

FILM-TECH

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SERVICE MANUAL FOR EX 1520

SPECIFICATIONS FOR EX-1500

Power source	:	115v, 60 Hz, 7.8 amps
Xenon Arc lamp	:	300 watts UShio UXL 300 DE-0 1000 lumens Eiki # 5106 6000° K (color)
Optimum current	:	DC 15 amps (1000 hrs.)
Maximum current	:	DC 20 amps (600 hrs.)
Amplifier	:	solid state integrated circuit, 20 watts RMS
Preamplifier	:	one transistor for magnetic head
Sound source	:	optical--solar cell magnetic--100 mil head (full track)
Film speed	:	24 and 18 fps
Reel arms	:	2000' reel capacity
Lens	:	2" f/1.3 standard
Motors	:	one 1/20hp for film drive and lamp cooling one 1/25hp for rectifier cooling
Wow and flutter	:	Less than 0.25%
Frequency response	:	40--7000 c.p.s. +3 d.b.
Optical	:	40--7000 Hz + 3d.b.
Magnetic	:	40--10,000 Hz + 4 d.b.
Exciter lamp	:	BRK (4v--0.75 amp D.C.)
Dimensions	:	Height 26" to supply spindle Width 28" to take-up spindle Depth 9"
Weight	Projector	: 45 pounds
	Rectifier	: 49 pounds

Item Discussed

Claw	S.1.1,S.1.4,S.1.5	Idler Rollers	S.6, S.7
Stop Lever	S.1.2	Loop Restorer	S.8
Worm Gear	S.1.3	Film Gate	S.9
Cam Tank Removal	S.1.6	Lens Holder	S.9.4
Cam Tank Repair	S.1.7	Sound Pick-up	S.10
Take-up Arm	S.2.2	Sound Drum	S.11
Gears	S.3	Speed Change	S.13
Cam Clutch	S.4	Cooling	S.12, S.14
Sprockets	S.3	Lamp and Mirror	S.15
Sprocket Shoes	S.5	Amplifier	S.16, Schematics

GENERAL NOTES ON SERVICING INTERNATIONAL PROJECTORS:

- A. Metric Thread screws, standard throughout the world, are used in all International projectors. We offer an assortment of screws, nuts, bolts, washers, drills, and taps for your convenience.
- B. Most repairs and adjustments can be made on International projectors using two sizes of Phillips screwdrivers, a blade screwdriver, and standard 16mm film as a thickness gauge. (Most 16mm film is about .005" thick.) To avoid damage to screw heads, it is important to remember the adage, "Use 80 per cent push, 20 per cent turn."
- C. Lubrication and Cleaning

Lubrication is normally not required for average operation. It is recommended that once a year or every 1000 hours, whichever occurs first, the moving parts be inspected for signs of excessive wear cleaned and lubricated.

Use methyl hydrate, alcohol or tri-chloroethylene as cleaning agents. We do not recommend carbon tetrachloride due to the dangers involved.

Polyurethane belts must be clean and dry. Remove oil and dirt accumulation with cloth moistened with cleaning agent.

Ball bearings should be clean and roll smoothly. If bearings are noisy or do not roll freely, they should be replaced. Shafts without ball bearings should be clean and lubricated with silicone fluid or a light smear of silicone compound. Remove excess.

Rollers must rotate freely. Shafts and inside surface of rollers must be clean, free from burrs, scratches or other defects. Lubricate sparingly with a light silicone oil or other fine oil. Remove excess.

Cam tank shutter assembly is packed with silicone compound, Dow Corning No. 44 or equivalent. Use approx. 1 teaspoonful around fiber cam.

Shutter pulley cone clutch surface and surface of shutter blade hub should be clean and dry. Use light silicone oil or fluid to lubricate bronze bushing in shutter pulley.

Fiber gears must not be allowed to run dry. Use light silicone oil or other light fine oil and cover all teeth with oil. Wipe off excess. This treatment will generally last many thousands of hours.

S.1 CAMTANK ASSEMBLY (Shutter Claw and Clutch) X1-11001

S.1.1 CLAW ST-11191

Function: 2 tooth claw is made of extremely hard material, precision ground for maximum efficiency.

Face of claw teeth are ground at a slight angle. Claw then loses contact immediately as it begins to retract. Film then rests undisturbed till next pulldown.

Check: Claw screws must be tight, Do not overtighten! Claw lever is made of aluminum.

Adjustment: Holes in claw are slightly oversize. Angle of claw teeth may be adjusted slightly by loosening screws and tilting claw.

Claw angle may be further adjusted if necessary by bending claw lever in flat area. Use a pair of long-nosed pliers with a right angle bend.

S.1.2 STOP LEVER ST-11301

Function: When FULLY depressed, assembly is placed between lamp and aperture. This action also moves shutter, compressing spring ST-11141. This releases shutter pulley, allowing it to rotate freely on shaft. Special shoulder screws ST-11271 are used to mount stop lever.

S.1.3 WORM GEAR X1-11501

Check: Worm gear must be mounted and secured to eliminate any "end play" of shutter shaft.

Camtank assembly must be mounted so that there is a small amount of "play" between worm gear and fibre gears. Rotate fibre gears to check.

Adjustment: Reposition as necessary and tighten screws securely.

S.1.4 CLAW POSITION

Check: Claw must enter film perforation, refer to section S.9 dealing with gate adjustments.

Claw must not touch sides of perforations at any time during its entry, pull-down or exit.

Claw should leave film so that frame is centered over aperture with framing lever in midway position.

Adjustment: Slightly loosen 2 screws that hold fulcrum collar horizontally and/or vertically to correct position.

Check: Check for correct framing with film in projector and operating.

S.1.5 CLAW PROTRUSION

Check: Claw protrusion should be $.040" \pm .005"$. Use gauge to determine.

Adjustment: Remove cover X1-32361. Turn inching knob so that claw is fully retracted.

Use claw adjustment tool to carefully bend claw lever. Be sure claw is not touching film gate during bending. Claw breakage could result.

Check: Horizontal position of teeth is affected by protrusion adjustment. Recheck and readjust as necessary.

NOTE: Claw protrusion may be affected by camtank position when reinstalling. Check and reposition camtank if necessary.

