WIDE RANGE
Western Electric
SOUND SYSTEM
THE NEW VOICE OF ACTION

OPERATING INSTRUCTIONS

For

"U" TYPE SOUND SYSTEMS

Using

WESTERN ELECTRIC REPRODUCER SETS

Issued by

Electrical Research Products Inc.

250 West 57th Street
New York, N. Y.

ERPI-371 (4-34)

OPERATING INSTRUCTIONS

For

WESTERN ELECTRIC

"U" TYPE SOUND SYSTEMS

(Using Western Electric Reproducer Sets)

Distributed and Serviced by

ELECTRICAL RESEARCH PRODUCTS INC.
250 West 57th Street,
New York, N.Y.
U.S.A.

Issued by Operating Engineering Dept., Equipment Div.
of Electrical Research Products Inc.
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ERPI-371 (4/34)

FIELD SERVICE

Electrical Research Products Inc. maintains a country-wide organization of highly skilled engineers and technicians at strategic points, so that both exhibitors and studios may have the full benefit of prompt service. Routine inspections of the system for both recording and reproduction of sound are the best insurance against interruptions or irregularities in operation.

The facilities of the Bell Telephone Laboratories (owned jointly by the American Telephone and Telegraph Company and the Western Electric Company) are available through Electrical Research Products Inc. to study difficulties and develop improvements in the reproduction of sound.

If trouble which cannot be readily cleared, is experienced in the operation of the Sound System, telephone or telegraph the ..... District Office, the address of which is:

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.....
Telephone .....

Emergency parts are stocked at the above address, and Service Engineers are on duty as follows:

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Your ERPI territory Engineer will furnish you with his personal address and telephone number which it is suggested should be noted below for convenient reference.

.....
.....
.....

The address of the General Office is:

Electrical Research Products Inc.
250 West 57th Street,
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Equipment (no records or films) should be returned prepaid to the destination specified by the ERPI Engineer.

CONTENTS

FIGURES

1. GENERAL

The Western Electric "U" Sound Systems are used with standard (35 m/m film) motion picture projection equipment for the reproduction of speech, music and sound effects in synchronism with motion pictures, and are so arranged as to create the illusion to the audience of the sound emanating from the characters or action on the screen. These systems include Western Electric Reproducer Sets, sometimes spoken of as "Universal Bases".

Systems and Auxiliaries: The several "U" type Systems are graded by output capacity, and accordingly the size of the auditorium determines the "U" type System supplied. Each system includes all equipment essential for sound-on-film reproduction, and is suited for operation from the specified power supply. If other facilities than standard sound-on-film reproduction are required, auxiliary equipment is available to provide the following:-

Wide Range Reproduction
Synchronous Reproduction from Disc Records
Non-Synchronous Reproduction (78 RPM)
Announcing and/or Voice reinforcement facilities
Hearing Aid

Figure 1, shows a schematic of a typical "U" type System.

Sound-On-Film, Principal of Operation: The film leaves the upper magazine and enters the scene projector, where the light from the projection lamp projects the picture through a lens to the screen. As the film leaves the projection mechanism, it enters the sound compartment where an intense beam of light from the exciter lamp is concentrated by an optical system containing a slit which brings the light to focus as a fine line across the sound track (Fig. 4). The film moves evenly from the sound compartment to the take-up magazine at the same speed that is used in recording the sound, i.e., 90 feet per minute.

The density of each particular line (variable density recording), or the width of the transparent part (variable area recording) of the sound track as it passes the light beam determines the amount of light permitted to pass through the film into the photoelectric cell. The current from this cell is therefore modulated in accordance with the sound record. There are 14-1/2 inches of film (19-1/3 frames) between the picture gate in the projection compartment and the sound gate in the sound compartment, but since the sound record is printed on the film 14-1/2 inches in advance of the picture, the sound and picture will reach their respective gates at the same time. The photoelectric cell output is strengthened by a small amplifier in the reproducer set. The output from this amplifier goes to the "fader", a double potentiometer which combines volume control and sound "changeover" facilities, and then is carried to the main amplifier, the output of which passes to the loudspeakers located behind the screen, from which the sound issues in synchronism with the action of the picture.

