

FIGURE 9. TYPE 902 IGNITIONSCOPE BLOCK DIAGRAM OF CIRCUITS

The vertical deflection generator moves the beam across the tube from top to bottom. With both generators operating, the line traced out would be diagonal from top-left to bottom-right.

For the purposes of displaying the ignition pattern, the horizontal deflection line length must be many times longer than the vertical movement caused by the vertical deflection generator. To place all of this horizontal line on the screen at the same time, the line is broken up, and the segments are shown one under the other.

So that the sections of the screen pattern are readily identified with the engine ignition timing, two synchronizing signals are applied to the deflection generators. The No. 1 Cylinder connection causes the vertical movement to start at the top of the screen, making the first segment, or line, the signal pattern of the No. 1 Cylinder.

The segments, or lines, are started at the left side of the tube screen by the synchronizing action of the ignition coil connection. As the firing of the No. 1 Cylinder started the beam at the top, it will return to the top again only when No. 1 Cylinder fires again. But the ignition coil pulsations take place when each cylinder fires, so the beam starts again from the left although slightly lower on the screen for each cylinder firing. Because the No. 1 Cylinder is the top line, the remaining lines are, in order, the patterns of the ignition signal in the firing order of the engine.

To cause the beam deflection, both the horizontal and vertical deflection generators produce the beam movement by slowly charging the capacitors in the plate circuits of V1 and V3 (see the Schematic Diagram of Figure 16). Returning the beam to its starting point is accomplished by discharging the capacitors suddenly.

V1 and V3 are gas-type tubes that conduct heavily when the proper signal voltage is applied to their inputs. The high conduction causes the capacitors to discharge through the tube. The discharge of V1 occurs each time No. 1 Cylinder fires, returning the beam to the top.

The discharge of V3 occurs each time any cylinder fires due to the ignition coil voltage pulsation, returning the beam to the left.

The Cylinders-Speed switch selects one of three ranges of capacitor charge to allow for a wide selection of the number of engine cylinders.

Both the No. of Lines and Hor. Lock controls are adjustments to set the level of the synchronizing signals to be applied to the grids of V1 and V3. They serve much the same purpose as the horizontal and vertical hold controls of a television receiver, synchronizing the deflection generators to the engine operation.

V2 and V4 are push-pull amplifiers providing signal voltages of the proper amplitude to cause the deflection of the beam of the cathode-ray tube. The Line Spacing control adjusts the amplitude of the vertical deflection voltage causing the individual lines to be closer together or further apart. With the control fully counterclockwise, no signal from V1 is passed on, so that all the lines are superimposed on each other.

The Line Length control adjusts the amplitude of the horizontal deflection voltage to shorten the line or lengthen it to spread out the signal information for close study.

The Hor. and Vert. Center controls set dc voltages on the tube deflection plates, moving the entire pattern left and right, and up and down, for centering purposes.

Up to this point, all of the description has been to produce the lined pattern on the cathode-ray tube screen. The characteristic ignition signal occurs in all engines on the same ignition coil lead connected to the horizontal deflection generator. The ignition signal is therefore coupled from the ignition coil connection through C12 to the vertical deflection amplifier V2. Here the more rapid vertical pulsations of the ignition system are superimposed on the normal vertical movement of the beam caused by the vertical deflection generator. The size of these superimposed pulsations are adjusted by the Signal Size control. This control should be set so that the pulsations of one cylinder do not interfere with the screen pattern of another cylinder.

To provide the usual high and low voltages required for operation, two power supplies are included in the IgnitionScope. The low voltage supply is a conventional unregulated circuit with a full-wave rectifier applying its dc output to a single-section capacitor-input smoothing filter.

The high voltage supply is of the high-frequency oscillator type. The ac oscillations are rectified by a half-wave rectifier V6. The resultant dc is about 2000 volts and is used for the operation of the cathode-ray tube. The voltage divider supplying the proper voltages for the tube elements, contain the Brightness, Focus and Astigmatism adjustments, while the actual high voltage is pre-set by the HV Control in the oscillator circuit.

E1, E2 and E4 in the input signal leads prevent shock hazard by causing a short circuit to ground in case a dangerous high voltage is accidentally applied.

## 4.0 IGNITIONSCOPE MAINTENANCE

### 4.01 General

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. How often it is checked will depend on the installation and the conditions of operation. In general, portable units moved about constantly will require more frequent service than units fastened down permanently.

For these regular checks, clean all dust and dirt from the unit, using a light air blast or soft brush. Be sure dust is removed from around tube socket contacts and terminal strip connections.

In the design of this Du Mont equipment, care has been taken to use the proper tubes for the application desired, and to use them in such a manner that considerable weakening can take place before replacement is necessary. While checking tubes is desirable, a tube should only be replaced when it is actually causing a degradation in unit performance. A simple test for tube checking is to insert a tube known to be good and look for an improvement in performance.

### 4.02 Service Adjustments

Due to the very simple circuits used in the IgnitionScope, only two electrical adjustments are required. In addition, there are two control knob settings that will aid the operator in his daily use of the unit.

To reach the two electrical adjustments, the cabinet cover must be removed. To do so, remove the two screws shown in Figure 10, and pull out the unit.

In all cathode-ray tubes, a small bright spot created by the electron beam can burn a permanent mark on the screen surface. The IgnitionScope is designed so that such a spot can only occur when the horizontal sweep circuit fails completely. Normally this circuit always forms a horizontal line across the screen in the absence of an applied input signal. To prevent such screen burning by the spot in case of trouble or during some of the adjustments to follow, KEEP THE BRIGHTNESS LOW.

### 1. Astigmatism

With the IgnitionScope disconnected from any engine, pull tube V4 from its socket. See Figure 14 for the location of this tube.

Turn on the unit, and, after it warms up, adjust the Center controls until the spot is located in the center of the tube. KEEP THE BRIGHTNESS LOW.

Adjust both the Focus control on the front panel (Figure 3) and the Astigmatism control (Figure 13) together until the spot on the screen is sharply defined and round in shape.

Turn off the unit and replace V4.

### 2. High Voltage

Connect a 20,000-ohms-per-volt meter capable of reading at least 2000 volts dc, between the junction of R48 and R51 and ground (chassis). The negative probe should be at the resistor junction, positive on ground.

Set the HV Adjust control fully counterclockwise to start. With the IgnitionScope disconnected from any engine, turn the IgnitionScope on.

After it warms up, turn up the HV Adjust control until a reading of 2000 volts is obtained.

Turn off the unit, remove the meter leads and replace in its cabinet.

### 3. Centering the Vertical and Horizontal Knobs

Turn the Line Length control fully counterclockwise.

With the IgnitionScope disconnected from any engine, turn the IgnitionScope on.

After it warms up, turn the Horizontal and Vertical Center controls until the trace shown on the screen is in the center of the screen area.

At this point the indexing line on the Vertical and Horizontal Center knobs should be pointing straight up. If they are not, loosen the set screws holding the knobs to the shafts and turn the knobs without turning the control shafts. When the index line is located straight up, tighten the set screws again. Turn off the unit.