S.1.6 CAMTANK ASSEMBLY REMOVAL

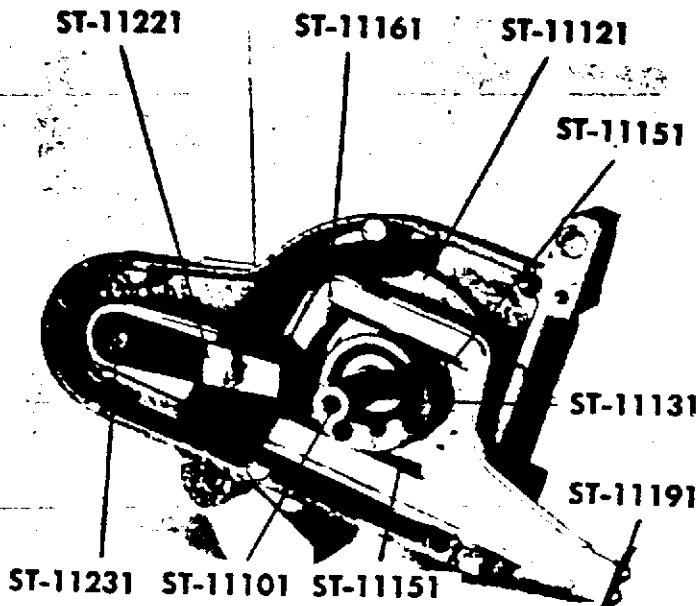
- a) Remove cover X1-32361
- b) Remove rear cover.
- c) Remove shutter pulley belt.
- d) Turn inching knob to fully retract claw.
- e) Depress stop lever halfway.
- f) Remove 2 mounting screws.
- g) Remove assembly, being careful not to damage claw.

NOTE: When installing, be sure to provide a small amount of "play" between worm gear and fibre gears.

S.1.7 CAMTANK DISASSEMBLY

- a) Depress stop lever halfway.
- b) Remove screw in end of shaft.
- c) Remove plate washer ST-11351 and pulley.
- d) Raise stop lever and remove shutter blade and hub.
- e) Depress stop lever part way to expose 4 heads of cover plate mounting screws and remove screws.
- f) Remove cover.

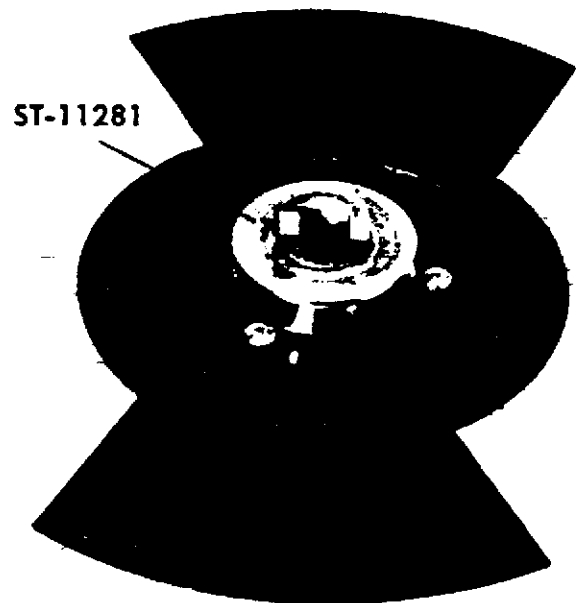
- g) Observe location of fiber cam and springs inside claw lever:
 --Curved shock absorber spring ST-11161 is at top, in "hump"
 --Straight spring ST-11151 is next.
 --Cam rotates between this and another ST-11151 at bottom of hole.



- h) Felt spring ST-11211 is used to hold felt in place as well as provide side tension to keep claw lever against cam plate.
 i) Hole in felt spring fits OVER fulcrum pin. When reassembling be sure that spring is not jammed between end of fulcrum pin and washer ST-11231.
 j) Shaft X1-11101 should have no end play. Worm gear must be installed without clearance.
 k) Ball bearings must be free from any play. Replace if necessary.
 l) 2-bladed shutter is mounted to hub ST-11281 so that raised semicircle of hub is facing one blade. (3-bladed shutter is automatically correct.) Shutter blade is depressed in centre to offset blades. Hub is inserted into hole of blade from depressed side.
 m) Shutter blade has elongated mounting holes. Travel ghost is at a minimum normally if blade is mounted with holes centered. If necessary, move blade slightly to overcome travel ghost.

- n) Further timing is predetermined by fibre cam mounting screws placed in an "off centre" position.
 o) Lubricate fibre cam area with silicone grease. Use approximately 1 teaspoon.
 p) Shutter pulley must be clean and dry on both sides.
 q) Shutter shaft must be clean.
 r) Lubricate bronze bushing of shutter pulley and shutter shaft with a small amount of silicone oil.

AVOID OVERLUBRICATION



S.2 REEL ARMS

- S.2.1 Upper (Supply) - Arm is mounted on top of projector head and secured by two screws.
 S.2.2 LOWER (Take-Up) - This lower take-up arm is mounted on the bottom of the projector head.

S.2.3 Slip Clutch - The spindle drum, is lined with a cork or felt liner. This acts as a slip clutch arrangement over the spindle drum. There should be some clearance between the spindle drum and liner and the plastic drum. The automatic action of this clutch provides adequate take-up operation, as the weight of the film on the take-up reel increases, the friction also increases, thus driving the reel and keeping a relatively uniform wind on the film.

S.3 DRIVE GEARS & FILM SPROCKETS

S.3.1 When assembling the sprocket shaft and fibre gears, care should be taken to allow .003" end play. Use a fine lubricating oil SPARINGLY on the bronze bushings and shaft. Observe the flat spots on the shaft for the purpose of tightening the gears, collars, etc. The shaft should be "rocked" back and forth before the final turn of the tightening screw. Be sure the screw is perpendicular to the flat spot on the shaft.

S.3.2 Sprocket tooth position is adjusted by loosening screw in end of shaft, thus releasing the pressure of the face plate against the sprocket plate. Observe position of film in relation to loop restorer roller. If film tends to strike roller during projection, rotate #2 sprocket plate counter-clockwise 1/3 - 1/2 frame. Tighten screw. Perpendicular film movement midway between sound drum and #3 sprocket should be approximately 3/16". Adjust #3 sprocket if necessary, for proper film tension over sound drum.