Equipment Classification: Each system for two projectors consists essentially of the following:-

1 - Pick-Up Equipment, including two Western Electric Reproducer Sets with either film only, or film and disc reproducers, drive motors with control cabinets (if required) and 49 type Amplifiers. The reproducer sets provide mountings for projector mechanisms and lamphouses to be furnished by the customer. 702 and 703 type Control Cabinets (volume control) are also included as part of the Pick-Up equipment.
2 - Main amplifier assembly consisting of from one to four units depending on the type of system furnished. In the 3U-46 System this may be mounted on the rear or side wall, and in the other systems, it is mounted on a rack at a convenient location in the projection booth usually parallel to the rear wall.
3 - One, two, or three loudspeaking (16 or 17 type) Horns each equipped with one, two or four 555 type Receivers, to be supported or suspended on the stage directly behind an approved acoustic screen. If the system is equipped for Wide Range, the horns are used for middle frequency reproduction only, and a baffle with low and high frequency loudspeaker units is installed below the horns.
4 - One or two low voltage Power Units consisting of rectifiers and filters to operate from one of the standard power supplies listed in Section 3. Storage batteries and later, a motor generator, were formerly standard equipment for this purpose.

2. PROJECTORS

The following projector mechanisms are adaptable to the "U" type Systems. Projector mechanisms, upper magazines and lamps, etc. are to be furnished by the Customer.

Simplex - All late models
Surefit - All late models
Powers - 6A or 6B
Motiograph - F or H
Superior - U or MV; or X, M or R after modification to XS, MS or RS
Fulco

3. POWER SUPPLY

Standard: These systems require a 105-125 volt, 50-62½ cycle AC supply, with a separate circuit fused at 15 Amps. for each of the following:-

Each projector motor
Main amplifier
Each power unit
Stage loudspeakers (if system is Wide Range)

The power supply capacity for the sound system should be at least 60 amperes at 110 volts in addition to that required for the arcs, lights, fans, etc.

Special: If the power supply is DC or AC of other voltage or frequency than that specified above, special equipment is required.

4 HORN MOUNTINGS AND SCREEN

The customer is required to furnish structures for supporting the stage horn(s) which