## 4.03 Replacing the Cathode-ray Tube

CAUTION

THE CATHODE-RAY TUBE SHOULD BE HANDLED WITH GREAT CARE TO PREVENT BREAKAGE BECAUSE SERIOUS INJURY CAN OCCUR FROM FLYING GLASS. DO NOT APPLY FORCE AT ANY TIME. WHEN HANDLING SUCH TUBES, WEAR GLOVES AND GOGGLES FOR PROTECTION.

To remove the cathode-ray tube:

1. Disconnect the IgnitionScope from the engine and from the source of ac power.
2. Take off the cabinet by removing the two screws shown in Figure 10 and pulling the unit out.
3. Pull off the calibrated scale.
4. Remove the four screws around the bezel ring (Figure 3).
5. Remove the four screws that were hidden under the bezel. This releases the scale holding clips, a black ring and filter.
6. Loosen the tube clamp at the socket and pull off the socket itself.
7. Pull the tube out through the front panel.

To replace the tube, reverse the above procedure. Before tightening the tube clamp, plug the IgnitionScope into the ac power and turn it on. After it warms up, note if the horizontal line traced on the screen is truly horizontal. The tube should be turned as necessary to make it horizontal if it is not.

To do this, hold the tube socket to turn the tube. BE CAREFUL NOT TO TOUCH NEARBY HIGH VOLTAGE POINTS.

## 4.04 Trouble-shooting Hints

Because of the small number of vacuum tubes used in the IgnitionScope, any tube failure is easily identified by its effect on the screen pattern. As a servicing aid, the following hints are provided.

1. Unit does not operate, tube filaments are not lit: Fuse F1 is located in the ac line to the power transformer. It is the only fuse in the unit. If the fuse is blown, it usually means some more serious trouble is occurring within the IgnitionScope circuit. Such faults as a partially shorted power transformer, shorted electrolytic capacitors, shorted tube elements, etc., can cause the fuse to blow.
2. Unit does not operate but tube filaments are lit except for the rectifier tube V8: Replace V8.
3. Tubes are lit, B+ is applied, but no pattern appears on screen: High voltage power supply probably at fault. Check tubes in this circuit. If tubes test satisfactorily, look for open transformer winding, shorted capacitors, etc.
4. Single horizontal line only on screen, No. of Lines control does not affect pattern: Fault is in Vertical Deflection circuit; check tubes and components as necessary.
5. Single vertical line only on screen, Hor. Lock and Line Length controls, and No. of Cylinders switch do not affect pattern: Fault is in Horizontal Deflection circuit; check tubes and components as necessary.

Note that V9, the neon bulb connected to the No. of Cylinders switch, is intended to insure the appearance of a horizontal line on the screen even with no signals applied to the IgnitionScope. If the bulb is faulty, no line may appear without signals applied, but the line pattern will appear when an engine is connected and running.

## 4.05 Identifying Parts for Replacement

The Parts Lists and photographs to follow should identify any part liable to fail in the life of the IgnitionScope. When ordering a replacement part, always give the Du Mont Part Number, the item description and the electrical symbol number if any.