S.4 CAM CLUTCH

S.4.1 Rewind: This clutch is part of the #1 sprocket and gear shaft assembly. See parts list. This clutch engages when the film direction is in REWIND. This is necessary to rewind the film on the supply reel. When assembling, turn or position the gear so that the protruding pin

in the hub of the gear is in the "1:30 o'clock" position. Hang the curved cam ST-14071 on the pin. Place clutch pulley X5-15501 on shaft. Install retaining collar ST-15141 fastening the screw on the flat spot of the shaft. Be sure to allow a slight amount of "end play" on the shaft, approximately .003".

S.4.2 CAUTION This machine is not intended to rewind a large reel of film. The rewind facility is provided only for the use of small reels, such as 400' type.

S.5 SPROCKET SHOES:

S.5.1 The sprocket shoes prevent the film from skipping over the sprocket. The oversize holes in the shoe mounting bracket allow for proper positioning of the shoe in relation to the sprocket. The stationary roller should clear the sprocket by approximately .015" - .020". This will allow the film to be threaded easily without damage. The moveable roller should be as close as possible to the sprocket (without a film), and yet be free to turn.

S.6 IDLER ROLLERS:

S.6.1 Idler rollers must turn freely. Use oil SPARINGLY.

S.7 TENSION ROLLER ASSEMBLY X1-17941.

S.7.1 This roller, is between the sound drum and the #3 sprocket. The tension at the roller should be approximately 2 1/2 oz.

S.7.2 Remove flywheel and #2 fibre gear to provide access to spring tension adjustment.

S.7.3 To adjust, loosen spring bracket, on rear of shaft and move as necessary to achieve the correct spring tension. Tighten screw securely. See also S.3.2.

S.8 AUTOMATIC LOOP SETTER XI-18001

S.8.1 This device maintains the correct lower loop size. As the loop is lost, the film applies pressure to the sensing roller ST-18021. This causes it to begin a counter-clockwise revolution. The rubber tire XI-18071 at the rear of the shaft then engages the #2 fibre gear causing the loop setter to make a complete revolution. The sensing roller should stop at the 3 o'clock position. Adjust bracket ST-18031 as necessary.

S.8.2 The tension spring between the rubber wheel and case holds the loop setter in neutral position. If loopsetter does not stay in neutral, and keeps rotating, adjust by sliding rubber wheel closer to case, thus increasing the spring tension.

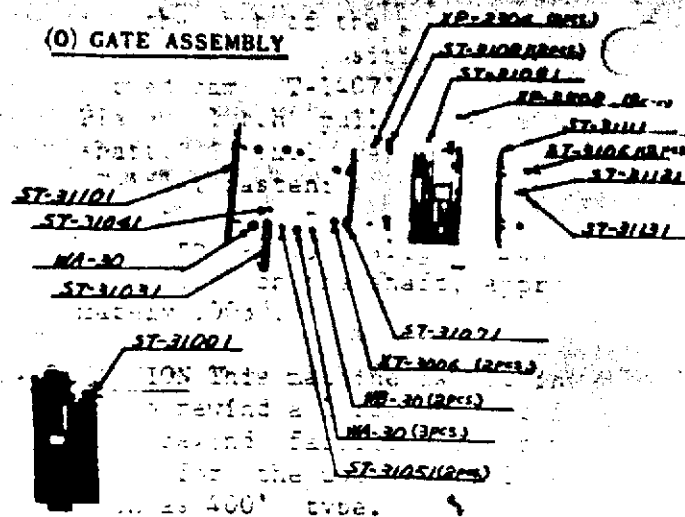
S.8.3 Adjust sprocket plates as necessary as per S.3.2.



S.9 FILM GATE ASSEMBLY XI-31001

S.9.1 Outer Guide Rail ST-31071 is secured to gate plate by 2 screws and located against shoulder of film gate ST-31101. This assures proper vertical travel of film, parallel to film gate.

Diagonal travel of film may cause picture or sound track portion of film to touch raised sections of film gate. Film damage will result.



S.9.2 Inner Guide Rail is spring loaded, and held in place by 2 shoulder screws ST-31061. With screws secured, guide rail should be free to travel with a minimum of clearance under screw head. Spring tension must be sufficient to hold film against outer guide rail, thus establishing side tension on edge of film. Check for additional clearance of inner guide rail to accommodate wider film or scotch tape wrapped around film.

S.9.3 Film shoe is mounted on 2 pins and held in place by a locking lever under lower pin. Retaining plate ST-30041 is secured to lens holder by 2 screws. Holes in lens holder are oversize, allowing for adjustment of film shoe position.

Check: Outer guide rail must be snug against shoulder of film gate. Swing lens in to close gate. Clearance between outer guide rail and outer edge of film shoe should be the thickness of 1 film.

Adjustment: Cut a 4" length of 16mm film 1/2" wide. Insert between film shoe and outer guide rail. Film shoe should be moderately snug. If adjustment is required, loosen 2 screws that hold retaining plate ST-30041. Reposition plate and tighten screws. Shoe must not bind on guide rails.

Check: Be sure pins do not bind when fully depressed in lens holder. With gate closed and lens removed, check that hole in film shoe clears the film aperture on all sides.

NOTE: Lower shoe pin spring ST-30071 is longer than upper spring ST-30061. Extra tension is designed to overcome film movement caused by claw action at lower end of film shoe.

S.9.4 LENS HOLDER ASSEMBLY X1-30201

Check: Optical axis of lens must be perpendicular to film plane. Set projector at exact right angles to screen. Without film, project light beam. A 3' wide area is a good size. Both side edges of illuminated area must be focused, equally sharp.

Adjustment: Loosen lock nut and adjust screw located under front of lens holder to achieve optimum equal focus. Tighten lock nut.

NOTE: The Super F1.3 high speed lens has a shallower depth of focus and requires a more accurate adjustment than other slower lenses.

