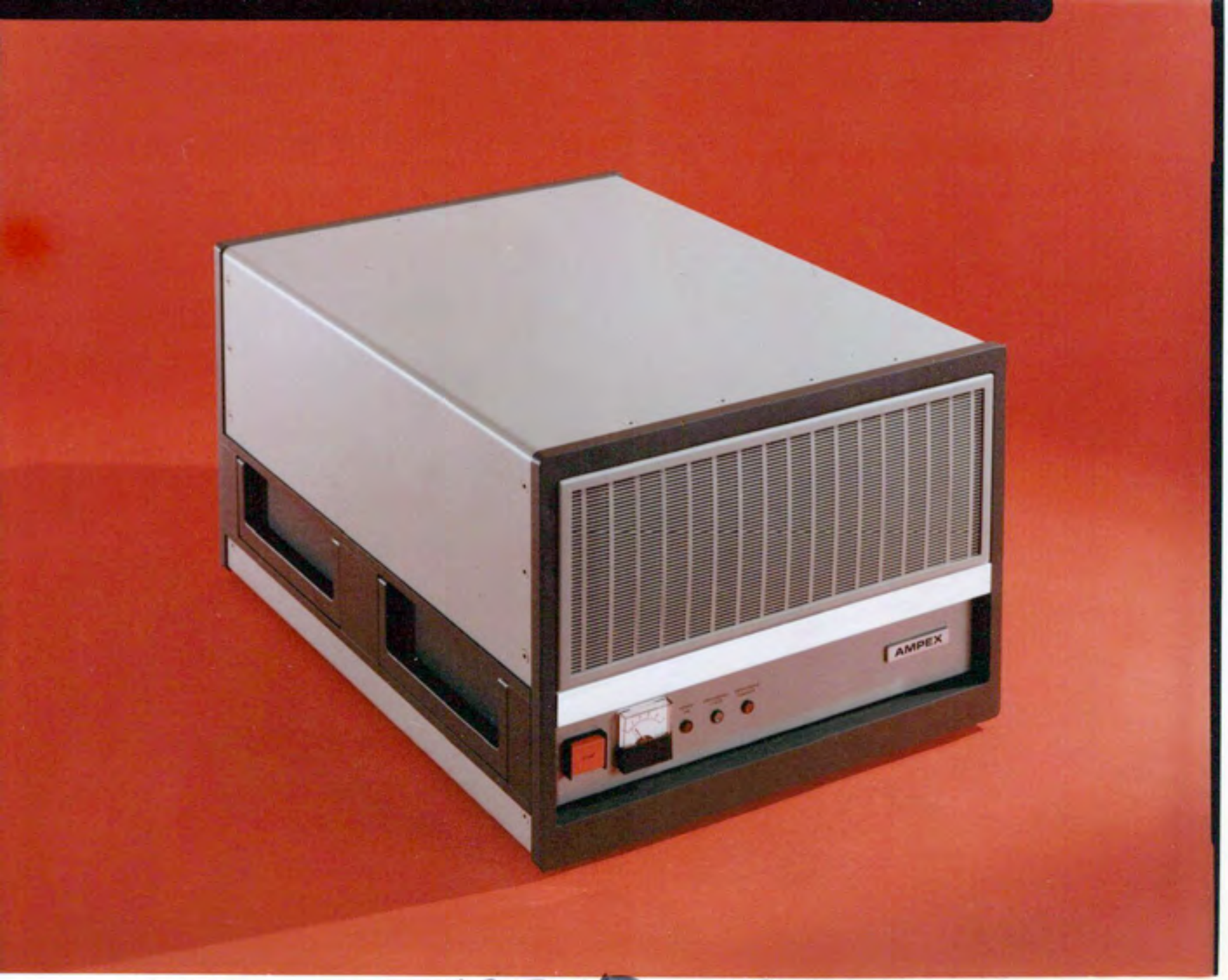
SE 20 – DEGAUSSER – 12-1-67

10348-16

10348-17

10348-18

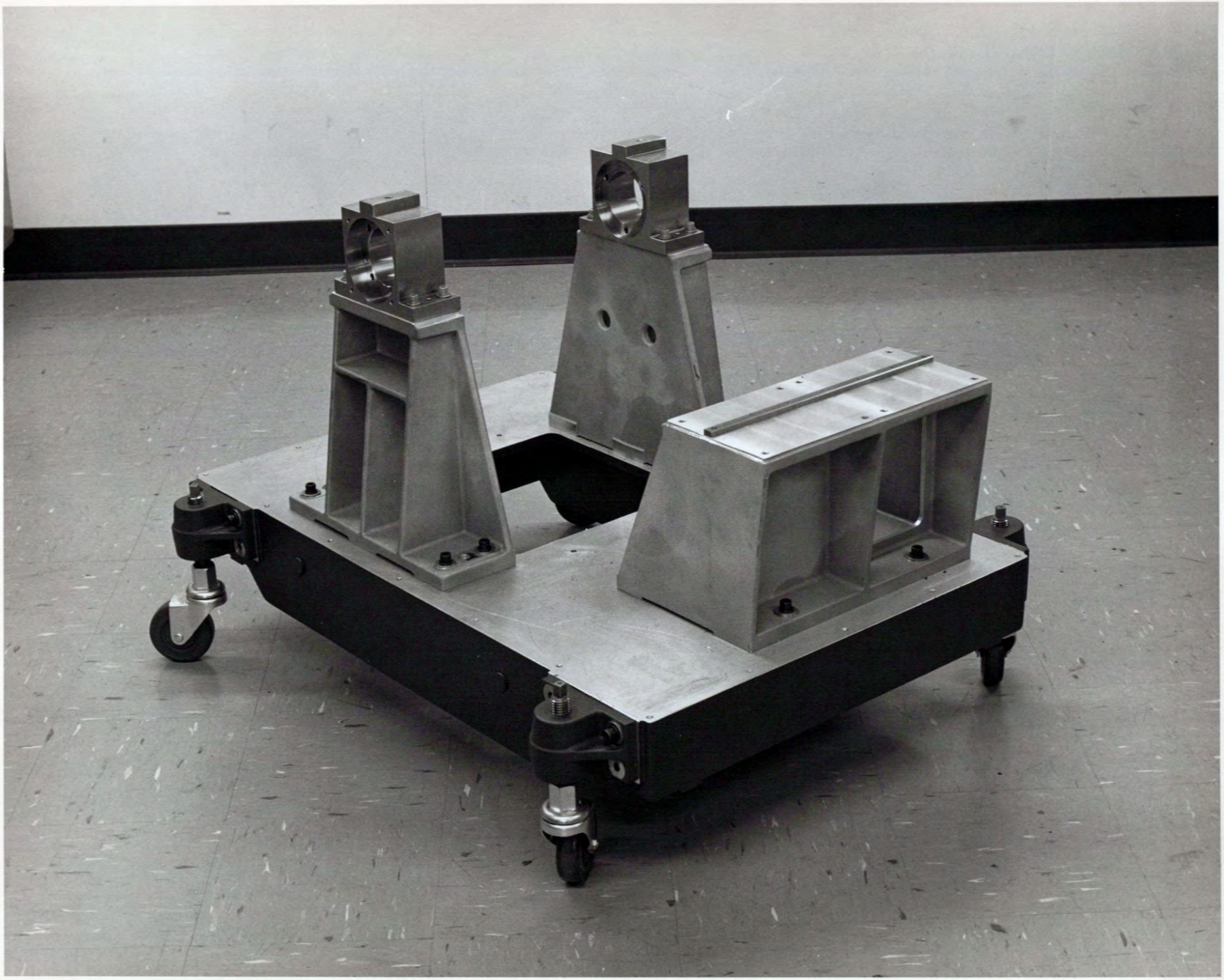
SE 20 – DEGAUSSER – 12-1-67

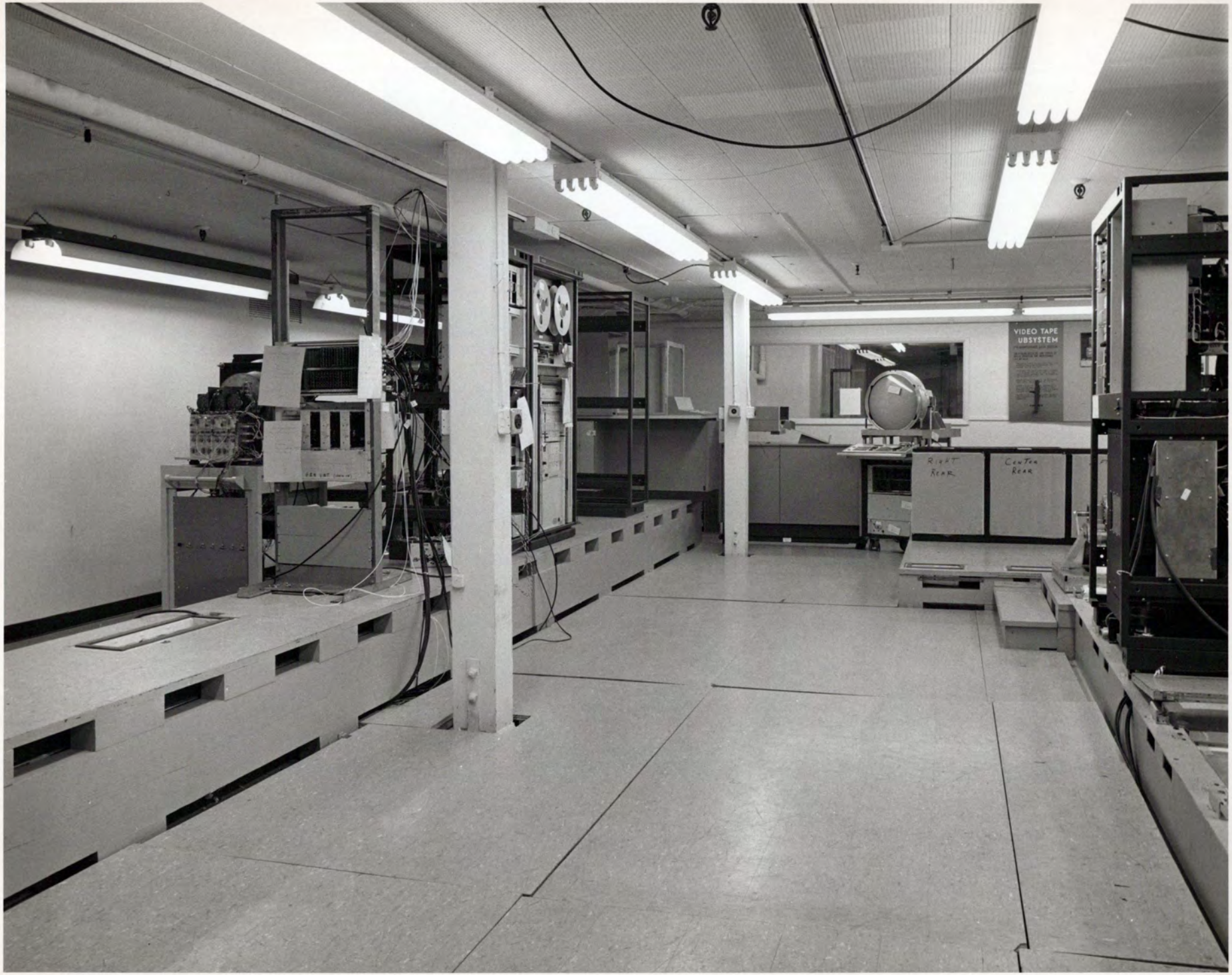


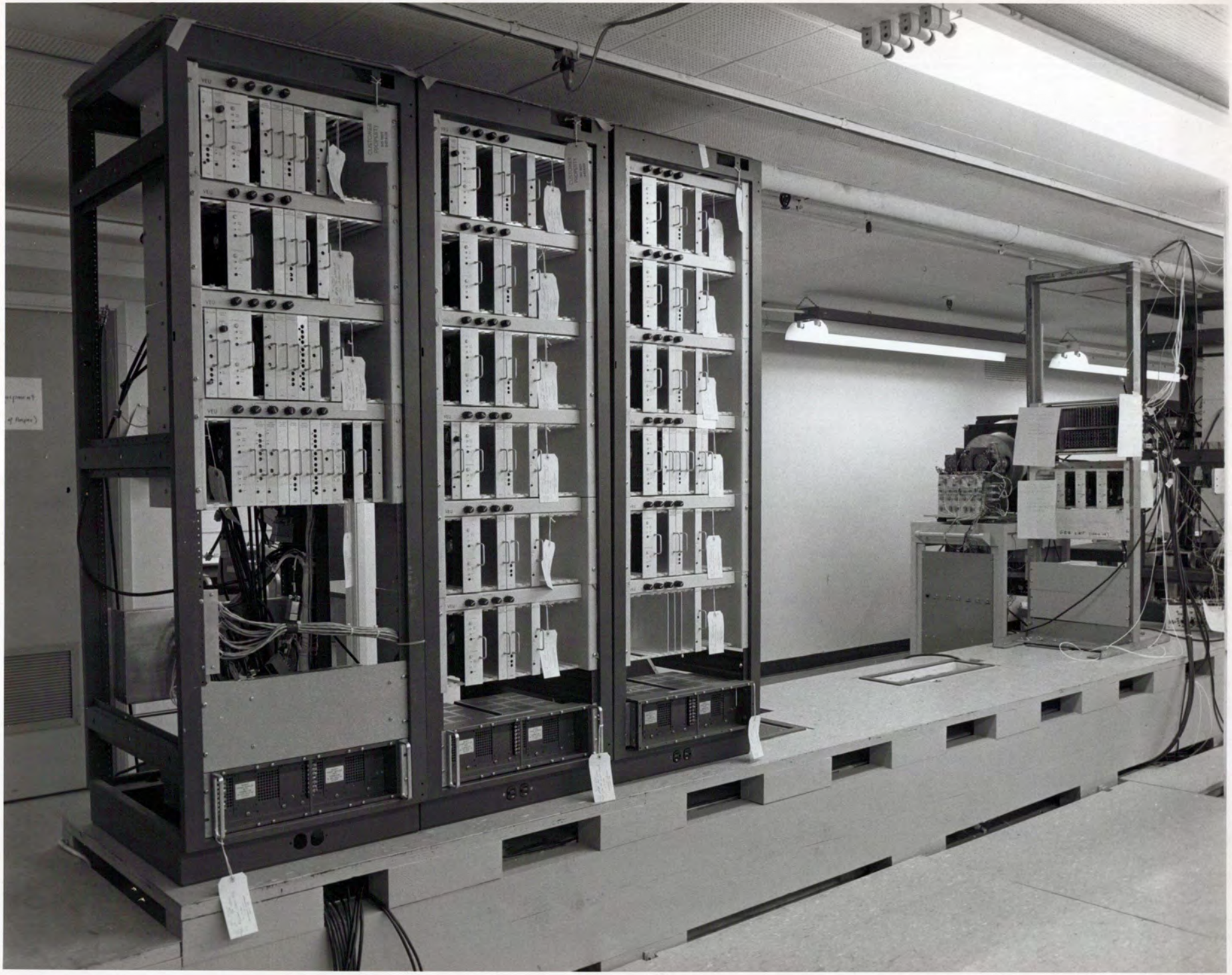
10348-19

10348-2b






VIDEO TAPE
UBSYSTEM
RIGHT
REAR
CENTER
REAR



RECEIVED
APR 11 1968
VIDEOFILE SYSTEMS DIVISION

PHOTOGRAPHIC DEPT.

X468-7

AMPEX CORPORATION


DIFFERENTIAL DC AMPLIFIER
INPUT-1
GND
INPUT-2
BAL.
X1 X10
GAIN
ZERO
GND
OUTPUT-1
OUTPUT-2
SQUARE WAVE GENERATOR
EXT. C
10 100 900 1000
f = 10/C
FREQUENCY-cps
AMPLITUDE
GND
R.M.S. VOLTS
DECIBELS
BURR-BROWN
AC VOLTMETER
METER
OSC.
-10 .3
-20 .1
-30 .03
-40 .01
-50 .003
-60 .001
DB-VOLTS
1 0
3 +10
10+20
30+30
100+40
300+50
VOLTS-DB
GND
BATTERY SUPPLY
AMP SWG METER
OSC
VOLTAGE REF.
ON
TEST
VOLTAGE REF.
VOLTS
X1 X10 X100 X1000
MULTIPLIER
VERNIER
CYCLES
CYCLES
LOW DISTORTION OSCILLATOR
AMPLITUDE
.1v -20db
.03v -30 db
.3v -10db
1v 0db
3v +10 db
ATTENUATOR
GND
MANUFACTURED FOR
AMPEX
BURR-BROWN
Ercokit

County of Los Angeles, Sheriff's Department. One of the largest law enforcement agencies in the United States:

- With over 6,000 career personnel
- Providing total law enforcement to over 1,100,000 residents of 3,000 square miles of unincorporated county area.
- Providing total law enforcement to more than 733,000 residents of over a score of incorporated cities under the Contractual Law Enforcement System.

"ORACLE will provide the world's most advanced and efficient law enforcement records system for the unincorporated areas of Los Angeles County and the 30 incorporated cities policed by the Sheriff's Department."

—Peter J. Pitchess, Sheriff of Los Angeles County



The ORACLE SYSTEM, utilizing the Videofile Information System techniques, is the only commercially available equipment that can meet and exceed the dynamic record-keeping requirements of the Los Angeles County Sheriff's Department. This system, however, does not in any way conflict with existing County computer systems but, rather, is an outstanding complement to them.