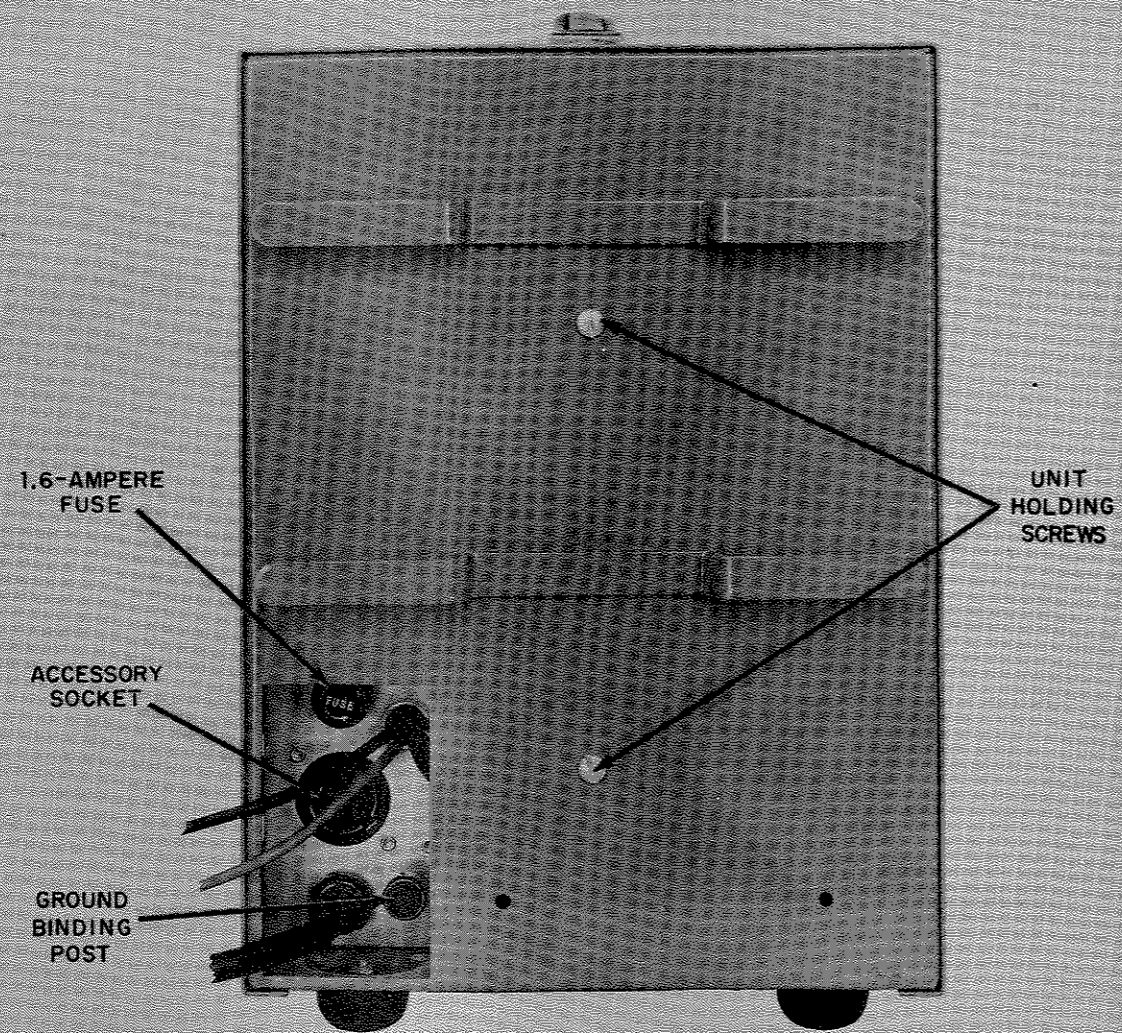


FIGURE 10. REAR VIEW SHOWING SCREWS TO BE REMOVED TO TAKE UNIT FROM CABINET

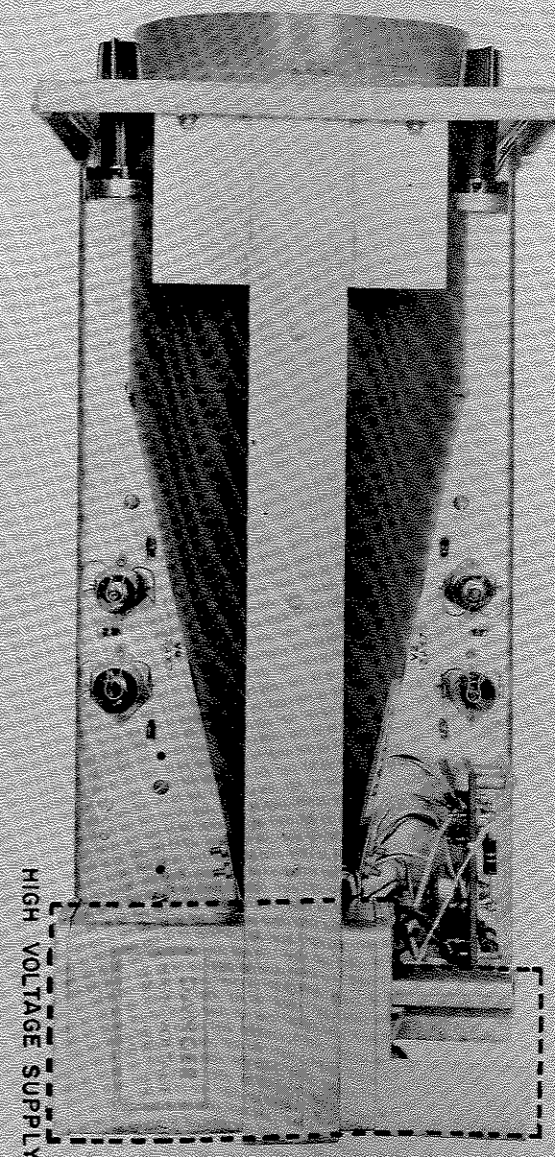


FIGURE 11. TOP VIEW



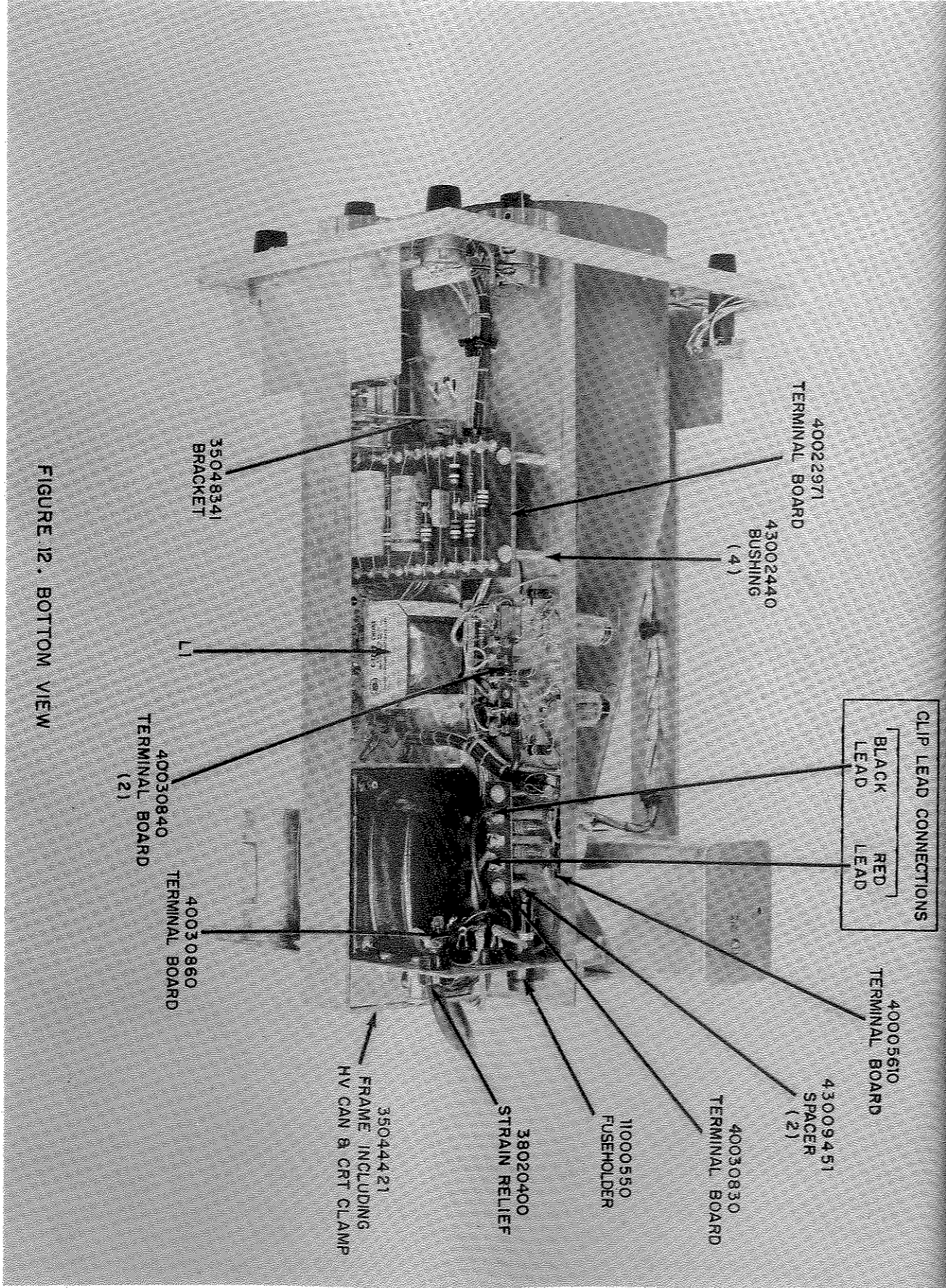


FIGURE 12. BOTTOM VIEW

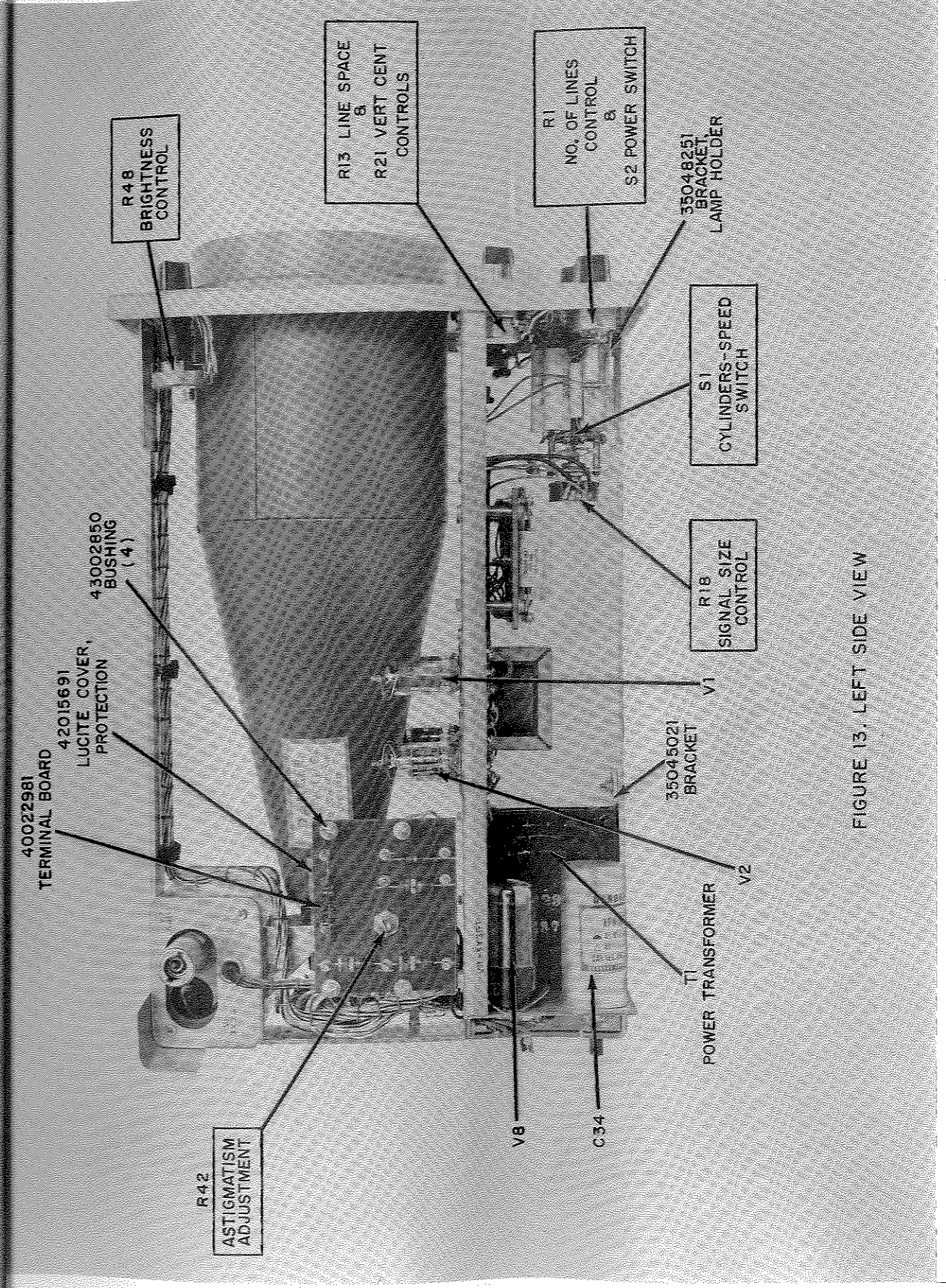


FIGURE 13. LEFT SIDE VIEW



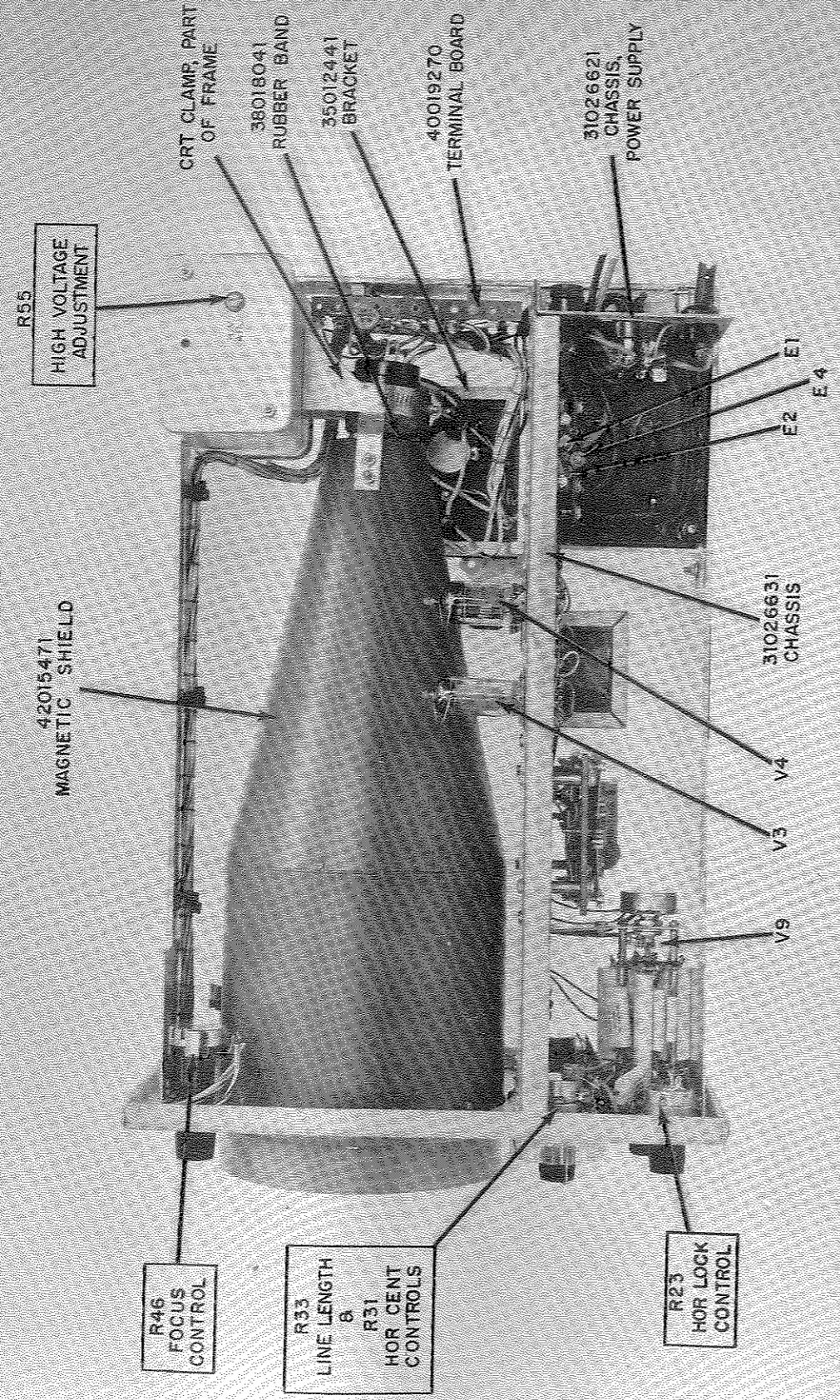


FIGURE 14. RIGHT SIDE VIEW

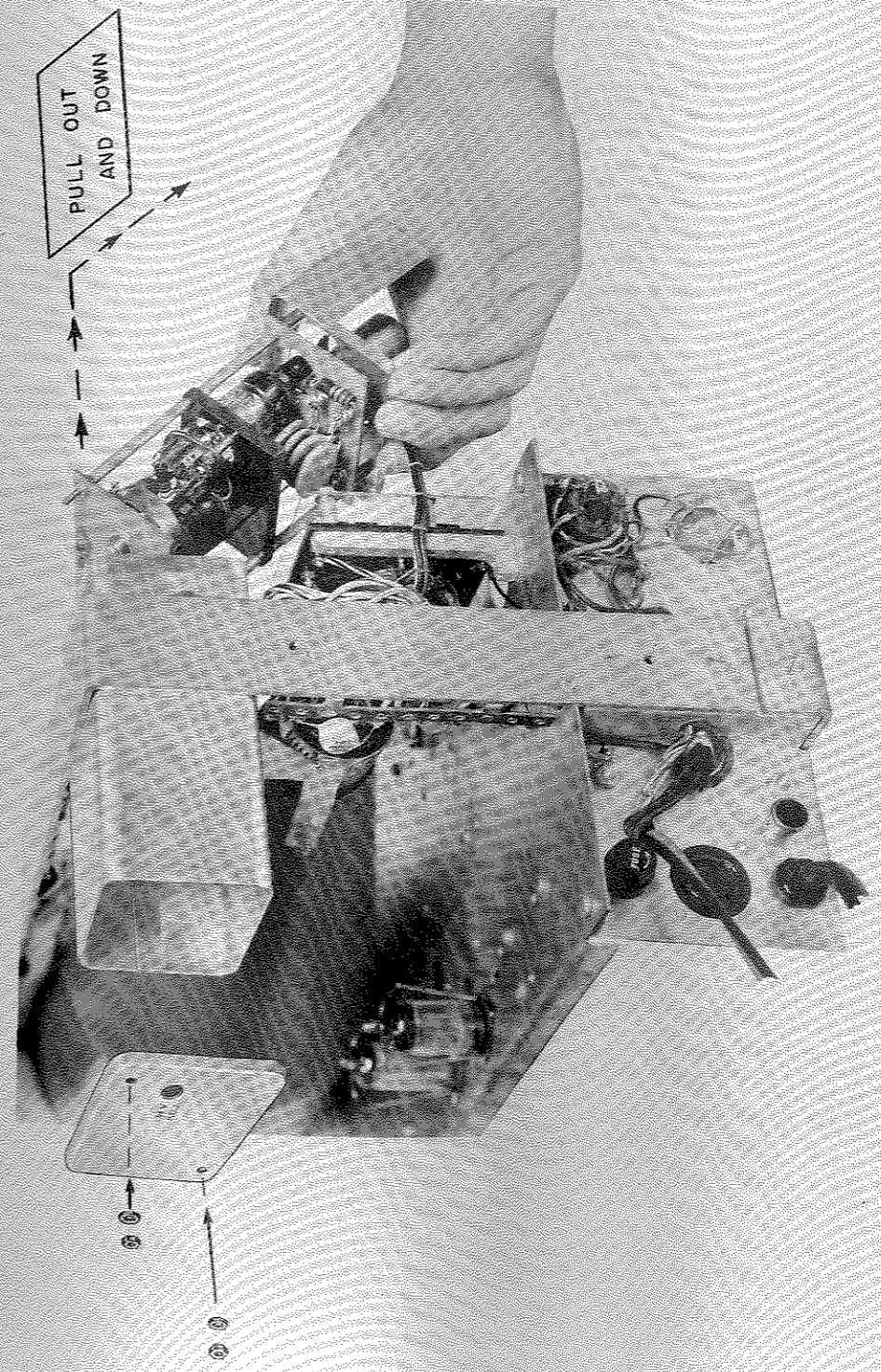


FIGURE 15. REMOVING THE HIGH VOLTAGE SUPPLY



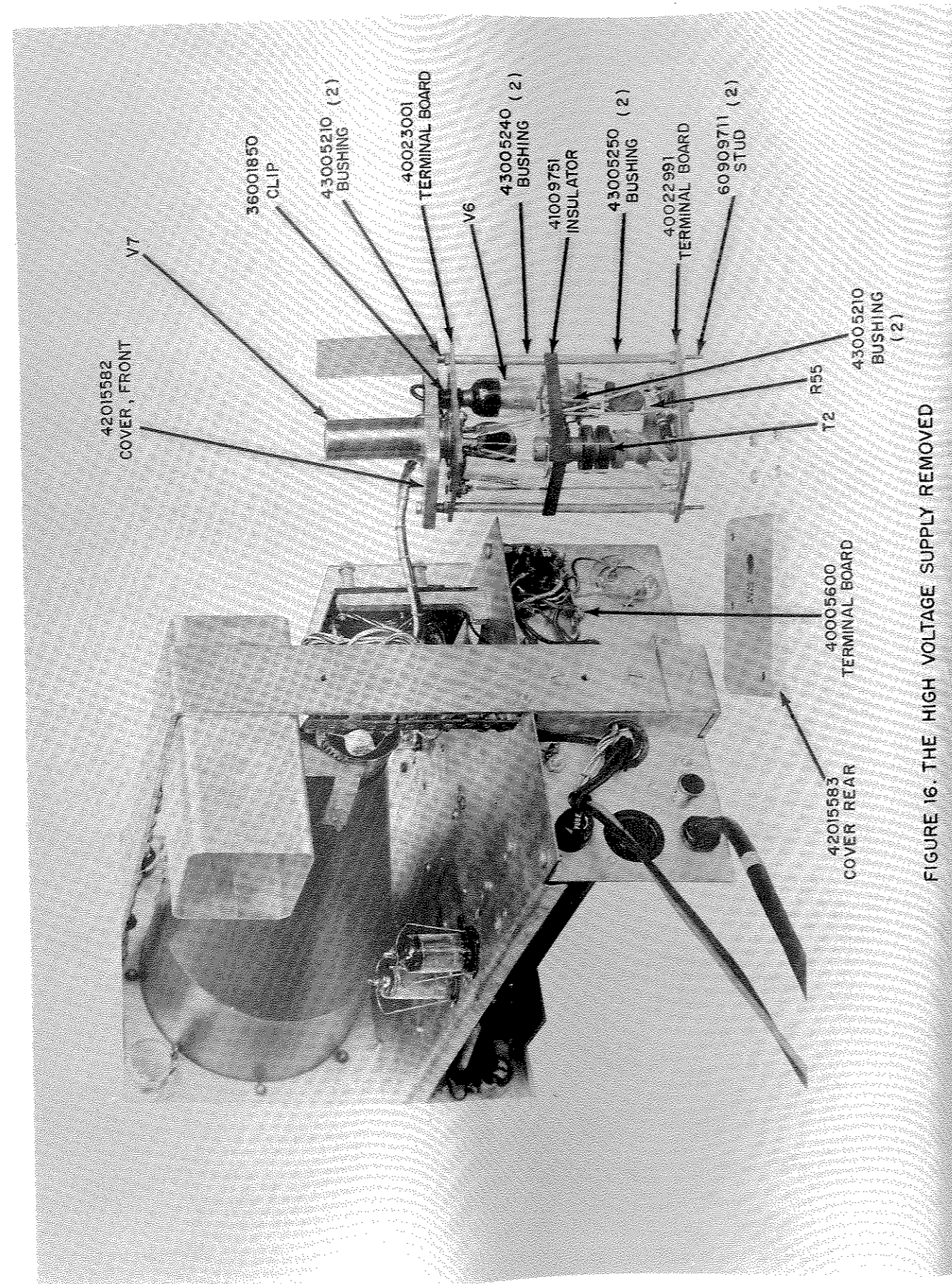


FIGURE 16. THE HIGH VOLTAGE SUPPLY REMOVED

## 5.0 PARTS LISTS

## 5.01 Electrical

Symbol	Du Mont Part Number	Description
<u>CAPACITORS</u> (fixed, plastic, $\pm 20\%$ , 400 V, unless otherwise specified)		
C1 & C2	0302 2620	mica, 240 uuf, $\pm 5\%$ , 500 V
C3	0302 0510	mica, 470 uuf, $\pm 10\%$ , 500 V
C4	0318 3760	.47 uf
C5	0318 3720	.22 uf
C6	0318 3760	.47 uf
C7	0318 3710	.1 uf
C8	0300 0040	electrolytic, 25 uf, + 150 -25%, 50 V
C9	0313 9610	ceramic, .02 uf, + 100 -0%, 500 V
C10	0302 0900	mica, 51 uuf, $\pm 5\%$ , 500 V
C11	0302 0510	mica, 470 uuf, $\pm 10\%$ , 500 V