S.10 SOUND PICK-UP

S.10.1Function: The focus and azimuth of the optical sound lens are very critical and are adjusted simultaneously. Note position of filament of exciter lamp. It must be in center line of optical lens. The scanning beam must be a sharp thin line focused on the film sound track. The scanning beam must also strike the center of the sound track. In this position it will clear the edge of the sound drum and strike the solar cell.

S.10.2Check: A frequency test film should provide a good response up to 6000 or 7000 Hz. A normal sound test film should produce enough high frequency tones for a pleasant sound balance.

Adjustment: To adjust optical lens for focus and azimuth it is necessary to use a test film with a 7000 cycle tone. SMPTE PH 22.42--7000 is such a film. A 3-foot length of this film

should be spliced to form a loop. Installed in the projector it will provide the necessary signal for accurate adjustment. Remove exciter lamp cover for any adjustments to optical lens.

Install an 8-ohm 10-watt resistor across speaker output. Connect a low reading AC voltmeter and an Oscilloscope across resistor, with projector operating, set meter and scope for convenient reading with volume control at approx. "9 o'clock" ($\frac{1}{2}$ rotation) and treble control at maximum. Loosen screw in lens holder bracket X1-40011, thus allowing lens to be moved. Rotate lens for azimuth adjustment. Observe clean sine wave pattern on oscilloscope. Set for maximum reading. Slide lens forth and back for focus. Observe meter reading or oscilloscope amplitude. Set for maximum reading on both azimuth and focus with simultaneous adjustment, tighten screw to clamp lens. Observe meter or scope. Output should not drop. Seal set screw with paint.

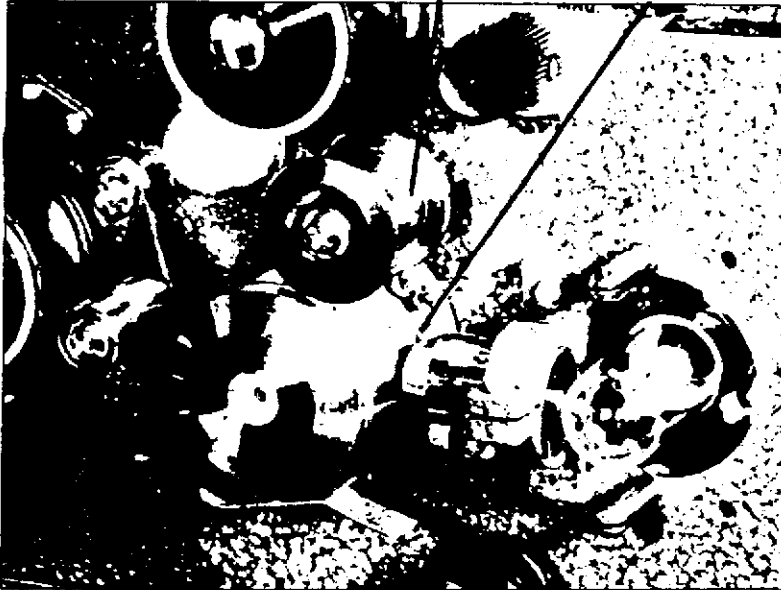
S.10.3Check: Scanning beam must fall on center of optical sound track of film. Excessive noise will be heard together with distorted sound if scanning beam position is incorrect. Use SMPTE "Jiffy" test film to check. It contains a section of Buzz Track test film.

Adjustment: To adjust, use SMPTE PH 22.57 Buzz Track Test Film. A 3-foot length to form a loop is convenient. (SMPTE "Jiffy" test film may be used.) The guide roller ST-17231, just above the sound drum is adjustable horizontally to guide the film so that the scanning beam strikes the sound track properly. A test film is available from the Society of Motion Picture + TV Engineers to assure proper alignment. (SMPTE Buzz Track PH22.57). Loosen set screw on collar behind roller and slide roller horizontally until no sound is heard. Too far in one direction produces a low tone, other side produces a high tone. Tighten set screw after adjustment.

S.10.4Be sure lens is clean.

S.10.5 Use BRK 4 volt 0.75 amp exciter lamp. Using lamp with filament in opposite orientation results in loss of high frequency and distorted sound.

S.10.6 The solar cell is located in the casting collar X1-41031, just under the edge of the sound drum. Remove the leads from the terminal strip before removing the housing. After the housing is replaced, be sure that solar cell is in line with the optical lens. The Scanning beam must fall on the cell.



S.10.7 This projector has a magnetic head and associated switch and circuit for magnetic playback. In the OPT position, the wafer contacts connect the solar cell circuit and exciter lamp circuit to the amplifier. The magnetic sound head is lifted off the film by the action of the lever attached to the end of the switch shaft. The sound head is directly behind the sound drum. The bracket and shaft assembly is spring loaded so that when the selector switch is in the MAG. position, the spring pulls the magnetic sound head down in contact with the magnetic sound strip on the film. In the OPT position, the switch lever strikes the sound head shaft bracket, lifting it up. Observe this action and adjust the position of the switch lever if necessary. This is done by releasing the set screw in the end of the switch shaft. Wafer contacts must make full contact in either selector switch position.

S.10.8 NOTE: Selector switch should be in MAG. position when removing and replacing sound drum. This will avoid bending magnetic head bracket.

S.11 SOUND DRUM AND FLYWHEEL ASSEMBLY

S.11.1 The sound drum shaft is mounted in the shaft housing, with ball bearings. The retaining collar should be installed with .002" clearance. Shaft must not bind in rotation. Flywheel should be secured so as not to allow it to slip or loosen.

S.11.2 NOTE - MAG. - OPT. switch must be in MAG position when removing the sound drum shaft.

S.12 MOTOR AND COOLING FAN

S.12.1 When mounting motor and fan observe the clearance on either side of cooling fan. Tighten set screw securely.

S.12.2 Be sure to install belt pulley on motor shaft before mounting motor and fan housing to projector chassis. After securing motor mounting, align the motor belt pulley with the idler pulley. Tighten set screw to flat spot on motor shaft.

S.13 SPEED CHANGE

S.13.1 Sound Speed (24 frames per sec.) is obtained by placing the belt on the large size motor pulley.