One of the most dramatic improvements that the ORACLE SYSTEM will provide for the Los Angeles County Sheriff's Department is the reduction of annual expenditures. More efficient use of document filing practices, reduced storage space, more efficient use of employee time and talents, and the elimination of duplicate files, all add to the total effective savings.

The ORACLE SYSTEM's potential contributions to the law enforcement community and its role as a major breakthrough in crime prevention are consistent with current federal, state and local community requests for improved law enforcement. The Los Angeles community will also benefit greatly from the ORACLE SYSTEM as a general service when considering the thousands of civilian requests for information. The ORACLE SYSTEM will be a stepping stone for improved law enforcement record-keeping and will be a model for all other major law enforcement agencies in the nation.

Sheriff's Department, County of Los Angeles

Peter J. Pitchess, Sheriff, Hall of Justice, Los Angeles, Ca 90012

LITHO IN U. S. A. F017-6-69

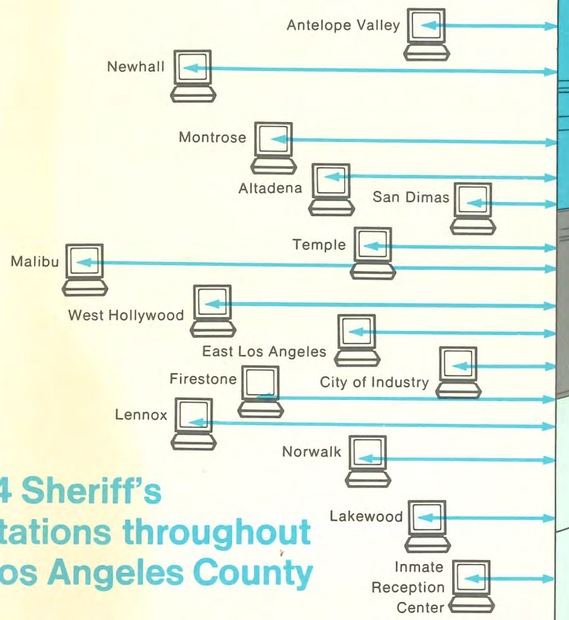
The Los Angeles County Sheriff's Department

ORACLE* SYSTEM

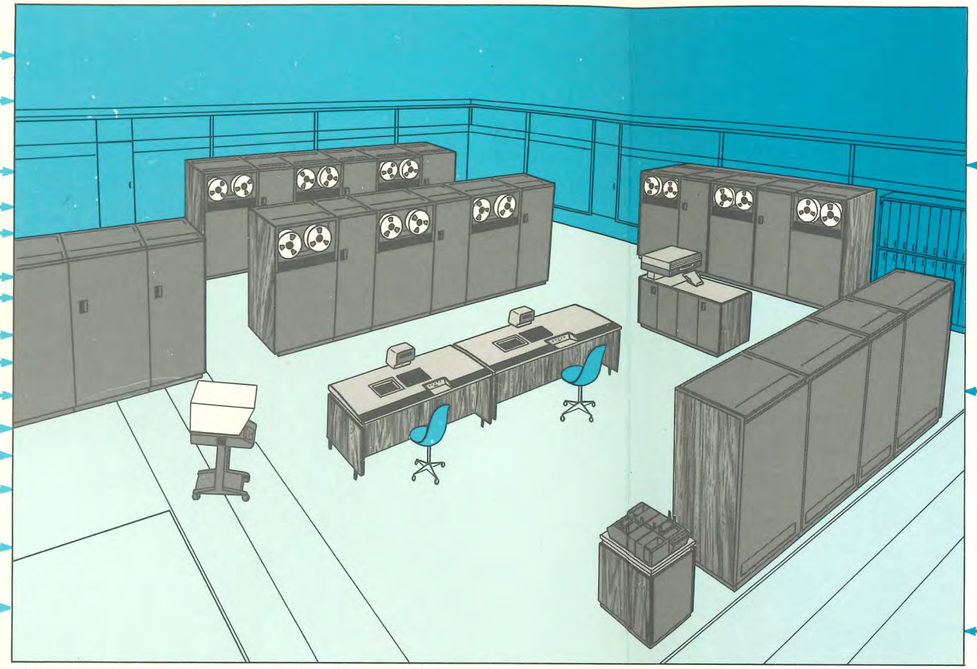


*ORACLE—Optimum Record Automation for Court and Law Enforcement

The Los Angeles County Sheriff's Department Automated Information System

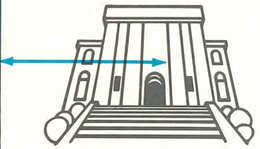


14 Sheriff's stations throughout Los Angeles County

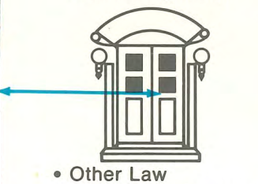


Central File at Hall of Justice... Includes Summary Dossier File, Master Dossier File, Master Fingerprint File, Master Case File, Central Juvenile Index, Intelligence File, Personnel File, Administrative Services File.