C12	0302 0900	mica, 51 uuf, $\pm 5\%$ , 500 V
C13 & C14	0302 2620	mica, 240 uuf, $\pm 5\%$ , 500 V
C15	0318 3760	.47 uf
C16	0318 3720	.22 uf
C17	0318 3710	.1 uf
C18	0318 3720	.22 uf
C19	0318 3710	.1 uf
C20	0302 0900	mica, 51 uuf, $\pm 5\%$ , 500 V
C21	0318 3700	.047 uf
C22	0318 3760	.47 uf
C23	0318 3720	.22 uf
C24 & C25	0318 3710	.1 uf
C26	0302 0330	mica, 15 uuf, $\pm 10\%$ , 500 V
C27	0315 1490	ceramic, 100 uuf, + 100 -0%, 7.5 Kv
C28 & C29	0316 9870	ceramic, .005 uf, + 100 -0%, 3 Kv (2 each in parallel)
C31	0314 6090	ceramic, 1.5 uuf, $\pm 5$ uuf, 5 Kv
C32	0310 4250	paper, .1 uf, 600 V
C33	0315 1480	ceramic, .01 uf, + 80 -20%, 600 V
C34	0318 6240	electrolytic, 40 x 40 uf, + 50 -10%, 500 V
<u>NEON LAMPS</u>		
E1 & E2	1200 3960	NE-2
E4	1200 3960	NE-2
<u>BINDING POST</u>		
E3	5101 8780	Ground terminal



<u>Symbol</u>	<u>Du Mont Part Number</u>	<u>Description</u>
<u>FUSE</u>		
F1	1100 0980	1.6 amperes (115-volt unit)
F1	1100 0760	1 ampere (230-volt unit)
<u>LAMP</u>		
I1	1200 1310	incandescent, bayonet, .15 ampere
<u>RECEPTACLE</u>		
J1	3400 1420	5 contacts
<u>INDUCTOR</u>		