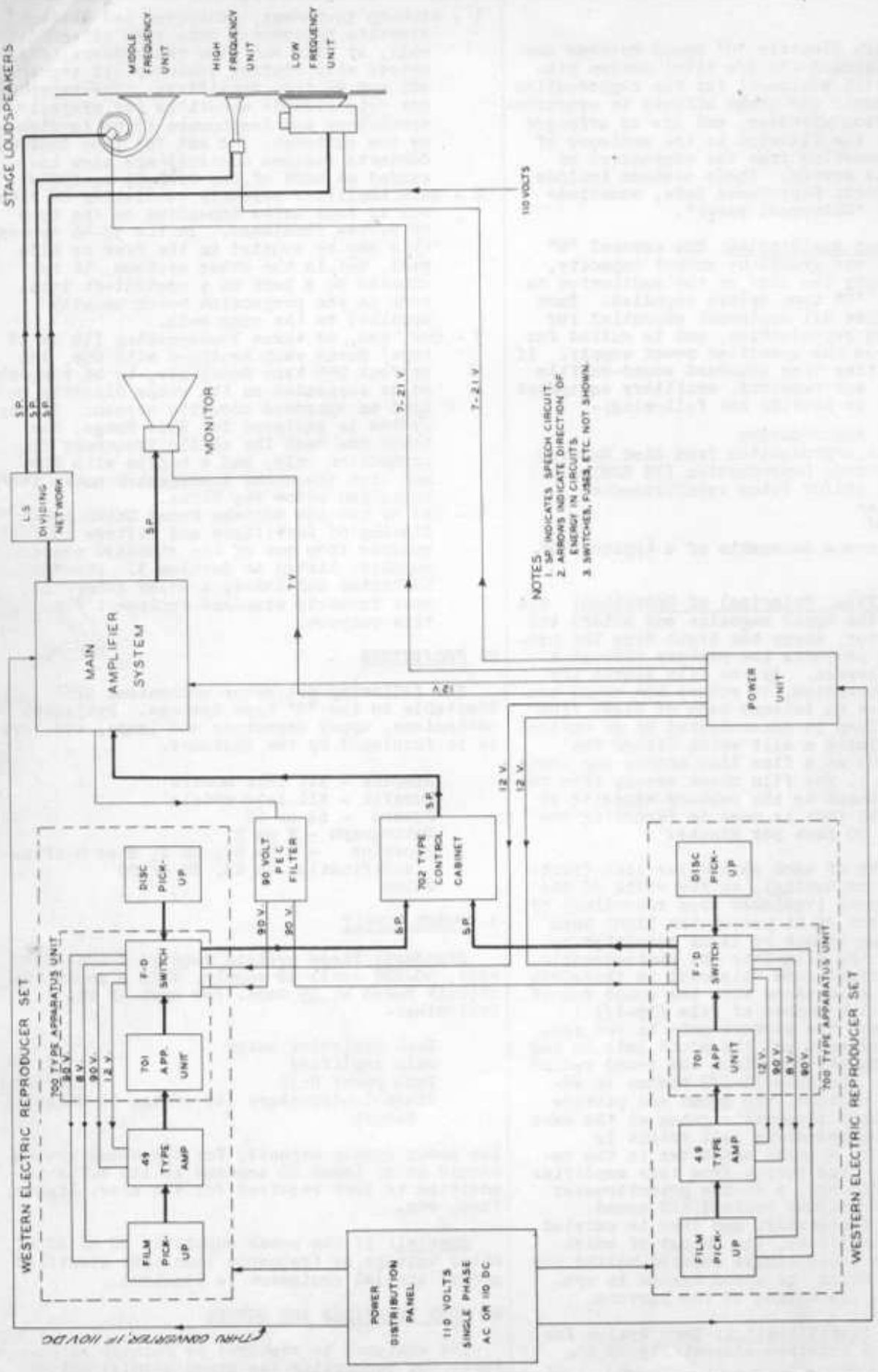


FIG. 1
"U" TYPE WIDE RANGE SYSTEM, USING POWER UNIT
BLOCK SCHEMATIC

weigh (16 type Horn) 400 to 450 lbs. each, or (15 type Horns) 130 to 150 lbs. each. The horn(s) may be hung from lines or mounted on towers, trolleys, monorails or elevators.

An acoustic screen approved by ERPI as to its acoustic qualities should be obtained by the customer and should be at the auditorium when our engineer arrives. The screen should be at least 6" larger on all four sides than the actual picture size desired, and the frame inside should be 6" larger on all four sides than the screen size.

5. BUILDING REQUIREMENTS

The projection booth for "U" type Systems, except 3U, for two projectors only, must be at least:

9' long x 10' deep x 7'6" high, or,
12' long x 7' deep x 7'6" high.

For the 3U System, it must be at least

9' long x 8' deep x 7' high, or
11' long x 7' deep x 7' high.

Local City or State ordinances may require a booth of larger dimensions.

The booth must be of strong construction and fireproof, and the floor should be sufficiently rigid to avoid appreciable vibration. A space for low voltage power equipment is required adjacent to or at a distance not exceeding 30 ft. from the booth and should be at least:

4' wide x 3' deep x 7' high.

This equipment may be located in the booth if local ordinances permit.

Loudspeaker Space: A 3 ft. space is required behind the screen for the horn loudspeaker equipment of the 3U System. (For this system a 6' space behind the screen is necessary, if the house is less than 30' wide.) For the other systems a 4 to 5 ft. space is required.

Installation: The sound system is installed by the customer in accordance with ERPI specifications under the supervision of an ERPI engineer. Any necessary modifications in the projection booth or stage should be completed before the ERPI Engineer arrives.

Acoustic Treatment: The Acoustic Consulting Department of Electrical Research Products Inc. will advise if any acoustic treatment is required in the auditorium after the system has been installed.