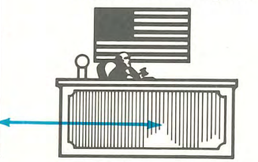
Potential Future Utilization



- Other State and Federal Agencies



- Other Law Enforcement Agencies



- Courts

Modern methods from voice prints to helicopter patrols have streamlined many phases of law enforcement, but the handling of fingerprints and other information vital to quick suspect identification has changed little since the 19th century. The immediate availability of criminal record information is vital to coping with the ever increasing crime rate and current legal restrictions on police detention practices.

A unique system to move law enforcement record keeping from the quill-pen era into the electronic age will be installed in 1970 by the Los Angeles County Sheriff's Department. The new program is ORACLE (Optimum Record Automation for Court and Law Enforcement), a county wide television information system to speed and automate the handling of more than 18,000,000 Sheriff's Department law enforcement documents.

The key element in ORACLE will be a Videofile® Information System, developed by Ampex Corporation. The system will store law enforcement records including fingerprints and photographs as television recordings on video tape and make them immediately viewable as television images. All records will be retained in this electronic form in a central file located at the Hall of Justice, in downtown Los Angeles. Immediate access to the file for filing or retrieval of records is available via electronic cable for authorized users within the Hall of Justice building, and via microwave transmissions for outlying sheriff's stations throughout Los Angeles county, including the Inmate Reception Center.

The system uses special document input consoles containing television cameras, magnetic Videotape recorders, television displays and hard copy electrostatic printers. The television camera scans the information on a document and an exact electronic image is recorded by a Videotape recorder into a "magnetic file folder." The system maintains its own internal indexing and searching scheme so that any requests for a document from the many millions that will be filed in the Sheriff's record system will be instantly available for viewing on television displays and/or for hard copy print-out.

Total equipment in the Hall of Justice will include two filing sections, nine videotape transports, 21 video buffer sections that store images temporarily, 36 television displays at various locations in the building, two paper-copy printers, and two system control sections. Each outlying Sheriff's facility will have a filing section and one or more television displays.

The speed and flexibility of ORACLE will bring the key operation of record keeping into modern step with other advanced law enforcement techniques already used by the Los Angeles County Sheriff's Department.

First Application of the Videofile System in Law Enforcement Provides Exceptional Advantages

The overall operating capability and efficiency of the ORACLE SYSTEM will provide significant contributions to the Los Angeles County Sheriff's Department in the following areas:

Rapid Identification Positive identification of arrestees or suspects can be made within only a few minutes if they have ever been on record within the jurisdiction of the Los Angeles County Sheriff's Department or in their files for any other reason. With the present manual system this was very difficult if not impossible to do before the suspect's release, particularly by remote stations. Once positively identified, the suspect's entire record can, in only a few seconds, be retrieved and electronically transmitted to the requestor, whether a remote station or Hall of Justice personnel.

One Central File The various units within the Hall of Justice and the remote stations will no longer need to maintain their own specialty files in order to have rapid access to needed information. All will have immediate filing and retrieval access to one central master file information base.

Never an "Out-of-File" The electronic concept of the ORACLE Videofile system eliminates "out-of-file" conditions. No matter how many users are referring to a specific document, a master image of the document will always be in the central file. This overcomes a problem of files checked-out to users for extensive periods and therefore not available for other users or for new material to be added.

Continuously Updated, Automatically Purged Automatic purging of archival or obsolete information no longer required for retention, such as juvenile records or want notices, will be easily accomplished. The manual approach was very time consuming and often times urgent priorities precluded a purging effort. The Videofile System has the capability to easily add information into certain existing documents such as rap sheets, which will allow a current state of information to exist on any particular file. The system will greatly reduce the possibility of having current information that is waiting to be filed not available when required, resulting in law enforcement judgments being made on less than current information.

Security Unauthorized access to records is virtually eliminated because the Videofile System stores them in electrical form on Videotape, retrievable only by

VIDEOFILE® is a trademark of Ampex Corporation

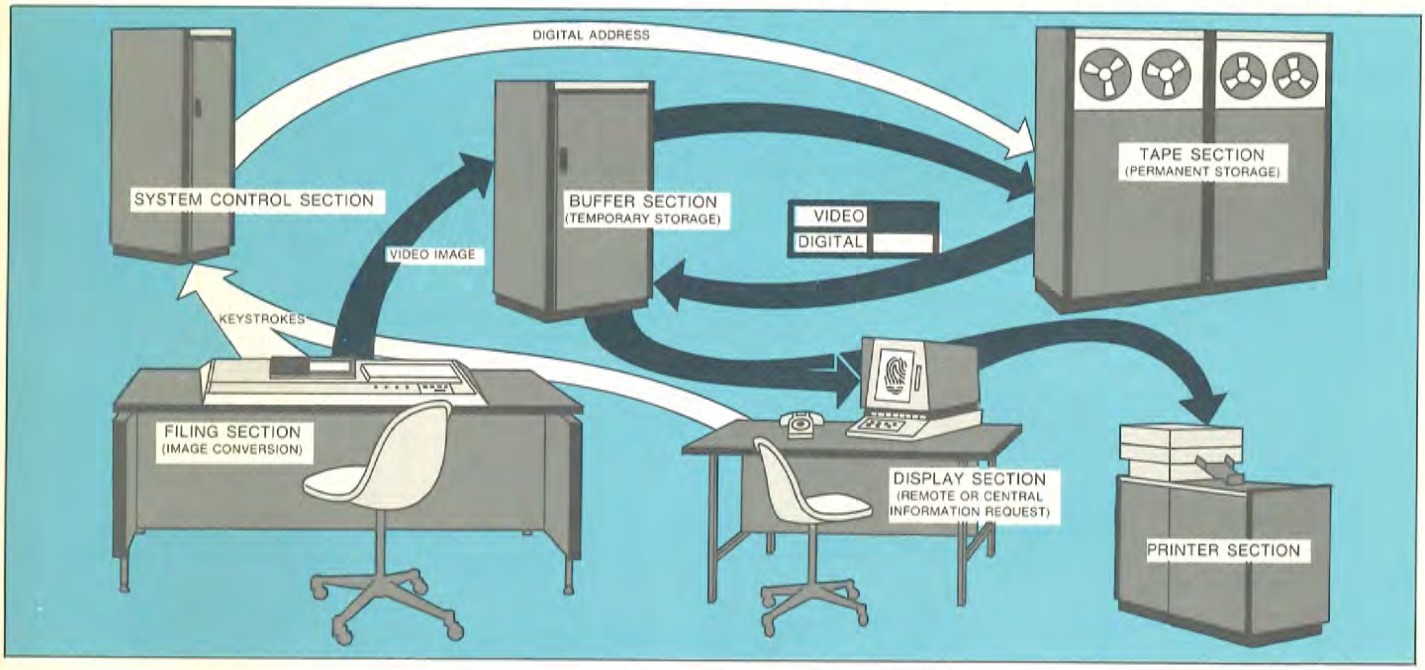
authorized persons and only by the use of the Videofile System equipment. Access to classified or confidential information is completely controlled—automatically. Unauthorized attempts at entry, either remotely or centrally, are automatically prevented and visually noted so that immediate action can be taken.

Less Space The ORACLE SYSTEM will reduce the amount of floor space required by the Los Angeles County Sheriff's Department to maintain its entire law enforcement information files to less than 1/10 of that presently used: a reduction from 40,000 to 3,000 square feet.

More Useful Files The ease and speed of locating and retrieving documents will significantly increase the use of existing records. Complete dossiers on individuals will now be generated and maintained on a current basis.

Future Expansion The design of the ORACLE SYSTEM allows for efficient expansion of file size to meet increased activity within the Sheriff's Department.

Savings When operational, the ORACLE Videofile System will reduce the Los Angeles County Sheriff's Department records system operating expense by approximately 70% annually, in salaries alone.



How documents become television recordings

To file a document in the Ampex Videofile System, an operator seated in front of a filing console places the document face down on a glass plate. Underneath the plate and pointed upward is a high-resolution television camera which scans and televises the document.

The camera, which has the highest resolution commercially available, converts the image to television signals. These video signals are guided by the system control section to one of several large tape transports and recorded on magnetic video tape. This is video recording, familiar to many people as television's video tape and "instant replay."

A second set of signals is also sent to the tape transport at the same time, but in computer language (digital code). These signals, which identify the document by an "address" so it can be retrieved, are keyed in by the operator while the document is being televised. To confirm that the operator has keyed the proper address into the system, the address is displayed by a viewer on the filing console. The address is recorded on the tape with the graphic document recording.

To retrieve the document, a requestor keys in the series of numbers which translate into the document's digital address code. The appropriate reel of tape is located and the tape transport, directed by the system control section, searches the tape for the document.

Once found, the document recording is played back by the transport into intermediate holding equipment (video buffer section). There, a metal disc magnetically records the incoming signals, duplicating the document recording. The disc then plays the recording back through a television display for viewing or through a printer to produce a paper copy. Since the magnetic disc records an electronic duplicate of the original document image that remains on tape in the master file, no document is ever "out-of-file" to other requests.

About 125,000 document recordings are stored in 3,600 feet of two-inch-wide tape on a 10½-inch reel. A comparable number of paper documents would require 10 four-drawer file cabinets for storage. Total storage capacity of the system is limited only by the number of tape reels used.

The unique properties of magnetic tape allow documents to be added to existing tape files wherever and whenever desired. They also may be erased, changed or purged within the file without disturbing or altering the adjacent information on the tape.

The ORACLE system in action

Fast identification of suspects is often a prime factor in crime prevention. In operation, the ORACLE SYSTEM will shorten from hours to minutes the time required to find and retrieve a fingerprint or other record and will dramatically speed the positive identification of arrested persons. The following hypothetical case illustrates how and why, and demonstrates ORACLE's flexibility in bringing various files to bear on identifying and processing an arrested person:



8 pm An auto theft suspect is brought to the West Hollywood station. He gives the name of John Smith and produces a driver's license as proof. Fingerprints are taken of the suspect's right index and middle fingers.