L1	2100 3890	8 henries
<u>RESISTORS</u> (fixed, composition, $\pm 5\%$ , 1/2 W, unless otherwise specified)		
R1	0108 0400	variable, 15K ohms, $\pm 20\%$ , 1/4 W (No. of Lines control, including S2 Power switch)
R2	0203 1120	470K ohms
R3	0203 0800	22K ohms
R4	0203 7040	220K ohms, 2 W
R5	0203 1200	1M ohms
R6	0203 3550	2K ohms, 1 W
R7	0203 1170	750K ohms
R8	0203 0000	10 ohms
R9	0203 4040	220K ohms, 1 W
R11	0203 1280	2.2M ohms
R12	0203 1120	470K ohms
R13/R21	0107 1511	variable concentric controls, $\pm 20\%$ , 1/4 W 15K ohms (Vertical Center) 2M ohms (Line Spacing)
R14	0203 3810	24K ohms, 1 W
R15 & R16	0203 1120	470K ohms
R17	0203 3960	100K ohms, 1 W
R18/S1	0501 3271	Assembly of control and switch R18, 0106 6450, 500K ohms, $\pm 20\%$ , 1/4 W (Signal S S1, 0501 3272, rotary, 3 pos tions (Cylinders-Spe
R19	0203 4070	300K ohms, 1 W
R21	See R13/R21	

<u>Symbol</u>	<u>Du Mont Part Number</u>	<u>Description</u>
R22	0203 3810	24K ohms, 1 W
R23	0106 5550	variable, 15K ohms, $\pm 20\%$ , 1/4 W
R24	0203 1120	470K ohms
R25	0203 0800	22K ohms
R26	0203 4040	220K ohms, 1 W
R27	0203 1170	750K ohms