6. OPERATION

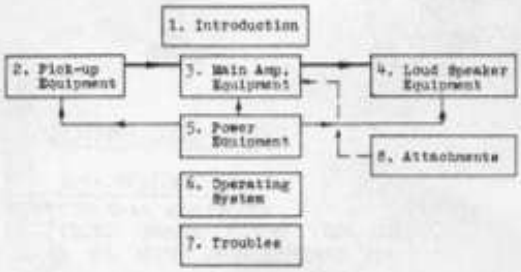
Western Electric "U" type Sound Systems are simple to operate. However, close familiarity with their parts and principles will avoid loss of time in case trouble is experienced. In such event, analyze the difficulty in accordance with the Trouble Section of these instructions so that, if the necessity arises for communicating by telephone with the ERPI Engineer, the difficulty can be helpfully discussed.

7. MAINTENANCE

Strict cleanliness and proper maintenance is of course, essential. The stock of spare parts should be fully maintained. Unauthorized changes or experimenting are not permitted and will result in unsatisfactory operation, and possibly damage for which the customer would be liable.

8. INSTRUCTION SCHEME

To facilitate explanation, these instructions are grouped according to the functions of the various parts of the system, as follows:-



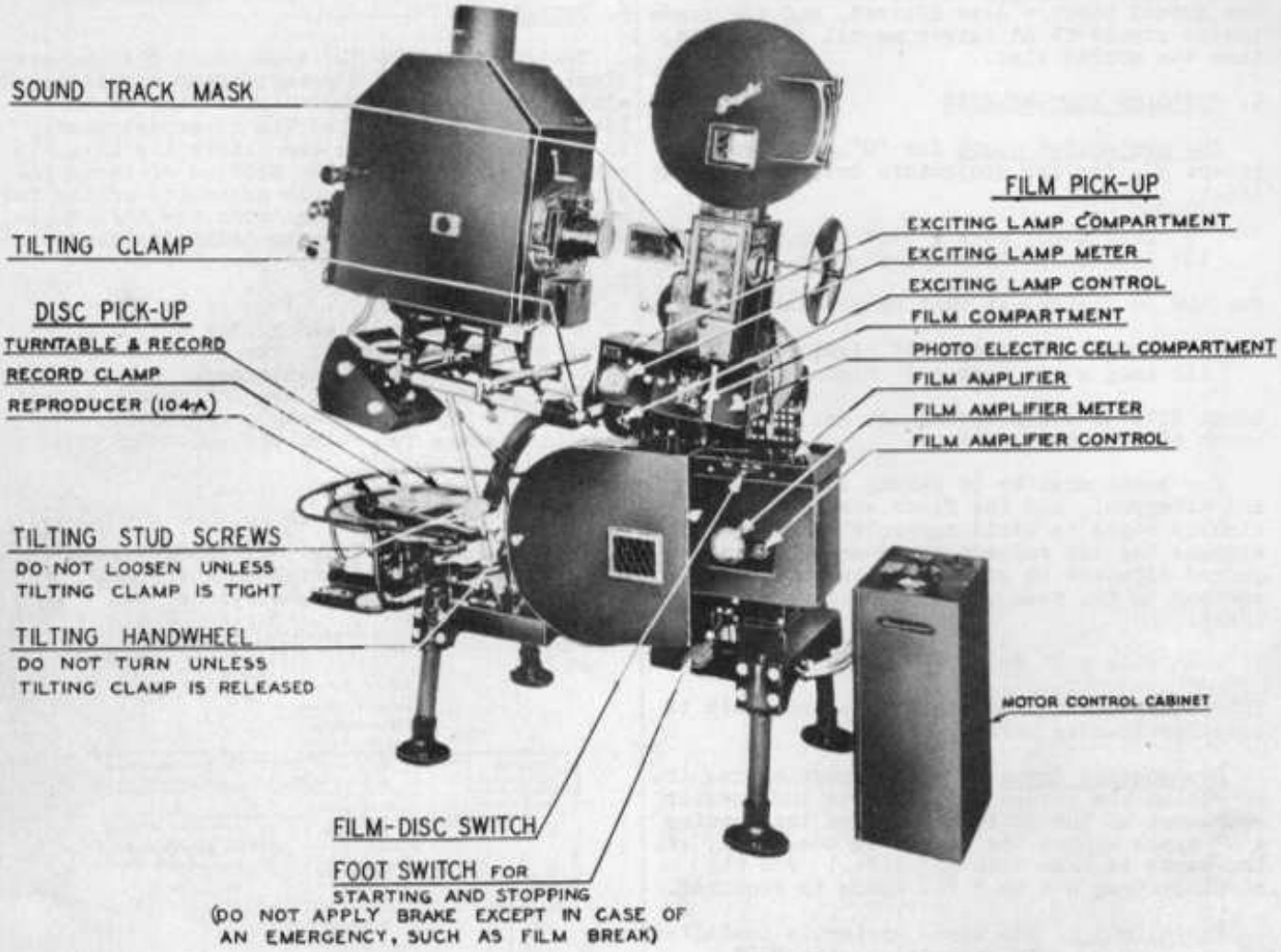


FIG. 2
PROJECTOR AND REPRODUCER SET
OPERATING SIDE

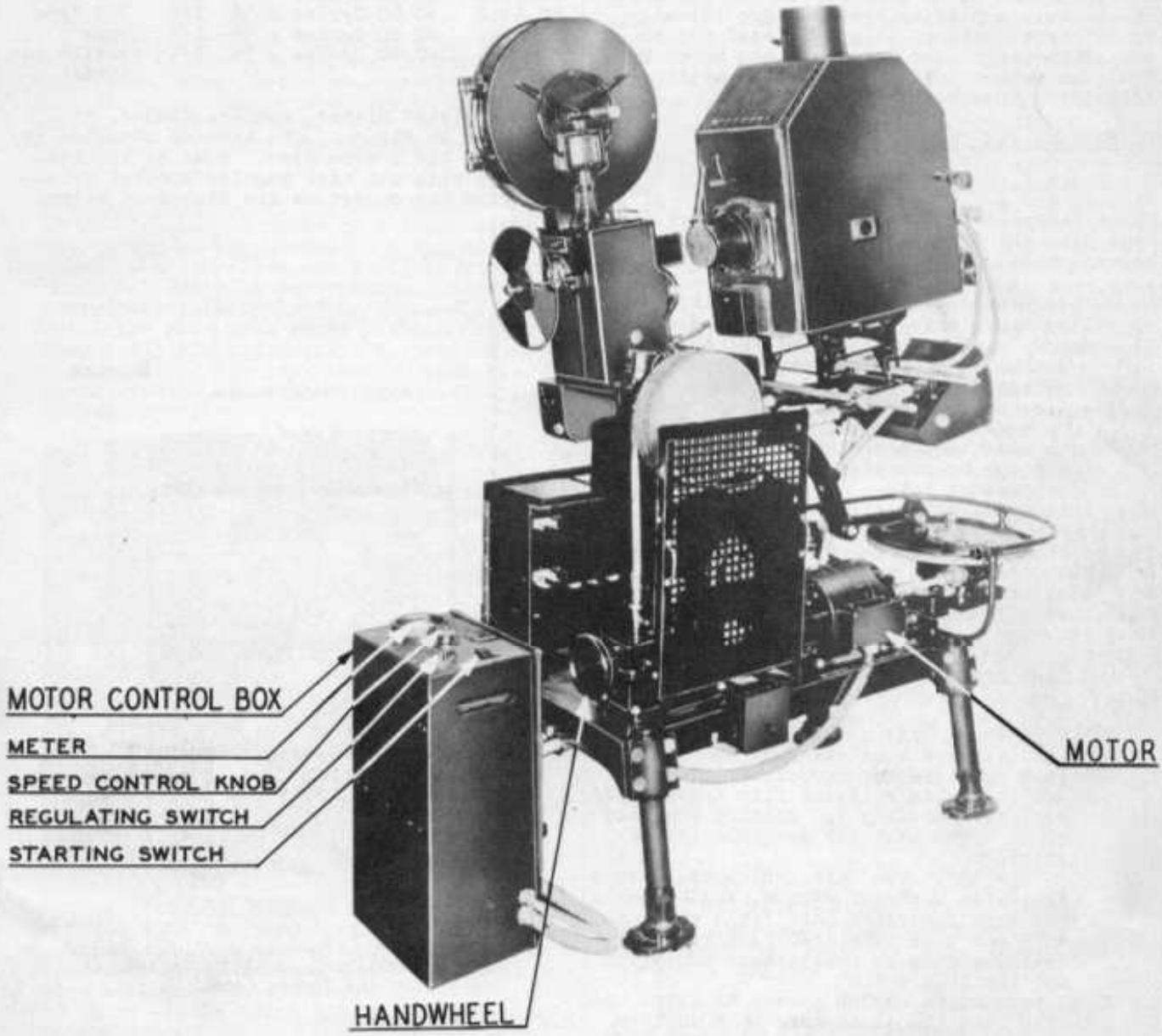


FIG. 3
PROJECTOR AND REPRODUCER SET
DRIVING SIDE

1. GENERAL

The Pick-Up Equipment includes the equipment and apparatus associated with the sound circuits from their beginning at the film or disc reproducers, through the preliminary amplifiers and volume control, and to the input of the main amplifier system. Specifically, in "U" type Systems, it consists of two or more W.E. Reproducer Sets, and the Motor Control Cabinets and Volume Control Cabinets associated therewith.