8:05 Officer uses a Videofile System filing console at the station to transmit the fingerprints by microwave link to the master ORACLE file in the Los Angeles County Hall of Justice. They are recorded on video tape.

8:05 At the same time, Smith is questioned and held on suspicion of auto theft. Officer suspects Smith has a criminal record and may be wanted on further charges. Officer telephones ORACLE headquarters and requests a search for matching fingerprints.



8:07 At ORACLE headquarters, Smith's fingerprints are played back from the video tape for viewing on a television display in another part of the Hall of Justice. A fingerprint analyst studies the images and, from the suspect's name, age and basic fingerprint characteristics, composes a search address.



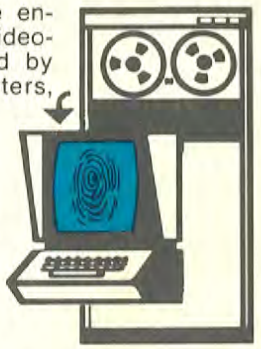
8:08 The search address is fed into the system control section of the Videofile System. The address "tells" the Videofile tape transports to search particular reels for fingerprints with addresses similar to the Smith address.

8:08 At the West Hollywood station, Smith has telephoned a lawyer. He is preparing to obtain release on the bail set for auto theft.



8:10 At the ORACLE central file the appropriate tape transports have been searching the Summary Dossier file, at the rate of 66,000 documents per minute. The file contains fingerprints and criminal index data of repeated offenders for quick reference. Three sets of fingerprints are found which might match those of Smith. They are transferred to an intermediate electronic holding unit (video buffer section) which plays them back, one after another, onto a second television display in front of the fingerprint analyst, who compares them with the Smith prints still shown on the first display. It is a 60-percent probability that the search would end here, according to Sheriff's Department statistics. Fingerprints matching Smith's would be found and he would be positively identified within ten minutes after arriving at the West Hollywood station. But for this case incident, assume the fingerprints are not found in the search of the Summary Dossier file.

8:11 The prints do not match those of Smith. The Hall of Justice analyst telephones the West Hollywood station and requests copies of all ten fingerprints of the suspect.



8:16 The new fingerprints are entered into the station's Videofile System equipment, transmitted by microwave to ORACLE headquarters, recorded on a work tape of the master fingerprint file, and immediately shown on the analyst's television display. The analyst composes a new search address based on the characteristics of all ten fingerprints, feeds it to the ORACLE Videofile System, and the tape transports begin a high-speed search of the large master fingerprint file.

8:21 Smith's lawyer arrives at the West Hollywood station. He tells Smith to remain silent and prepares to post bail to release the suspect.



8:21 At the same time a set of ten fingerprints that match the search address appears on the analyst's second television display, with data indicating the retrieved prints are those of Jonathan Doe. The analyst briefly compares the set with those obtained from Smith. The prints match. The analyst picks up the telephone.

8:21 At the other end of the telephone, an officer at the West Hollywood Station turns around and tells Smith his fingerprints have been identified as those of Jonathan Doe and that he will be held for further investigation.

8:23 Station personnel assigned to the case request the suspect's complete criminal history from ORACLE's Master Dossier file. The entire dossier may be played back page by page via microwave transmission to television displays at the station. Specific pages may be specified for printed paper copies to be made at the Hall of Justice for forwarding to the station. Later the West Hollywood station enters a case report of this incident, by microwave, into the ORACLE case file at the Hall of Justice. From this point, all new records resulting from further investigation of the case, including the processing of Doe in the Inmate Reception Center, will be filed, stored and retrieved via ORACLE. The central file will always be up-to-date for all personnel who need information on Doe.



Not only is the Doe file expanded to include the new material, but records of the Smith case incident are also filed separately, under Smith, and cross-referenced to the Jonathan Doe file.

If no fingerprints were found in the master ORACLE file to match those of Smith, and thus no previous record identified with the suspect, his fingerprints would be sent by facsimile system to other agencies, including the FBI and major police and sheriff's departments throughout the country, for priority checks of their "most wanted" files.

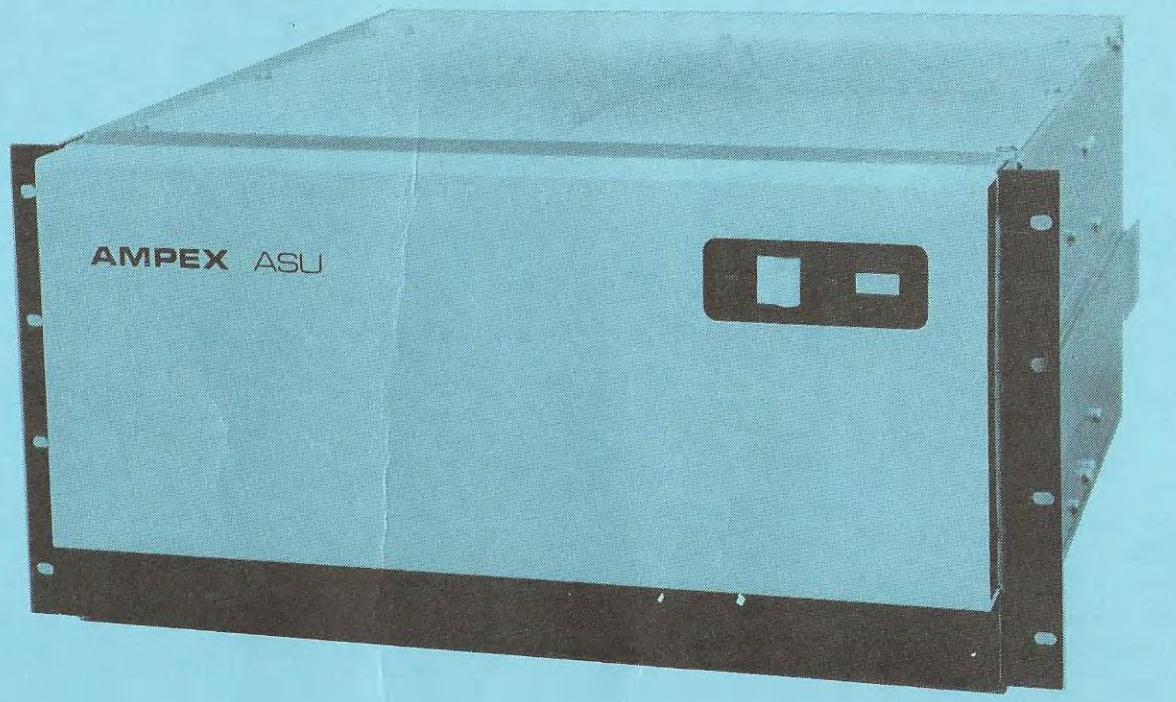
The flexibility of ORACLE enables it to respond to almost all possible circumstances, from multiple aliases to first offenses to crime without immediate suspects.

BCC-20 ASU

AUTOMATIC SETUP UNIT

SERVICE DATA PACKAGE

1809543



16157-1

AMPEX

ID-891

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, WALTER K. BOCKHOLT, a citizen of the United States of America, residing at the City of Redwood City, County of San Mateo, and State of California, have invented certain new and useful improvements in

ELECTRONIC TESTING EQUIPMENT

of which the following is a specification.

This invention relates in general to electronic testing equipment and more particularly to equipment for measuring and adjusting the distortion level of an electronic signal.

- 2 -

Applicant's distortion level monitor will be described in connection with magnetic tape recorder applications, but it is to be understood that this invention may be applied to electronic equipment of all types wherein it is necessary to monitor signal harmonic distortion or to adjust it to a predetermined level. In the magnetic tape recorder field, the main figure of merit or standard in regard to distortion is that of percentage third harmonic distortion. Second harmonic distortion is also of great interest in some cases; but third harmonic distortion is the most prominent because it indicates the presence of signal flattening due to saturation of tape and head. Since the signal-to-noise ratio of a tape recorder improves as the signal level of the recorder is raised, much effort is expended to adjust the signal level as high as possible without reaching too far into the tape or head saturation level, where flattening and third harmonic distortion occur. Many tape recorder manufacturers specify a certain percentage third harmonic distortion (usually at 1KC; but sometimes at 100KC or 25,000KC) which their recorder will not exceed; as for example, one percent third harmonic distortion.

Varying brands or types of tapes for use in magnetic tape recorders will have varying signal levels in a given machine beyond which they cannot operate without an increase in distortion above the specified level. Even variations of the speed of the same tape in the same machine will alter the distortion level. Thus, whenever the tape speed, brand, or type in any tape recorder is changed, it is necessary to readjust the record level of the tape recorder so as not to exceed the critical distortion point of the new tape or tape speed. The record level of a tape recorder is changed by altering the gain of its direct

record amplifiers while feeding in a test signal and analyzing the output of the recorder to ascertain percentage third harmonic distortion.

Prior distortion level analyzing equipments were heavy and costly, and their operation was so complicated that record level adjustment of just one tape channel often took ten minutes or more. In the operation of such an analyzer, a test signal was fed in and a band-pass filter was tuned to pass some desired harmonic of the test signal. In order to monitor percentage harmonic distortion, it was necessary to switch back and forth, taking readings first of the entire test signal and then of the passed harmonic. Naturally, any change in input level of the test signal while these observations were being made would require that they be recommenced. Thus, with tape recorders having fourteen tracks or more, the adjustment process could be oppressively lengthy, making frequent testing impossible. In practice the main problem causing this difficulty of adjustment was that the prior distortion analyzers changed readings (due to variation in input level) whenever the tape sturcture varied in any way -- a phenomenon known as "reproduce bounce".

It is, therefore, the general object of this invention to provide an improved distortion level monitor.

Another object of this invention is to provide a distortion level monitor that can shorten the time required to adjust the record level of a magnetic tape recorder.

Another object of this invention is to provide a distortion level monitor which is cheaper, lighter, and therefore more easily adaptable to a large, composite test set than prior equipment used for this purpose.

In the achievement of these and other objects and as a feature of Applicant's invention, there is provided a distortion level monitor which compares the total output signal of a magnetic tape recorder under test with some selected harmonic from the output signal. A preferred test set according to the principles of the invention processes this output signal in the following manner: the signal is first divided into two paths which lead to opposite sides of a distortion level meter -- essentially a center scale voltmeter. The first such path merely rectifies the signal being sampled and then smoothes it before applying it to the distortion level meter. The second path consists of band-pass filters and amplifying circuits which separate out a given harmonic of the test signal (usually the second or third harmonic) and then amplify it by a large factor (usually 100 plus an additional amount to compensate for filter insertion loss). The amplification factor is so selected and adjusted in the amplifiers of the distortion level monitor that after the amplified harmonic is rectified, smoothed, and applied to the opposite side of the distortion level meter from the full signal, the distortion level meter will read zero when the record level of the magnetic tape recorder is such as to achieve the desired percentage harmonic distortion.