S.13.2 For silent (18 framers per sec.) place the belt on the other pulley. Align motor pulley according to use.

S.14 LAMP HOUSE COOLING FAN

S.14.1 This is located underneath the lamphouse. Access may be gained to the belt by removing the large plate on the front of the projector under lamphouse door.

S.14.2 All bearings in motor and fan housing assembly are factory lubricated and will normally not require any attention.

S.14.3 Pulleys must be aligned correctly for maximum belt lift. Improper alignment causes the belts to oscillate.

S.15 LAMPHOUSE AND MIRROR

S.15.1 Lamp is mounted with plus sign (anode) towards the front of the projector. When mounting lamp be sure that the locking nut on either end of the lamp are securely tightened, to ensure a good contact.

S.15.2 FOCUSING LAMP - Focusing of the lamp is accomplished by three focus adjustment screws. These screws move the lamp sufficiently to centre it in the focal point of the mirror, thus giving maximum light output. When focusing the lamp in relation to the mirror, it is necessary to have no film in the projector. Swing the lens holder out, with the lamp turned on, rotate the adjusting screws so that a circle of light is seen on the screen area. The centre of this circle will be a dark spot. Adjust each of the three knobs a little at a time to make this black area in the center as small as possible without diminishing the light area around it. It may be necessary to make a complete check with the focusing procedure, in that you will turn all the screws to a point where the general area becomes darker and you will note that you have passed the focal point. Turn the screws in the opposite direction until it becomes brighter and passed the bright uniform point back into the darker area. You will then be able to determine the best possible output of light by re-adjustment. After the adjustment of the screws, with the lens holder out, it will be necessary to check the uniform light distribution with the lens in place. Swing lens onto gate. Check the projected area for hot spots. If necessary a slight amount of adjustment on one or two of the screws may be required to re-distribute the light over the entire picture area.

S.15.4 CAUTION When lamp is on use a No. 10 dark welders glass when looking at the Xenon arc light. The harmful rays that are emitted from the highpowered light source are injurious to the eyes.

S.15.5 CAUTION Mirror is a front surface coated unit. DO NOT RUB EXCESSIVELY WHEN CLEANING. Use a soft cloth, moistened with alcohol or water, wiping gently.

S.15.6 CAUTION Xenon lamp has high internal pressure. Use safety helmet when removing or installing. Do not touch quartz bulb with hands. Wipe with soft cloth moistened with alcohol to clean.

S.16.1 To remove the amplifier unplug the necessary electrical connectors. Remove 3 knobs and 2 mounting screws.

S.16.2 In the event of sound problems, first of all check the fuse and other electrical connections. Refer to schematics for electronic checks and repairs.

XENON LAMP POWER SUPPLY

The following is an explanation of the Xenon lamp circuit. When the lamp switch is put to "on" position, there is AC power completed to the main power relay. The contacts close, providing power to the transformer. The secondary of the transformer is connected across a diode rectifier bridge. The output of this bridge, being DC, charges up the capacitors in the DC side of the circuit. When the voltage reaches approximately 60 - 65 volts, the relay in the starter circuit closes, thus energizing by its contacts the step-up transformer located on the starter. The secondary of this starter produces a high enough voltage to break down the spark gap. When the spark jumps across the spark gap, the secondary part of this transformer being connected in series with a condenser and the primary of the tesla-coil produces a high voltage, high frequency voltage. The secondary of the tesla-coil, which also acts as a transformer, produces a still higher voltage across the gap in the Xenon lamp. This voltage is on the order of 20-25,000 volts. As the gap is broken down in the lamp the Xenon gas ignites. When this happens, a current flows from the cathode to the anode, that is, from minus to plus in the lamp. When this current begins to flow and the Xenon gas is ignited, the resistance in the lamp decreases greatly. At this point, the voltage across the lamp drops down to approximately 22 volts. As the voltage drops down, the relay that is mounted in the starter drops out, therefore, disconnecting the line voltage from the primary of the step-up transformer. This removes any high voltage from the lamp. After ignition, the lamp will continue to operate at high current with only 20 or 22 volts across the lamp electrodes.

Connected to the transformer is a current control. On the this current control is accomplished by moving a variable resistor which is in series with a saturable reactor. This provides very efficient current control with good regulation.

To trouble shoot this circuit, it is wise to disconnect the line voltage wires to the starter that are connected to terminals number 3 and 4. Now switch the lamp switch to "on" position, this should provide an open circuit voltage which can be measured across terminals 1 and 2 which are the black and red wires and this open circuit voltage should be on the order of 75 to 90 volts. If this is not the case, there will be some element in the power supply circuit preceeding this that is defective. It would be necessary to check the diodes in the diode bridge for shorts or open condition. Measure the AC voltage appearing across the diode bridge which would be from the output of the power transformer. If no power appears at this point, determine if the primary of the transformer is receiving line voltage via the contacts from the relay. Be sure to check the fuses that are in series with both legs of the line voltage.

If there is power to the circuit and the proper open circuit voltage is available and the lamp still does not light, it will be necessary to check the relay in the starter circuit. Switch the main power off, reconnect the yellow and green wires to the terminals number 3 and 4 on the starter unit, switch power and lamp switch "on", the relay should close completing a circuit to the primary of the step-up transformer on the starter. If this is the case and voltage does appear at the primary

and the spark gap does not break down and arc as it ought to, then it would be necessary to check the voltage across the secondary of this transformer. Make sure that all the wire connections are tightly screwed down. Disconnect main power, use an ohmmeter to check continuity on the secondary of the step-up transformer. This can be done by putting the probes on the terminals across the spark gap. The spark gap is the cylindrical porcelain unit mounted close to the secondary of the step-up transformer. Also, it would be a good idea to check the continuity of the primary of the transformer. This would best be done by removing the yellow and green wires from terminals number 3 and 4 and then switching the lamp "on". When the relay contacts close, you should get a continuity reading by pressing the probes of the ohmmeter across terminals number 3 and 4 of the starter. If there is no reading, move the probe to the contact on the relay that is connected to one side of the transformer. The other probe would be held on terminal number 4 and a reading should be obtained at that point. If not, the indication is that the transformer is defective.