2. WESTERN ELECTRIC REPRODUCER SET

2.1 The W.E. Reproducer Set is shown in Figs. 2 and 3. It consists essentially of a black finished adjustable iron framework (1 type Base and 703 type Bracket), on which are mounted:

1 - Film Reproducer with PEC Amplifier
1 - Disc Reproducing Attachment (if desired)
1 - Motor, with associated Drives, Shafts, Chains, etc. for driving projector mechanism, film reproducer sprockets, disc reproducer turntable, and take-up magazine; one Motor Control Cabinet is sometimes associated with each motor and may be considered as part of the Reproducer Set.
1 - Take-Up Magazine.

In addition to the above, the Reproducer Set is arranged to mount any of the projector mechanisms listed on Page 1, and any standard lamphouse. The set includes a projection lamp switch.

The Film Reproducer consists essentially of:

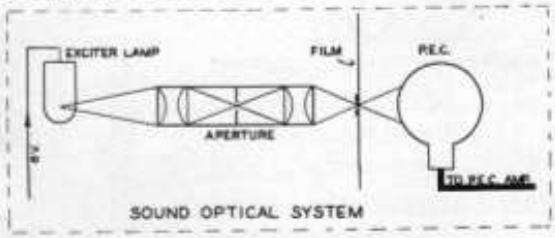
1 - 1 type Sound Unit containing an exciter lamp, a lens tube assembly and sound gate aperture, a photoelectric cell, and the guide rollers, film tension pad etc. for locating and guiding the film as it moves past the aperture (sound gate).