It should be noted that a very simple and inexpensive distortion level monitor could be constructed in accordance to the principles of Applicant's invention by dividing a test signal from a tape recorder, separating out one harmonic with a simple band-pass filter while attenuating the whole signal, then applying the harmonic to one side and the attenuated signal to the other side of a vacuum tube voltmeter, which need not be a part of the special test equipment. Thus, a very simple package containing only the

filter and the attenuator (with the latter properly adjusted according to some shop standard equipment) could be supplied in each tape recorder or in a small easily operating customer test set. Any standard vacuum tube voltmeter would then be plugged into the filtered attenuator package only when it is in use.

In essence then, the principle of Applicant's invention is to monitor percentage harmonic distortion of an input signal by separating out the harmonic from the whole input signal, then applying the harmonic and the whole signals to opposite sides of a voltmeter or the like at predetermined levels of attenuation. These predetermined attenuation levels may be selected such that the voltmeter will read zero when the harmonic is some certain percentage of the whole input signal being analyzed.

Since the above described distortion level monitor is a balanced system dealing only in percentage, it is not affected by the reproduce bounce phenomenon described above or by any of the other fluctuations of input level often encountered in tape recorder equipment. Monitors constructed in accordance with this invention may be small, inexpensive, and simple to operate; thus, they could be easily incorporated in a composite test set and, indeed, might well be incorporated as an integral part of a tape recorder, so that the alignment process could be performed frequently and the recorder could be operated in peak performance at all times.

Other objects and features of this invention and a fuller understanding thereof may be had by referring to the following description and claims taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a schematic drawing of a preferred embodiment of Applicant's improved distortion level monitor; and

FIGURE 2 is a block diagram for the purpose of illustrating the operation thereof.

Referrring to FIGURE 1, the circuit which is a preferred embodiment of Applicant's invention has an input terminal 10, a ground terminal 12, and AC power supply terminals 14. The AC power supply at 14 is converted into +DC (at the junction 16) and -DC (at the junction 18) in the following manner: the AC power supply is coupled across the primary 20 of a transformer 22. The secondary 24 of the transformer 22 has a center tap 26 coupled to one end of a capacitor 28; while the ends of the secondary are coupled through two rectifying diodes 30, 32 to the other end of the capacitor 28. The AC voltage developed across the capacitor 28 is smoothed by the RC combinations of resistors 34, 36, the capacitor 28, and another capacitor 38 and then applied across two Zener diodes 40 and 42, having noise decoupling capacitors 44 and 46, respectively. The Zener diode 40 and the decoupling capacitor 44 are coupled in parallel between the -DC junction 18 and ground 12. The Zener diodes 42 and the decoupling capacitor 46 are coupled between the +DC junction 16 and ground 12. Thus, a substantially constant DC voltage centered about ground 12 is maintained at the junctions 16 and 18 as a power supply for the rest of the circuit.

Signals appearing at the input terminal 10 are divided at the junction 50 into two paths. The first path, through the line 52, carries the whole signal to an input level meter 54. Beyond the input level meter 54, the signal is passed through a coupling capacitor 56 (grounded through a resistor 58) to a

rectifier 60. Following rectification at 60, the signal is smoothed in a filter comprising a resistor 62 and a capacitor 64 coupled in parallel to ground 12. After being smoothed by the filter network 62, 64, the signal is applied to one side of a distortion level meter 66, a center scale voltmeter.

While the signal path through the line 52 carries the entire signal to the one side of the distortion level meter 66, the other path beginning with a resistor 70 is designed to pass only one harmonic of the input signal. Thus, the signal is passed through a first series of band-pass filters, wherein the parallel combination of a capacitor 72 and an inductor 74 is coupled between the resistor 70 and ground and is connected through a resistor 76 to a second parallel combination of a capacitor 78 and an inductor 79. The output of this first series of filters is then applied to a first amplification stage.

The first amplification stage comprises the transistors T1, T2, and T3, having emitters 80, 90, and 100, bases 82, 92, and 102, and collectors 84, 94, and 104, respectively. The base 82 of the transistor T1 is coupled to receive the signal from the first series of filters and is coupled to ground through a resistor 86. The collector 84 of the transistor T1 is coupled to the -12 volt power supply line through a resistor 88 and is directly coupled to the base 92 of the transistor T2. Transistor T2 is coupled in emitter-follower configuration, its collector 94 being directly coupled to the -12 volt supply line; its emitter 90 is directly coupled to the base 102 of the transistor T3 and to the +12 volts supply line through a resistor 96. The emitter 100 of the transistor T3 is coupled to ground through the parallel combination of a capacitor 106 and resistor 107. The collector

104 of the transistor T3 is coupled to the -12 volt power supply line through a resistor 108.

A feedback network between the collector 104 of the transistor T3 (the output terminal for the first amplifier) and the emitter 80 of the transistor T1 comprises the parallel combination of a capacitor 110, a resistor 112, and the series combination of a capacitor 114 and resistor 116. This feedback network lowers the output impedance of the first amplifier and provides the usual flattening effect.

A variable resistance network comprising two resistors 118 and 120 and a variable resistor 122 is coupled between the collector 80 of the transistor T1 and the +12v DC power supply junction 16. The wiper of the variable resistor 122 is coupled to ground 12 through a capacitor 124.

The collector 104 of the transistor T3 is coupled to a second band-pass filter stage similar to the first described above, having two resistors 126 and 128, two capacitors 130 and 132, and two inductors 134 and 136 in the same arrangement. Following the second filter stage is a second amplifier similar to the first described above, with transistors T4, T5, and T6 (having emitters 140, 150, and 160, bases 142, 152, and 162, and collectors 144, 154, and 164, respectively), resistors 146, 148, 156, 166, and 168, capacitor 169, feedback network (resistors 170 and 172 and capacitors 174 and 176), and variable resistance network (resistors 180 and 182, variable resistor 184, and capacitor 186).

The output of the second amplifier (the signal on the collector 164 of the transistor T6) is applied through a coupled capacitor 188 to a drive amplifier comprising the transistors T7, T8, T9, T10, and T11 (having emitters 190, 200, 210, 220, and 230,

bases 192, 202, 212, 222, and 232, and collectors 194, 204, 214, 224, and 234, respectively) and their associated components. The transistor T7 is coupled in essentially grounded emitter configuration, with its base coupled to receive the signal to be amplified through the coupling capacitor 188 coupled to ground through a resistor 195 and to the +12v DC power supply 16 through a resistor 196. The base 192 is coupled to the +12v DC power supply 16 through two resistors 197 and 198, which have a decoupling capacitor 199 connected between them. A resistor 193 is coupled between the collector 194 and the -12v DC power supply 18.

The signal from the collector 194 of the transistor T7 is coupled directly to the base 202 of the transistor T8 and through a blocking capacitor 203 to the base 212 of the transistor T9. The base 212 is coupled to the +12v DC power supply 16 through a resistor 213. The emitter 200 of the transistor T8 is coupled to the -12v DC junction 18 through the parallel combination of a resistor 206 and a capacitor 208, while the emitter 210 of the transistor T9 is coupled to the +12v DC power supply 16 through the parallel combination of a resistor 216 and a capacitor 218. The collectors 204 and 214 of the transistors T8 and T9, respectively, are joined through a resistor 219. Thus, the transistors T8 and T9 are coupled to act as complementary push-pull amplifiers, with output appearing on the collectors 204 and 214.

The transistor T10, essentially in emitter-follower configuration, is coupled to receive the output of the transistor T8; accordingly, its base 222 is directly coupled to the collector 204 of the transistor T8. The collector 224 of the transistor T10 is coupled to the -12v DC power supply 18 through a resistor 226.

The transistor T11, also in emitter-follower configuration, is

coupled to receive the output of the transistor T9, its base 232 being directly coupled to the collector 214. The collector 234 of the transistor T11 is coupled through a resistor 236 to the +12v DC power supply 16.

The emitters 220, 230 of the transistor T10, T11, respectively, are coupled to an output junction 240 of the drive amplifier through resistors 228 and 238, respectively. Both AC and DC feedback are supplied from the output junction 240 to the emitter 190 of the transistor T7 through the parallel combination of a resistor 242 and a capacitor 244. DC stabilization feedback is also supplied from the emitter 220 of the transistor T10 to the bases 202, 212 of the transistors T8, T9, respectively, through a resistor 246.

The signal at the output junction 240 of the drive amplifier passes through a coupling capacitor 250 (grounded through a resistor 252) to a rectifier 254. Following rectification at 254, the signal is smoothed in a filter comprising a resistor 256 and a capacitor 258 coupled in parallel to ground 12. After being smoothed by the filter 256, 258, the signal is applied to a second side of the distortion level meter 66.

Referring to FIGURE 2, it will be seen that the overall system of which Applicant's distortion level monitor is one part begins with a test signal source 300, which feeds in a test signal of a given frequency to the tape recorder being tested, represented at 302. The output from the tape recorder being tested 302 is applied to an input jack 304 coupled to an emitter-follower or other such circuit, represented at 306, which serves to isolate Applicant's distortion level circuitry as shown schematically in FIGURE 1 from the circuitry of the recorder 302. The output of the

emitter follower 306 is fed into the terminal 10 where it is divided into the full signal path 52 leading to the full signal smoothing filters represented at 308 and the band-pass filter path, represented by the filters 310 and the amplifiers 312. After the selected harmonic passed by the filters (usually the third harmonic) has been amplified to the strength equal to the full signal input passing through the path 52, it is applied to a smoothing filter network represented at 314.

In the use of the above-described distortion level monitor for adjusting the record level of a tape recorder, a signal from the reproduce amplifier of the recorder to be adjusted is fed into the input jack 304. The signal then passes through the emitter follower 306 and is applied to both the 3 KC narrow band-pass filter 310 and to the input level monitor meter 54. Then the record amplifier of the recorder is adjusted to a record level that will produce 1% third harmonic distortion of a recorded signal of 1 KC.

The signal applied to the input level monitor 54 is rectified by the circuit 308, consisting of the rectifier 60, resistor 62, and capacitor 64, with voltage being developed across the resistor 62 and ripple being filtered by the capacitor 64. The voltage developed across the resistor 62 is applied to one side of zero-center distortion level meter 66. After the same 1 KC signal is passed through the 3 KC filter 310 only the third harmonic or 3 KC remains. The amount of 3 KC signal beyond this point is determined by the amount of third harmonic distortion contained in the 1 KC signal coming from the reproducer. The 3 KC signal is amplified in the amplifier 312, where the amplifier gain has been preadjusted using a standard third harmonic generator

such that the amplitude of the 3 KC signal is applied to the network 314 is equal to the amplitude of the 1 KC signal in the line 52 when the third harmonic distortion of the 1 KC signal is 1%. Thus, when any 1 KC signal is applied to the input terminal 10 and the distortion is 1% third harmonic, the meter 66 will read center scale.