R28	0203 3480	1K ohms, 1 W
R29	0203 1170	750K ohms
R31	0203 0000	10 ohms
R32	0203 4040	220K ohms, 1 W
R33/R39	0107 1511	variable concentric controls, $\pm 20\%$ , 1/4 W 15K ohms (Horizontal Center) 2M ohms (Line Length)
R34	0203 3880	47K ohms, 1 W
R35 & R36	0203 1120	470K ohms
R37	0203 3960	100K ohms, 1 W
R38	0203 4040	220K ohms, 1 W
R39	See R33/R39	
R41	0203 3860	39K ohms, 1 W
R42	0105 6330	variable, 250K ohms, $\pm 20\%$ , 1/4 W (Astigmatism)
R43	0203 0960	100K ohms
R44 & R45	0203 7120	470K ohms, 2 W
R46	0108 0740	variable, 500K ohms, $\pm 20\%$ (Focus)
R47	0203 7060	270K ohms, 2 W
R48	0108 0690	variable, 100K ohms, $\pm 20\%$ (Brightness)
R49	0203 3720	10K ohms, 1 W
R51	0203 4200	1M ohms, 1 W
R52	0203 3820	27K ohms, 1 W
R53	0210 0810	wire wound, 4.7 ohms, $\pm 10\%$
R54	0203 1000	150K ohms
R55	0101 4880	variable, 100K ohms, $\pm 20\%$ , 2 W (HV Adjust)
R56	0203 3880	47K ohms, 1 W
<u>SWITCHES</u>		
S1	See R18/S1	
S2	See R1/S2	
S3	0500 0420	Slide, DPDT (230-volt unit)
<u>TRANSFORMERS</u>		
T1	2001 2361	Power (115-volt unit)
T1	2001 2471	Power (230-volt unit)
T2	2000 7231	RF