1 - 700 type Apparatus Unit, which includes a film-disc transfer switch, and houses a 701 type Apparatus Unit (film attenuator) and a 49 type (PEC) Amplifier. The latter serves as preliminary amplifier for the film output.
1 - 707 type Drive, which serves to drive the film past the sound gate at a uniform speed. It consists of a sleeved shaft, having a film sprocket at one end, and a flywheel at the other end, and provided with a bevel gear drive through an air cushion filter.

The Disc Reproducing Attachment consists of a 3-A Turntable and 104 type Reproducer mounted on a 704 type Bracket, which mounts on the rear of the 1 type Base. The turntable gearing is driven from the motor through the 706 type Shaft. The disc attachment is supplied as an extra item, and not as part of the standard system.

The following types of Drive Motors and Control Cabinets have been, or are being supplied for use on the Reproducer Set:

Motor	110V. Power	HP	Control Cabinet
KS-5158	DC	1/5	706 Type
KS-5161	AC 60 Cycles	1/5	708 Type
KS-5258-A	AC 60 Cycles ± 3%	1/5	709 Type
KS-5260	AC 60 Cycles	1/5	708 Type
KS-5262	AC 60 Cycles ± 3%	1/5	709 Type
KS-6752	AC 60 Cycles ± 3%	1/5	None
KS-6953	AC 60 Cycles ± 3%	1/5	TA-4114 (At times)

The associated drives, shafts, chains, etc. are shown in Fig. 5. The take-up magazine is a part of the 1 type Base. Some of the features of this set that require special attention from the operators are discussed below.