An important feature of this device lies in the fact that if there is an increase in input amplitude at 304 the level at both networks 308 and 314 will increase a like amount, so that the meter 66 will still continue to read center scale; thus, a center scale reading means 1% distortion regardless of input amplitude.

A distortion level monitor in accordance with description and drawing was built and operated using the following components:

VOLTAGES:

14 - 117 volt, 60 cps AC

TRANSISTORS:

T1 - 2N504	T7 - 2N604
T2 - 2N414	T8 - 2N446A
T3 - 2N414	T9 - 2N414
T4 - 2N504	T10 - 2N414
T5 - 2N414	T11 - 2N446A
T6 - 2N414	

DIODES:

30 - SD94

32 - SD94

40 - 1N1594A

42 - 1N1594A

60 - 1N193

254 - 1N193

RESISTORS (ohms):

34 - 300
36 - 300
58 - 2.2K
62 - 4.7K
70 - 27K
76 - 18K
86 - 100K
88 - 66.5K
96 - 33K
107 - 365
108 - 2.26
112 - 45.3K
116 - 47K
118 - 180
120 - 35.7K
122 - 200
126 - 18K
128 - 18K
146 - 100K
148 - 66.5K
156 - 33K
166 - 2.26
168 - 365
170 - 45.3K
172 - 47K
180 - 180
182 - 35.7K
184 - 200
193 - 4700
195 - 3300
196 - 45K
197 - 680
198 - 10K
206 - 1500
213 - 10K
216 - 1500
219 - 530
226 - 470
228 - 47
236 - 600
238 - 47
242 - 3300
246 - 22K
252 - 2.2K
256 - 4.7K

CAPACITORS (microfards):

28 - 500
38 - 500
44 - 500
46 - 500
56 - .22
64 - 10
72 - .033
78 - .033

CAPACITORS (continued):

106 - 750 x 10^{-6}
110 - 5 x 10^{-6}
114 - 1.0
124 - 300
130 - .033
132 - .033
169 - 750 x 10^{-6}
174 - 1.0
176 - 5 x 10^{-6}
186 - 300
188 - 5
203 - 30
208 - 100 x 10^{-6}
218 - 100 x 10^{-6}
244 - 47 x 10^{-6}
250 - .22
258 - 10

INDUCTORS (microhenries):

74 - 100 Variable
79 - 100 Variable
134 - 100 Variable
136 - 100 Variable

The above specified circuit was operated with a 1,000 cps test signal supplied at 300 to the recorder being tested 302. The filters represented schematically at 310 passed the third harmonic of the test signal, i.e.- 3 KC. The input at the power supply terminals 14 was 117 volt, 60 cycle AC current. Although the time required to adjust the distortion level of one tape track using prior test equipment was over ten minutes, the time required using Applicant's distortion level monitor was less than one minute; in fact, ten seconds per channel is usual.

Thus, Applicant has provided an improved distortion level monitor which requires minimal time to adjust the record level of a magnetic tape recorder and yet is cheaper, lighter, and therefore more easily adaptable to large composite test sets than prior equipment used for this purpose. Since Applicant's distortion

level monitor is responsive only to the relative percentages of the input test signal and some selected harmonic (usually the third harmonic) thereof, it is not affected by the reproduce bounce phenominon or other input variations, which had made record level adjustment such a difficult task with prior distortion level monitors. The model constructed operated with the input varied between .5 and 2.5 volts r.m.s.

A number of alternative arrangements will readily suggest themselves to those skilled in the art. For example, N-P-N conductivity type transistors and P-N-P conductivity type transistors may be interchanged, if only the power supply, biasing elements, and other circuit components are appropriately reversed. However, although the invention has been described with a certain degree of particularity, it is to be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

JHG:klm

WHAT IS CLAIMED IS:

1. A monitor for measuring the amount of harmonic distortion in test signals comprising: an input terminal for the test signals, a first rectifier coupled to the input terminal, a first smoothing filter coupled to the first rectifier, a voltmeter having two input terminals, one of said voltmeter input terminals being coupled between the first rectifier and first smoothing filter, filtering means designed to pass a harmonic of the test signal coupled to the input terminal, amplification means coupled to the filtering means, the gain of said amplification means being preset such that said voltmeter will read at a preset point when the harmonics passed by said filtering means have amplitude a certain percentage of said test signal, a second rectifier coupled to the amplification means, second filtering means coupled to the second rectifier and a second input terminal of the voltmeter coupled between the second rectifier and the second filtering means.

2. A monitor for measuring the amount of harmonic distortion in test signals comprising: an input terminal for the test signals, a first rectifier coupled to the input terminal, the parallel combination of a first resistor and a first capacitor coupled to the first rectifier, a center scale voltmeter having two input terminals, one of said voltmeter input terminals being coupled between the first rectifier and the parallel combination of the first resistor and first capacitor, filtering means designed to pass only a harmonic of the test signal coupled to the input terminal, amplification means coupled to the filtering means, the gain of said amplification means being preset such that said voltmeter will read at a preset point when the harmonic passed by said filtering means has amplitude a certain percentage of said test signal, a second rectifier coupled to the amplification means, the parallel combination of a second resistor and a second capacitor coupled to the second rectifier, and a second input terminal of the center scale voltmeter coupled between the second rectifier and the second filtering means.

3. A distortion level monitor having an input terminal, a first rectifier coupled to the input terminal, a smoothing filter coupled to the first rectifier, a voltmeter having two input terminals, one of said input terminals being coupled between the first rectifier and the smoothing filter, filtering means coupled to the input terminal, amplification means coupled to the filtering means, a second rectifier coupled to the amplification means, a second smoothing filter coupled between the second rectifier and ground, and a second input terminal of the voltmeter coupled between the second rectifier and the second smoothing filter.

4. A distortion level monitor having an input terminal, first rectifier coupled to the input terminal, the parallel combination of a first resistor and a first capacitor coupled to the first rectifier, a center scale voltmeter having two input terminals, one of said input terminals being coupled between the first rectifier and the parallel combination of the first resistor and first capacitor, filtering means coupled to the input terminal, amplification means coupled to the filtering means, a second rectifier coupled to the amplification means, the parallel combination of a second resistor and a second capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

5. A distortion level monitor having an input terminal, a ground terminal, a first capacitor coupled to the input terminal, a first rectifier coupled to the first capacitor, the parallel combination of a first resistor and a second capacitor coupled between the first rectifier and the ground terminal, a center scale voltmeter having two input terminals, one of said input voltmeter terminals being coupled to the first rectifier, band-pass filtering means coupled to the input terminal, amplifying means coupled to the band-pass filtering means, a third capacitor coupled to receive the output of the amplifying means, a second rectifier coupled to the third capacitor, the parallel combination of a second resistor and a fourth capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

6. A distortion level monitor having an input terminal, a ground terminal, a first capacitor coupled to the input terminal, a first rectifier coupled to the first capacitor, the parallel combination of a first resistor and a second capacitor coupled between the first rectifier and the ground terminal, a center scale voltmeter having two input terminals, one of said voltmeter input terminals being coupled to the first rectifier, a first band-pass filtering network coupled to the input terminal, a first amplification stage coupled to the first band-pass filtering network, a second band-pass filtering network coupled to the first amplification stage, a second amplification stage coupled to the second band-pass filtering network, a third capacitor coupled to receive the output of the second amplification stage, a second rectifier coupled to the third capacitor, the parallel combination of a second resistor and a fourth capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

7. A distortion level monitor having an input terminal, a ground terminal, a first capacitor coupled to the input terminal, a first rectifier coupled to the first capacitor, the parallel combination of a first resistor and a second capacitor coupled between the first rectifier and the ground terminal, and a center scale voltmeter having two input terminals, one of said input terminals being coupled to the first rectifier, a second resistor coupled to the input terminal, the parallel combination of a third capacitor and first inductor coupled between the input terminal and ground, a third resistor coupled to the second resistor, the parallel combination of a second inductor and a fourth capacitor coupled between the third resistor and ground, a first amplification stage coupled to the third resistor, a fourth resistor coupled to receive the output of the first amplification stage, the parallel combination of a third inductor and a fifth capacitor coupled between the fourth resistor and ground, a fifth resistor coupled to the fourth resistor, the parallel combination of a fourth inductor and a fifth capacitor coupled between the fifth resistor and ground, a second amplification stage coupled to the fifth resitor, a sixth capacitor coupled to receive the output of the second amplification stage, a second rectifier coupled to the sixth capacitor, the parallel combination of a sixth resistor and a seventh capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

8. A distortion level monitor having an input terminal, a ground terminal, a first capacitor coupled to the input terminal, a first rectifier coupled to the first capacitor, the parallel combination of a first resistor and a second capacitor coupled between the first rectifier and the ground terminal, a center scale voltmeter having two input terminals, one of said input terminals being coupled to the first rectifier, a second resistor coupled to the input terminal, the parallel combination of a third capacitor and first inductor coupled between the input terminal and ground, a third resistor coupled to the second resistor, the parallel combination of a second inductor and a fourth capacitor coupled between the third resistor and ground, a first transistor having emitter, base, and collector, the base of the first transistor being coupled to the third resistor and being coupled through a fourth resistor to ground, the emitter of the first transistor being coupled to a first variable resistor, a wiper on the first variable resistor being coupled through a fifth capacitor to ground, a second transistor having emitter, base, and collector, the base of the second transistor being coupled to the collector of the first transistor, a third transistor having emitter, base, and collector, the base of the third transistor being coupled to the emitter of the second transistor, the emitter of the third transistor being coupled through the parallel combination of a fifth resistor and a sixth capacitor to ground, a feedback network between the collector of the third transistor and the emitter of the first transistor, said feedback network comprising the parallel combination of a seventh capacitor, a sixth resistor, and a seventh resistor and an eighth capacitor in series, an eighth resistor coupled to the collector of the third transistor, the parallel combination of a third inductor and a ninth capacitor coupled between the eighth resistor and ground, a ninth resistor coupled to the eighth resistor, the parallel combination of a fourth inductor and a tenth capacitor coupled between the ninth