If there is continuity between terminals 3 and 4 on the starter and also across the spark gap, that would indicate that the transformer is operating properly. Now would be the time to test the voltage on the secondary of the transformer. With the wires connected to 3 and 4, the switch lamp "on", use a high reading on the AC voltmeter. A reading of 8 to 10,000 volts will be obtained at the secondary side of the step-up transformer across the spark gap. If a reading is found and the spark gap does not arc, it is possible that the spark gap is defective and should be replaced. This is about the last item that would become defective other than by phy-

sical damage. If a high reading voltmeter is not available, a continuity check on the secondary will do.

A number of by-pass capacitors are used in the circuit to help eliminate stray RF from appearing at the wrong point. It may be necessary to replace the capacitors from time-to-time or at least check to make sure that they are operating properly.

If Lamp Does Not Light, it will be advisable to interchange lamps as a first item in determining why the lamp does not light.

In addition to any of the above procedures, it will be necessary to do the normal routine checking of making sure that all the wires are properly terminated and properly secured so that a good connection exists.

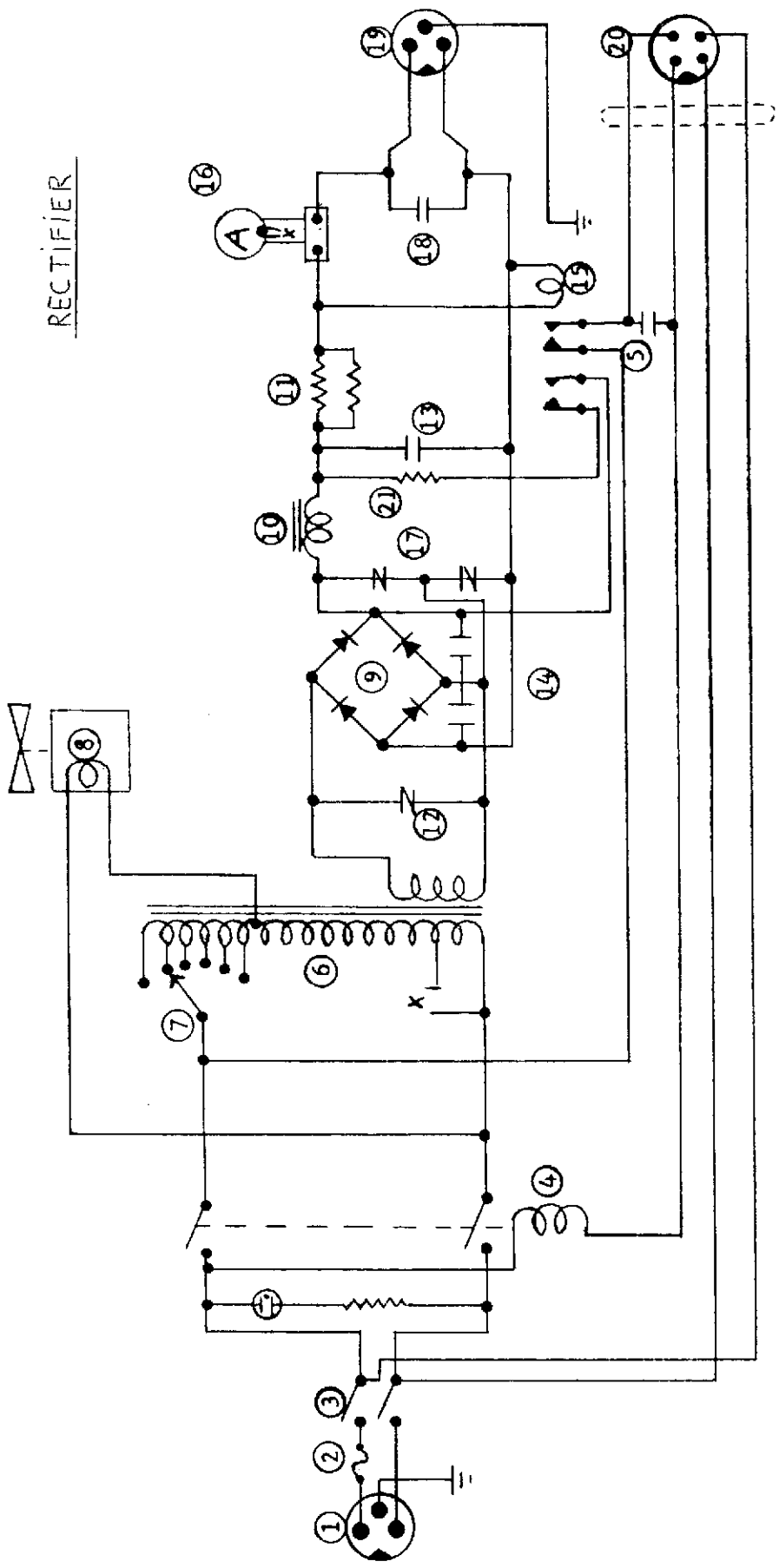
Be also sure to check the lamp switch itself to determine if it is defective or not.

Refer to schematics to trouble shoot and repair.