<u>Symbol</u>	<u>Du Mont Part Number</u>	<u>Description</u>
<u>TUBES</u>		
V1	2500 0770	2D21
V2	2501 1680	ECC83/12AX7
V3	2500 0770	2D21
V4	2501 1680	ECC83/12AX7
V5	2500 1420	5UP1
V6	2500 6490	1X2A
V7	2501 1750	6AQ5A
V8	2500 0220	5Y3-GT
V9	1200 3960	neon lamp, NE-2
<u>CABLES</u>		
W1	5009 3172	Test lead, red
W2	5009 3173	Test lead, black
W4	5026 9642	AC line cord assembly
--	0905 0850	AC line plug adaptor

## 5.02 Mechanical

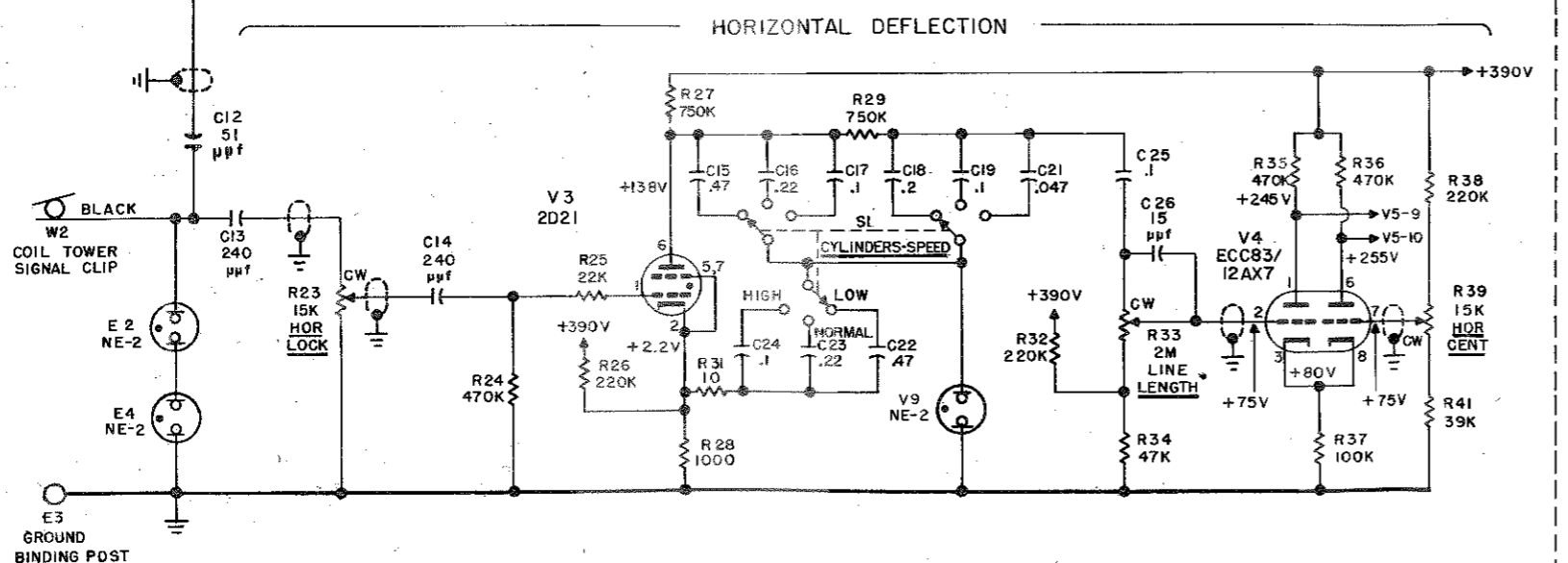
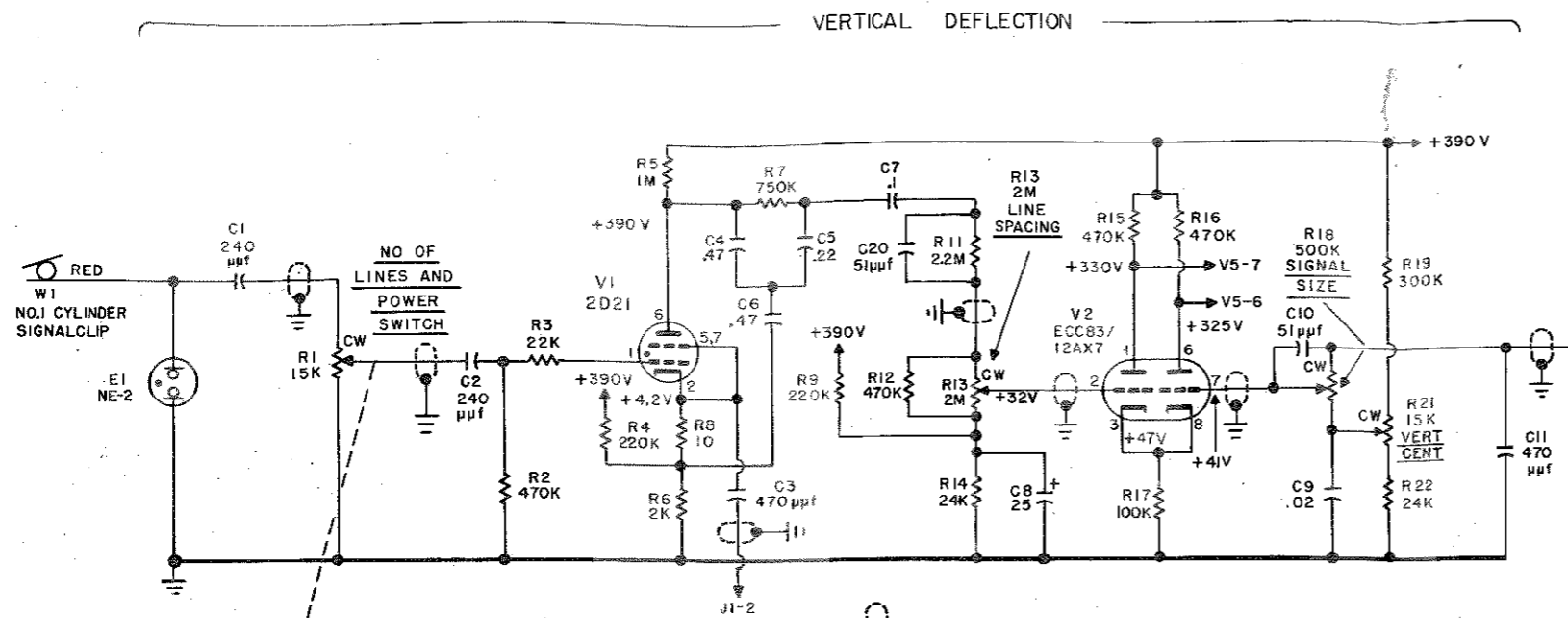
<u>Du Mont Part Number</u>	<u>Description</u>	<u>Shown in Figure</u>
3501 2441	Bracket, terminal board	14
3504 5021	Bracket, transformer	13
3504 4781	Bracket, tilt	--
3504 8251	Bracket, lampholder	13
3504 8991	Bracket, foot, tilt	--
3801 5591	Bumper, rubber, cabinet	--
4300 2440	Bushing, sleeve, 1 inch	12
4300 2850	Bushing, sleeve, 1/2 inch	13
4300 5210	Bushing, sleeve, 3/8 inch	16
4300 5240	Bushing, sleeve, 1-3/4 inches	16
4300 5250	Bushing, sleeve, 2-1/8 inches	16
4300 2800	Bushing, (230-volt unit)	--
3102 6621	Chassis, power supply	14
3102 6631	Chassis, main	14
3600 1380	Clip, electrical	--
3600 5311	Clip, mounting, neon lamp holding	14
3600 1850	Clip, electrical, 2-inch lead	16
4201 5582	Cover, front, rf supply	16
4201 5583	Cover, rear, rf supply	16
4201 5691	Cover, high voltage protection, lucite	13
4201 6311	Cover, cabinet	--
4800 3311	Filter, light, green, front panel	--
3504 4421	Frame, chassis	12
1100 0550	Fuseholder post	12
4100 9751	Insulator, rf supply	16
4500 4661	Knob, clear	--
4500 8701	Knob, black (for single control)	--
4500 8721	Knob, black (for dual control)	--
1200 5430	Lampholder	13
1200 7600	Lens, indicator lamp, red	--
6100 0240	Nut, hex., 4-40 x 1/4 inch	--
6100 0270	Nut, hex., 8-32 x 11/32 inch	--
6100 0600	Nut, hex., 6-32 x 1/4 inch	--
6100 0220	Nut, hex., 2-56 x 3/16 inch	--
6101 3860	Nut, hex., 3/8-32 x 1/2 inch	--