8. (continuted)

resistor and ground, a fourth transistor having an emitter, base, and collector, the base of the fourth transistor being coupled to the ninth resistor and coupled through a tenth resistor to ground, the emitter of the fourth transistor being coupled to a second variable resistor, a wiper of the second variable resistor being coupled through an eleventh capacitor to ground, a fifth transistor having emitter, base, and collector, the base of the fifth transistor being coupled to the collector of the fourth transistor, a sixth transistor having emitter, base, and collector, the base of the sixth transistor being coupled to the emitter of the fifth transistor, the emitter of the sixth transistor being coupled through the parallel combination of an eleventh resistor and a twelfth capacitor to ground, a feedback circuit coupled between the collector of the sixth transistor and the emitter of the fourth transistor, said feedback circuit comprising the parallel combination of a thirteenth capacitor, an eighteenth resistor, and a fourteenth capacitor and a nineteenth resistor in series, a fifteenth capacitor coupled to the collector of the sixth transistor, a seventh transistor having emitter, base, and collector, the base of the seventh transistor being coupled directly to the fifteenth capacitor, the emitter of the seventh transistor being coupled and through a sixteenth capacitor to ground, an eighth transistor having emitter, base, and collector, the base of the eighth transistor being coupled to the collector of the seventh transistor, a ninth transistor having emitter, base, and collector, the base of the ninth transistor being coupled through a seventeenth capacitor to the base of the eighth transistor, the collector of the ninth transistor being coupled through a fourteenth resistor to the collector of the eighth transistor, a tenth transistor having emitter, base, and collector, the base of the tenth transistor being coupled to the collector of the eighth transistor, and the

8. (continued)

emitter of the tenth transistor being coupled through a fifteenth resistor to the base of the ninth transistor, an eleventh transistor having emitter, base, and collector, the base of the eleventh transistor being coupled to the collector of the ninth transistor, a sixteenth resistor coupled to the base of the eleventh transistor, a seventeenth resistor coupled between the sixteenth resistor and the base of the tenth transistor, an eighteenth capacitor coupled between the sixteenth and seventeenth resistors, a second rectifier coupled to the eighteenth capacitor, the parallel combination of an eighteenth resistor and a nineteenth capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

9. A distortion level monitor having an input terminal, a ground terminal, positive and negative power supply terminals, a first capacitor coupled to the input terminal, a first rectifier coupled to the first capacitor, the parallel combination of a first resistor and a second capacitor coupled between the first rectifier and the ground terminal, a center scale volt meter having two input terminals, one of said input terminals being coupled to the first rectifier, a second resistor coupled to the input terminal, the parallel combination of a third capacitor and first inductor coupled between the input terminal and ground, a third resistor coupled to the second resistor, the parallel combination of a second inductor and a fourth capacitor coupled between the third resistor and ground, a first transistor having emitter, base, and collector, the base of the first transistor being coupled to the third resistor and being coupled through a fourth resistor to ground, the emitter of the first transistor being coupled to the positive power supply terminal through a first variable resistor, a wiper on the first variable resistor being coupled through a fifth capacitor to ground, the collector of the first transistor being coupled through a fifth resistor to the negative power supply, a second transistor having emitter, base, and collector, the base of the second transistor being coupled to the collector of the first transistor, the collector of the second transistor being directly coupled to the negative power supply, and the emitter of the second transistor being coupled through a sixth resistor to the positive power supply, a third transistor having emitter, base, and collector, the base of the third transistor being coupled to the emitter of the second transistor, the collector of the third transistor being

9. (Continued)

coupled through a seventh resistor to the negative power supply, and the emitter of the third transistor being coupled through the parallel combination of an eighth resistor and a sixth capacitor to ground, a feedback network between the collector of the third transistor and the emitter of the first transistor, said feedback network comprising the parallel combination of a seventh capacitor, a ninth resistor, and a series combination of a tenth resistor and an eighth capacitor, an eleventh resistor coupled to the collector of the third transistor, the parallel combination of a third inductor and a ninth capacitor coupled between the eleventh resistor and ground, a twelfth resistor coupled to the eleventh resistor, the parallel combination of a fourth inductor and a tenth capacitor coupled between the twelfth resistor and ground, a fourth transistor having an emitter, base, and collector, the base of the fourth transistor being coupled to the twelfth resistor and coupled through a thirteenth resistor to ground, the emitter of the fourth transistor being coupled through a second variable resistor to the positive power supply, a wiper of the second variable resistor being coupled through an eleventh capacitor to ground, the collector of the fourth transistor being coupled through a fourteenth resistor to the negative power supply, a fifth transistor having emitter, base, and collector, the base of the fifth transistor being coupled to the collector of the fourth transistor, the collector of the fifth transistor being coupled to the negative power supply, and the emitter of the fifth transistor being coupled through a fifteenth resistor to the positive power supply, a sixth transistor having emitter, base, and collector, the base of the sixth transistor being

9. (Continued)

coupled to the emitter of the fifth transistor, the collector of the sixth transistor being coupled through a sixteenth resistor to the negative power supply, the emitter of the sixth transistor being coupled through the parallel combination of a seventeenth resistor and a twelfth capacitor to ground, a feedback circuit coupled between the collector of the sixth transistor and the emitter of the fourth transistor, said feedback circuit comprising the parallel combination of a thirteenth capacitor, an eighteenth resistor, and a fourteenth capacitor and a nineteenth resistor in series, a fifteenth capacitor coupled to the collector of the sixth transistor, a seventh transistor having emitter, base, and collector, the base of the seventh transistor being coupled directly to the fifteenth capacitor, through a twentieth resistor to ground, and through a twenty-first resistor to the positive power supply, the emitter of the seventh transistor being coupled through a twenty-second resistor to the positive power supply and through a sixteenth capacitor to ground, the collector of the seventh transistor being coupled through a twenty-third resistor to the negative power supply, an eighth transistor having emitter, base, and collector, the base of the eighth transistor being coupled to the collector of the seventh transistor, the emitter of the eighth transistor being coupled through the parallel combination of a twenty-fourth resistor and a seventeenth capacitor to the negative power supply, a ninth transistor having emitter, base, and collector, the base of the ninth transistor being coupled through an eighteenth capacitor to the base of the eighth transistor and through a twenty-fifth resistor to the positive power supply, the emitter

9. (Continued)

of the ninth transistor being coupled through the parallel combination of a twenty-sixth resistor and a nineteenth capacitor to the positive power supply, the collector of the ninth transistor being coupled through a twenty-seventh resistor to the collector of the eighth transistor, a tenth transistor having emitter, base, and collector, the base of the tenth transistor being coupled to the collector of the eighth transistor, the collector of the tenth transistor being coupled through a twenty-eighth resistor to the negative power supply, and the emitter of the tenth transistor being coupled through a twenty-ninth resistor to the base of the ninth transistor, an eleventh transistor having emitter, base, and collector, the base of the eleventh transistor being coupled to the collector of the ninth transistor, the collector of the eleventh transistor being coupled through a thirtieth resistor to the positive power supply, a thirty-first resistor coupled to the base of the eleventh transistor, a thirty-second resistor coupled between the thirty-first resistor and the base of the tenth transistor, a twentieth capacitor coupled between the thirty-first and thirty-second resistors, a second rectifier coupled to the twentieth capacitor, the parallel combination of a thirty-third resistor and a twenty-first capacitor coupled between the second rectifier and ground, and a second input terminal of the center scale voltmeter coupled to the second rectifier.

10. A method for measuring the percentage of harmonic distortion in an input signal comprising: applying the input signal to one side of a voltmeter, passing the input signal through amplifying and separating means whereby certain harmonics of the input signal are separated out therefrom at a preset level of amplification, and applying the amplified, separated-out harmonic to the other side of the voltmeter.

11. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, a band-pass filter for filtering through a selected harmonic of the input signal coupled to the input signal source, and means operatively coupled to the band-pass filter and to the input signal source for deriving a percentage comparison of the filtered harmonic with the input signal.

12. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, a band-pass filter for filtering through a selected harmonic of the input signal coupled to the input signal source, attenuating means coupled to the input signal source, and means operatively coupled to the band-pass filter and to the attenuating means for deriving a percentage comparison of the filtered harmonic with the input signal.

13. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, a band-pass filter for filtering through a selected harmonic of the input signal coupled to the input signal source, attenuating means coupled to the band-pass filter, and means operatively coupled to the attenuating means and to the input signal source for deriving a percentage comparison of the filtered harmonic with the input signal.

14. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, attenuating means coupled to the input signal source, a band-pass filter for filtering through a selected harmonic of the input signal coupled to the attenuating means, and means operatively coupled to the band-pass filter and to the input signal source for deriving a percentage comparison of the filtered harmonic with the input signal.

15. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, means for deriving a percentage comparison of said harmonic with said input signal, and attenuating means and means for separating out said harmonic from said input signal operatively coupled between the source of input signal and the percentage comparison means.

16. A device for analyzing the percentage harmonic in an input signal, comprising: a source of the input signal, means for filtering through a selected harmonic of the input signal coupled to the input signal source, attenuating means coupled to the input signal source, a first rectifier coupled to the filtering means, a second rectifier coupled to the attenuating means, and means for deriving a percentage comparison of the filtered harmonic with the input signal coupled to receive the outputs of the first and second rectifiers.