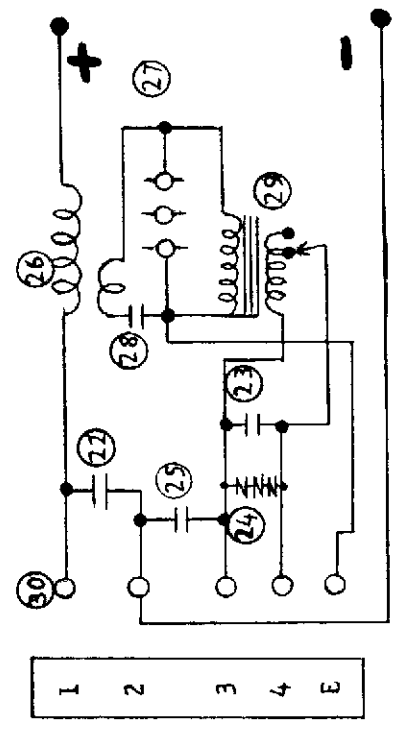
RECTIFIER AND STARTER

ITEM	DESCRIPTION	PART NO.
1	Input Receptacle 3-PIN	X1-62261
2	Fuse 10 Amp	X1-62011
3	Main Power Switch	X1-62021
4	AC Relay	X1-62031
5	By Pass Capacitor 1500 WV, 0.02 mfd	X1-62041
6	Power Transformer	X1-62051
7	Current Control SWITCH	X1-62061
8	Fan Motor	X1-62381
9	Silicon Diode Bridge	X1-62081
10	Choke	X1-62091
11	Resistor Coils 1.6Ω	X1-62111
12	Silister	X1-62121
13	Capacitor 75 WV; 2000 mfd	X1-62131
14	Capacitor 90 WV; 21.5 mfd	X1-62141
15	D.C. Relay	X1-62151
16	Ammeter, D.C.	X1-62161
17	Silister	X1-62121
18	By Pass Capacitor 1500 WV; 0.02 mfd	X1-62041
19	3 Pin Cable Plug ONLY	X1-62191
20	4 Pin Cable Plug	X1-62221
21	Resister 10 Watt 1 ohm	
22	By Pass Capacitor 1500 WV; 0.02 mfd	X1-62041
23	By Pass Capacitor 1500 WV; 0.005 mfd	X1-62281
24	Silister	X1-62121
25	By Pass Capacitor 1500 WV; 0.005 mfd	X1-62281
26	Tesla Coil	X1-62321
27	Spark Cap	X1-62331
28	Ceramic Capacitor 10 KV; 1500 pf	X1-62341
29	High Voltage Transformer	X1-62351
30	Terminal Strip	X1-62721
31	Neon Lamp ASSEMBLY	X1-62231