Du Mont Part Number	Description	Shown in Figure
3200 7211	Panel, front	--
3900 8631	Plate, voltage switch (230-volt unit)	--
3900 8321	Plate, name	--
3500 1800	Plate, mounting, capacitor C34	13
3900 8621	Plate, fuse identification	--
3700 2270	Retainer, tube V8	13
3702 0480	Retainer, tube V1 V3, base	13,14
3702 0490	Retainer, tube V2 & V4 base	13,14
3702 0540	Retainer, tube, V1 to V4, wire	13,14
6400 5232	Ring, front bezel	--
3501 5051	Ring, back (behind bezel)	--
3801 8041	Rubber band, cathode-ray tube base clamping	14
4500 6172	Scale, calibrated	--
6041 5530	Screw, self-tapping, pan head, 6 x 5/8 inch	--
6000 4320	Screw, machine, binder head, 4-40 x 1/4 inch	--
6000 4500	Screw, machine, binder head, 6-32 x 1/4 inch	--
6000 4520	Screw, machine, binder head, 6-32 x 3/8 inch	--
6000 4580	Screw, machine, binder head, 6-32 x 1 inch	--
6000 4720	Screw, machine, binder head, 8-32 x 3/8 inch	--
6000 7030	Screw, machine, flat head, 6-32 x 3/8 inch	--
6000 7220	Screw, machine, flat head, 8-32 x 3/8 inch	--
6000 4290	Screw, machine, binder head, 2-56 x 7/8 inch	--
6008 1260	Screw, machine, binder head, 6-32 x 5/8 inch	--
6008 0020	Screw, machine, binder head, 6-32 x 3/8 inch (Front Panel)	--
6008 0000	Screw, machine, binder head, 6-32 x 1/4 inch	--
6008 0320	Screw, machine, binder head, 8-32 x 3/8 inch	--
6009 6180	Screw, machine, binder head, 6-32 x 1/2 inch (Front Panel Bezel)	--
6000 4340	Screw, machine, binder head, 4-40 x 3/8 inch	--

Du Mont Part Number	Description	Shown in Figure
6000 6830	Screw, machine, flat head, 4-40 x 3/8 inch	--
6000 5800	Screw, machine, round head, 6-32 x 1-3/8 inches	--
4201 5471	Shield, magnetic, cathode-ray tube	14
4200 2760	Shield, tube, V7	16
4300 9451	Spacer	12
3000 9721	Spring, scale holder	--
3400 2610	Socket, 8-contact, V8	13
3400 2300	Socket, 9-contact, V6	16
3400 1460	Socket, 7-contact, V7	16
3400 3740	Socket, 7-contact, V1 & V3	13,14
3400 4050	Socket, 9-contact, V2 & V4	13,14
3400 3810	Socket, 12-contact, V5	14
3802 0400	Strain relief, line cord	12
6090 9911	Stud, threaded, 4-40 x 5-1/2 inches	16
4000 5600	Terminal board, 1 terminal	16
4000 5610	Terminal board, 3 terminals	12
4001 9270	Terminal board, 9 terminals	14
4002 2971	Terminal board	12
4002 2981	Terminal board	13
4002 2991	Terminal board	16
4002 3001	Terminal board	16
4003 0860	Terminal board, 3 terminals	12
4003 0830	Terminal board, 3 screw terminals	12
4003 0840	Terminal board, 8 terminals	12
5100 3620	Terminal lug, ring, #6	--
5100 1100	Terminal lug, ring, #4	--
5100 1110	Terminal lug, ring, lock, #6	--
5100 1120	Terminal lug, ring, #8	--
5100 1200	Terminal lug, ring, control ground, 3/8 inch	--
6200 3670	Washer, flat, #6	--
6200 3650	Washer, flat, #4	--
6210 0000	Washer, lock, #2	--
6220 0010	Washer, lock, #4	--
6220 0030	Washer, lock, #6	--
6220 0040	Washer, lock, #8	--
6220 0090	Washer, lock, 3/8 inch	--
6200 3680	Washer, flat, #8	--
6220 0710	Washer, lock, #6	--





- NOTES:
1. RESISTANCES ARE IN OHMS, K= THOUSAND, M= MILLION.
  2. CAPACITIES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
  3. FRONT PANEL FACILITIES ARE UNDERLINED. ⊕ INDICATES SERVICE ADJUSTMENT.
  4. VOLTAGE MEASUREMENTS MADE WITH 20,000-OHMS-PER-VOLT METER. CONTROLS SET TO NORMAL OPERATING POSITIONS, NO INPUT SIGNALS APPLIED.

**Figure 17. SCHEMATIC**  
**DU MONT TYPE 902 IGNITIONSCOPE**  
 (Reference Drawing 98000994-4, Issue 5)