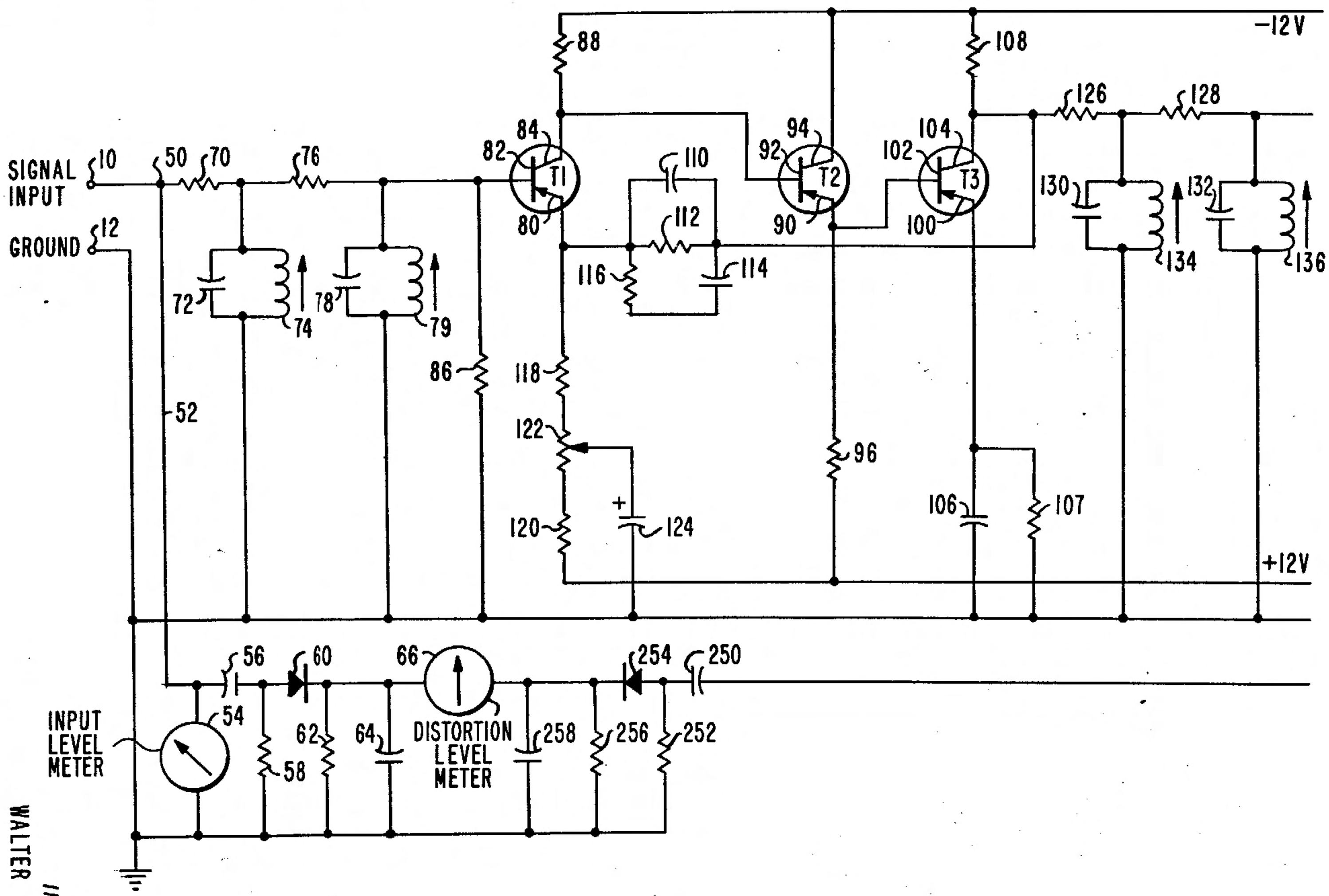


FIG.-1A

INVENTOR
WALTER K. BOCKHOLT
BY James H. Griffin
ATTORNEY

I.D. 891 1 of 3

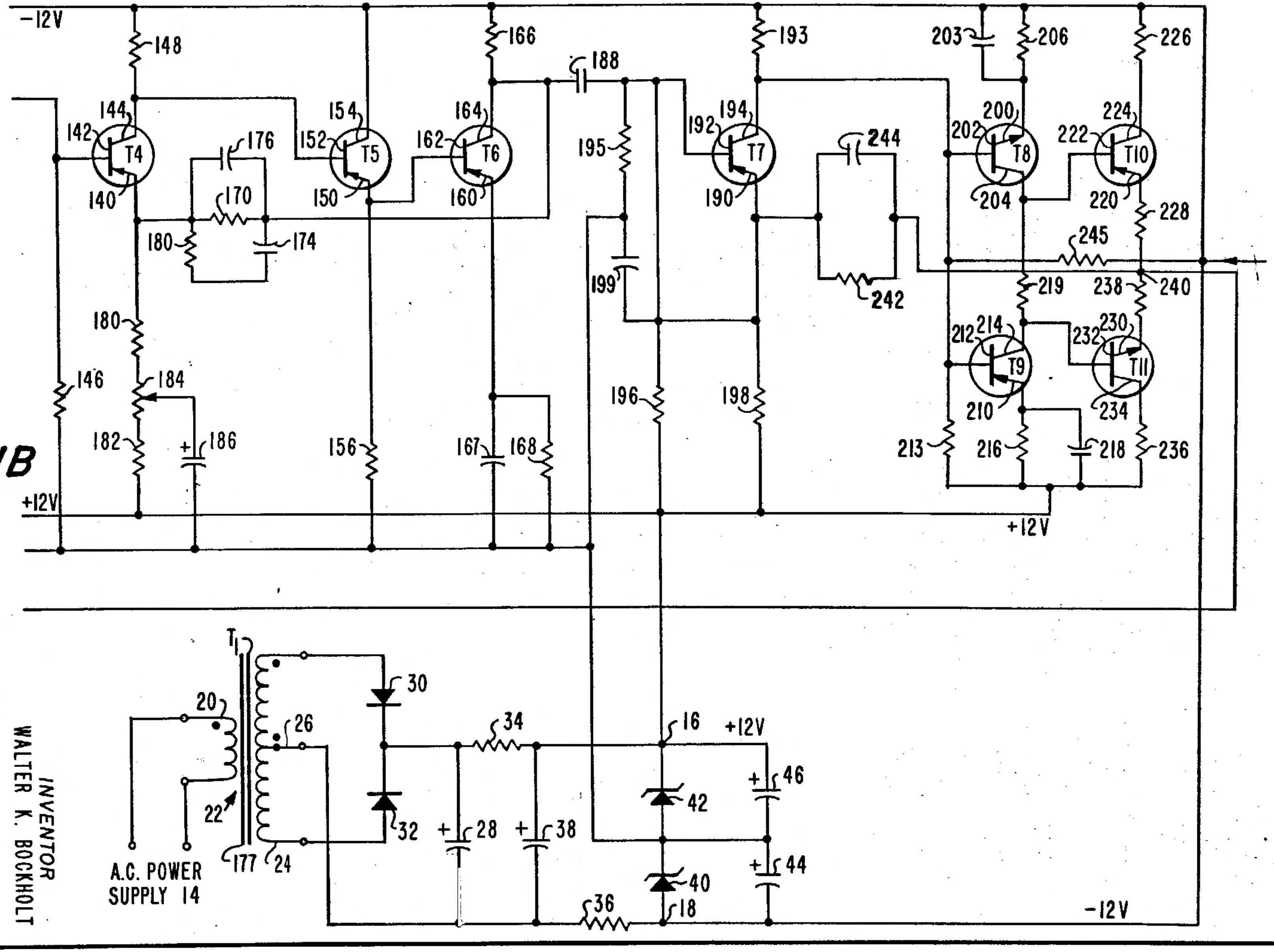


FIG.-1B

INVENTOR
WALTER K. BOCKHOLT

BY James H. Griffin

ATTORNEY

I.D. 891 2 of 3

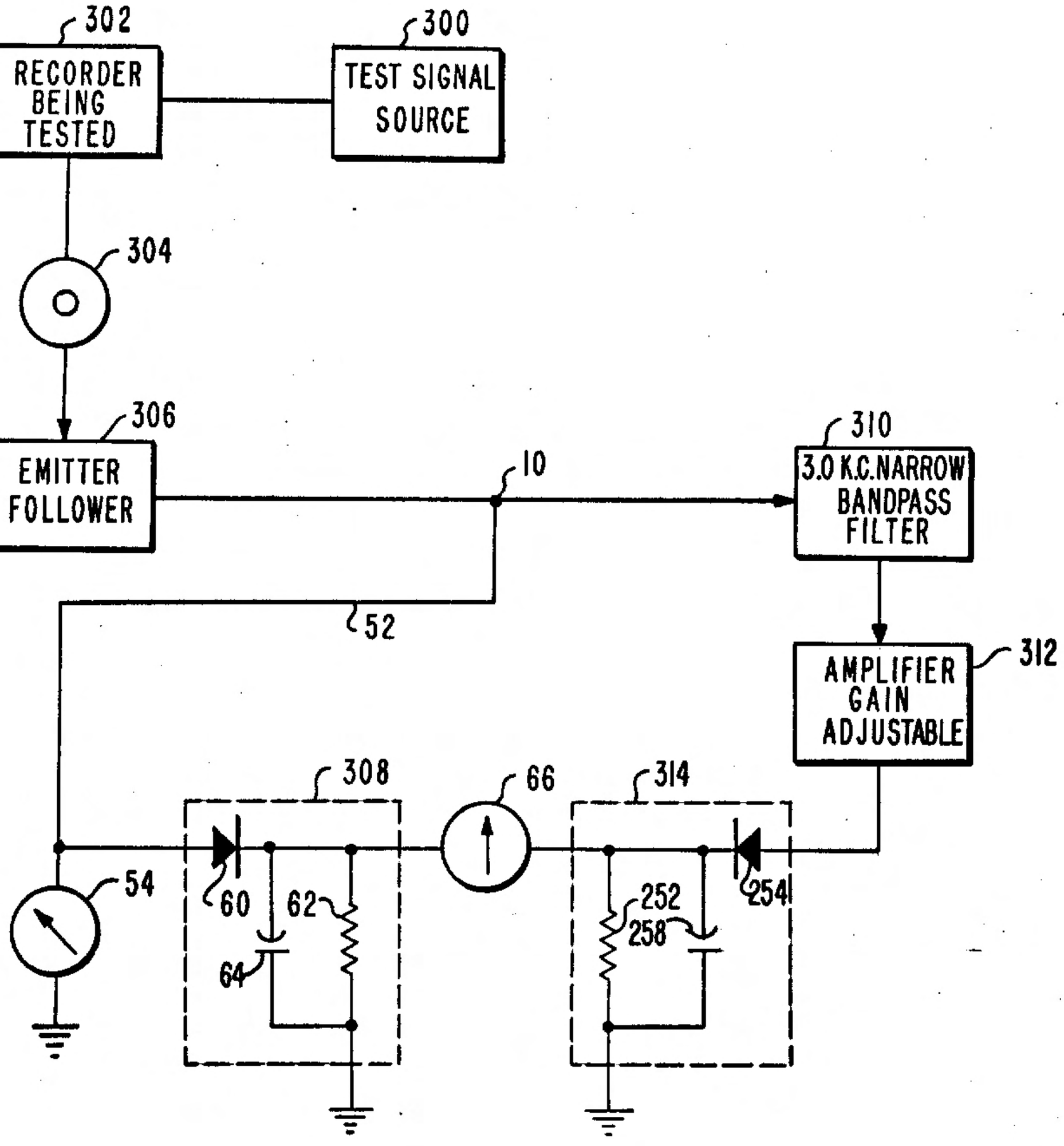


FIG.-2

INVENTOR
WALTER K. BOCKHOLT

BY James H. Giffin

ATTORNEY

I.D. 891 3 OF 3

Museum of Magnetic Sound Recording

preserving the history of sound recording

Museum of Magnetic Sound Recording

©2022 Museum of Magnetic Sound Recording and David Bockholt

Ampex professional photos donated to MOMSR by David Bockholt

David Bockholt's dad Walter Bockholt worked at Ampex from 1958 to 1987. He passed in 1996.



One of the 1962 newsletters from AMPEX in Redwood city where my dad worked listed Ken Patton as the company photographer. He would be the judge for employee photo contests.





Of note, I included a US PATENT invented by my father Walter Bockholt. It has to do with testing and controlling the distortion levels in magnetic recording.

I do not know what some of the equipment in the stack of photos are, but some to have labels on the edge of the photo or you can make out the model number in the photo.

My dad Walter on the far right above







Ampex Pro Photos donated to MOMSR by David Bockholt