RECTIFIER



STARTER

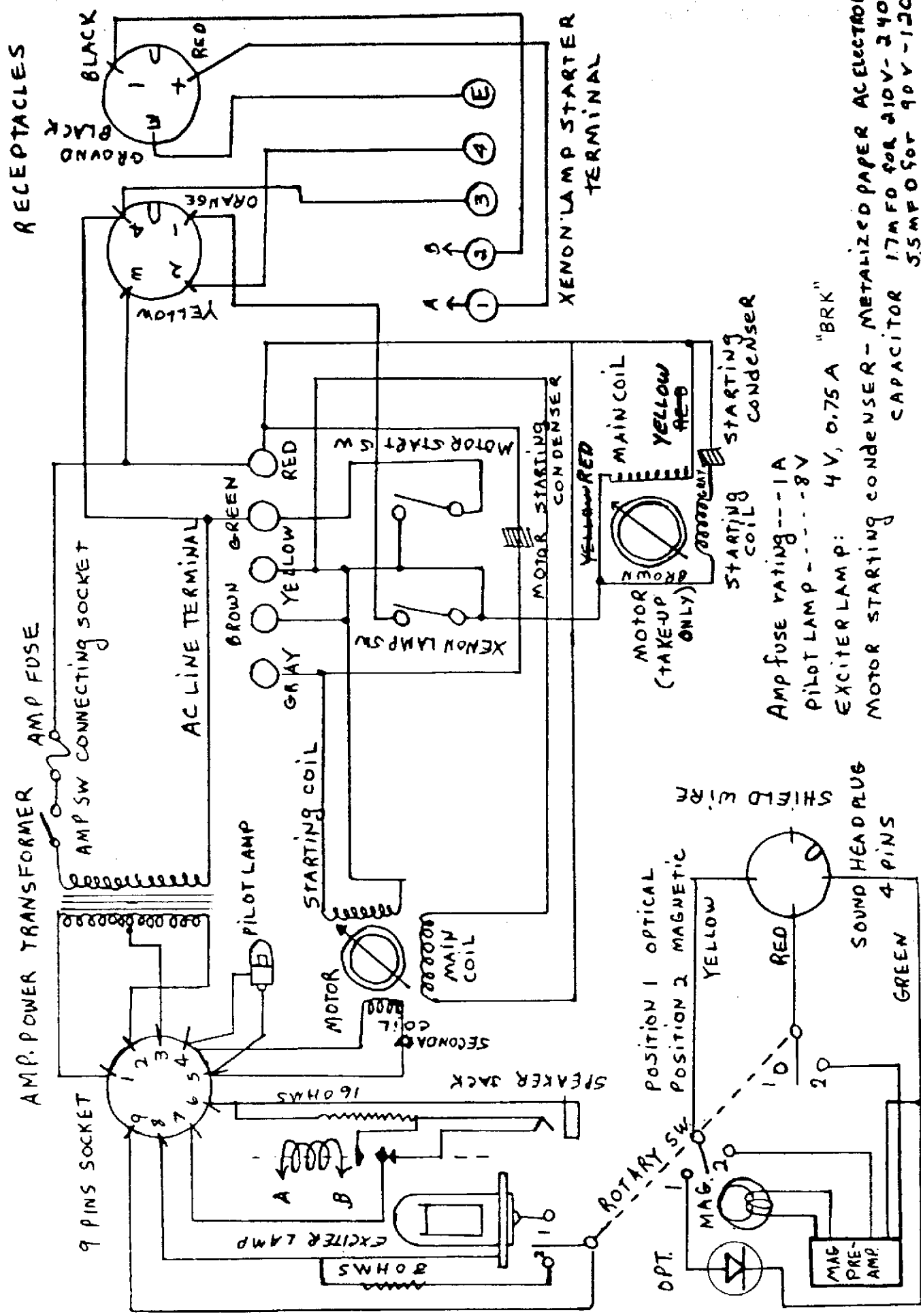


EX-1520 COLOR CODE

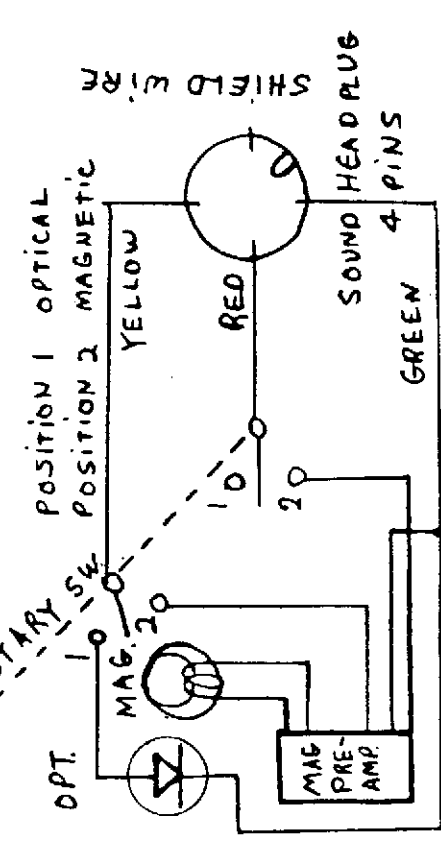
DSB-300E4

INPT VOLTAGE / COLOR	a	b	c	d	e	f	g	h	i
115	BLACK	WHITE	YELLOW	BLUE	GREEN	WHITE	BLACK	RED	BLACK
200	BLACK	WHITE	YELLOW	BLUE	GREEN	WHITE	WHITE	RED	BLACK
220 240	RED	BLACK	YELLOW	BLUE	GREEN	WHITE	BLACK	RED	BLACK

EX-1510-5 ELECTRIC SYSTEM DIAGRAM



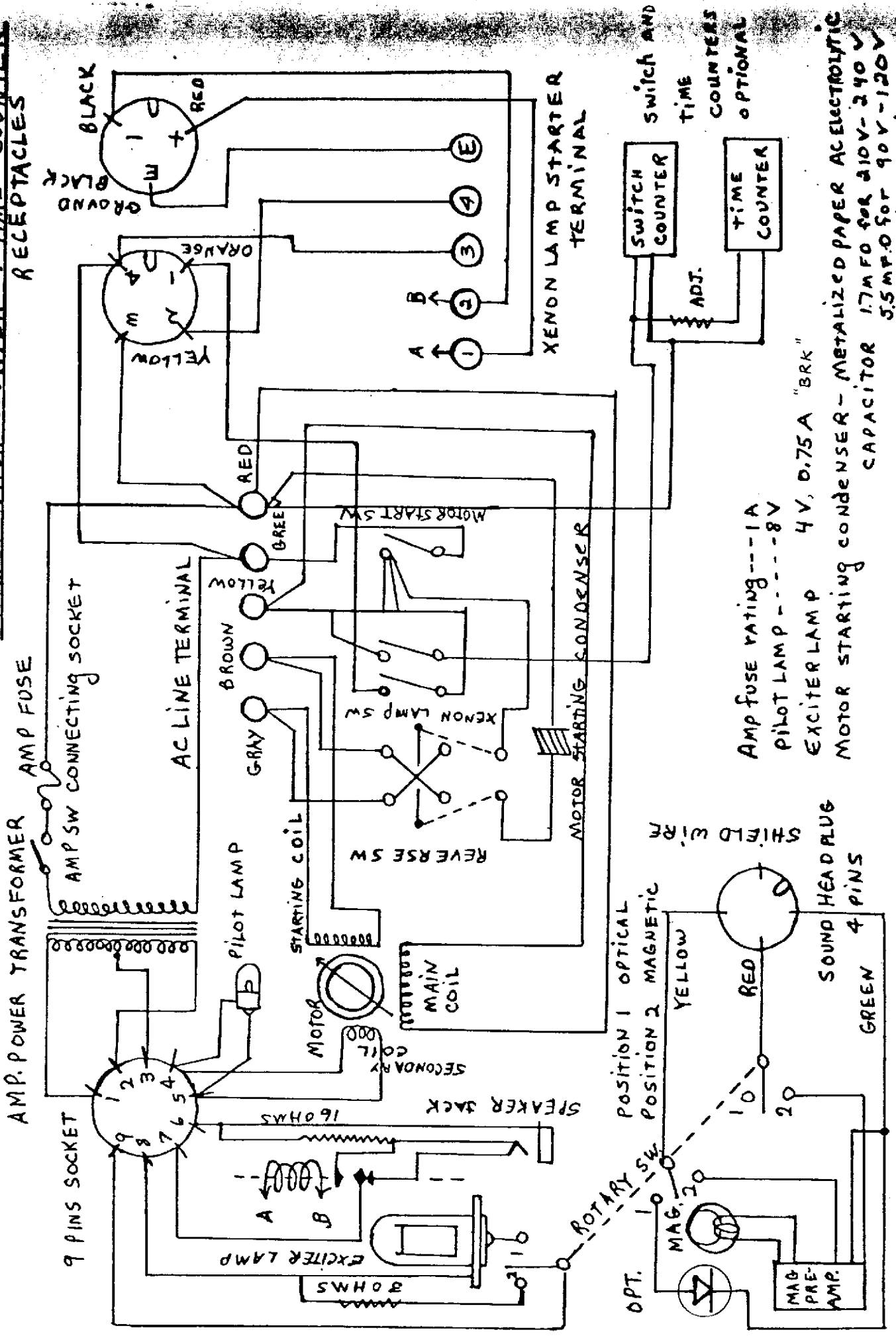
AMP FUSE RATING --- 1A
 PILOT LAMP --- 8V
 EXCITER LAMP: 4V, 0.75 A "BRK"
 MOTOR STARTING CONDENSER - METALIZED PAPER AC ELECTROLYTIC
 CAPACITOR 17MFD FOR 240V-240V
 5.5MFD FOR 90V-120V



THIS SCHEMATIC IS FOR PROTECTORS WITH 5000' REEL ARMS ONLY

EX-1510 ELECTRIC SYSTEM DIAGRAM

WITH SWITCH COUNTER & TIME COUNTER RECEPTACLES



AMP FUSE RATING --- 1A
 PILOT LAMP --- 8V
 EXCITER LAMP 4V, 0.75A "BRK"
 MOTOR STARTING CONDENSER - METALIZED PAPER AC ELECTROLYTIC
 CAPACITOR 1.7MFD FOR 210V-240V
 5.5MFD FOR 90V-120V

MODEL EX-1510 HELM. PROJECT

**AMPLIFIER LAYOUT
AND
WIRING DIAGRAM**

DATE: MARCH, 1948

NOTE: MAGNETIC PRE AMP.

(TRI) SEPARATE CHASSIS.