SOUND OPTICAL SYSTEM

FIG. 4
SCHEMATIC OF OPTICAL SYSTEM, AND SOUND FILM

2.2 Exciter Lamps

Types and Current Values: Two types of lamp are in use, and are listed below, with their normal filament current:-

"8.5V-4A" Exciter Lamp - 3.2 Amps.
"9V-2.15A" Exciter Lamp - 1.8 Amps.

The current is switched on and off by means of the film-disc switch in the 700 type Apparatus Unit.

Adjustment: The exciter lamp should be adjusted to produce a bright, clear rectangle of light on the aperture slit of the lens tube (Fig. 4). On pushing back the tension pad of the light shield and holding a white card in front of the aperture, an oval spot of light

will be seen on the white surface. The edges of this spot may be rather soft, but otherwise it should be clear, bright and uniform. There should not be colors or shadows at the top or bottom or at the ends. Check the current value and light spot at least once EVERY DAY.

The exciter lamp mounts on a bracket (Fig. 6) which, in turn, is mounted on two supporting pieces, which serve as contacts for the lamp circuit. The bracket can be removed by pulling it out sideways. Four adjustments for the exciter lamp are provided on this bracket, namely:

Clamping Adjustment: The lamp base is clamped in a socket by means of a thumb screw. At the bottom of the socket is a spring contact stud. The lamp base has a pin in each side which fit slots in the socket. Loosen the clamp screw, push down the lamp, and turn it until the pins lock it in place. Rotate the lamp until the filament is perpendicular to the length of the lens tube, - that is, parallel with the film. Tighten clamping screws.

Vertical Adjustment: Loosen the vertical adjustment clamp (Fig. 6), and move the lamp bracket up or down as required until the rectangle of light is centered on the slit. Tighten clamping screw.

Sideways Adjustment: Loosen the sideways adjustment clamping screw and move the lamp bracket sideways until the rectangle of light completely covers the slit. When moving bracket away from you, press steadily on the clamping screw, otherwise the bracket will not move. Tighten clamping screw.

Focusing Adjustment: Loosen the focusing adjustment clamping screw, and move it so as to get the sharpest and brightest light spot on the white card. If the lamp is too near the lens tube, the spot will have blue fringes; if too far away, there will be brown fringes. Tighten clamping screw.

The foregoing results in positioning the lamp are best obtained by noting the extreme positions of each adjusting screw at which shadows or color fringes first appear as the screw is turned in alternate directions. Lock the screw at the point midway between these two positions.

Exciter Lamp Replacement: Assuming that an exciter lamp is satisfactory from a noise standpoint and not burnt out, the only basis for its replacement should be the output level of the system in which it is used. Accordingly, no exciter lamp should be replaced unless an increase in level of at least 3 db results from the replacement; or unless the filament has sagged so badly that the noise level is raised or the possibility of failure by burned out filament becomes imminent. The blackening of the bulb or sagging of the filament has no effect on the frequency response. On the average, the level will fall considerably more than 3 db before there is danger of burn-out.

2.3 Aperture & Sound Gate: Cleaning

Aperture: It is essential that the front and rear lenses of the lens tube assembly be kept clean. The front lens particularly tends to collect oil and dust and should be cleaned with any wooden or fibre instrument which will reach in and around the rim of the optical tube. A small wad of "Japanese Lens Tissue" wrapped around the end of the instrument, should be used for wiping the lens. Another wad should be used for polishing. If the lens must be washed, dampen the cleaning wad with chemically pure carbon tetrachloride, and thereafter carefully polish away any residue. Do not touch the lenses with the finger.

Sound Aperture Plate: If the aperture is 4 type (non Wide Range Systems) clean the slot in the aperture plate several times each day and inspect it for cleanliness prior to threading each reel. Dirt or film chip in this slot may completely stop sound reproduction. The polished side of the aperture plate must also be kept clean and smooth, by rubbing with lens tissue or lintless cotton twill cloth. Obstinate patches of film emulsion, if they cannot be removed by rubbing with a damp cloth, can be scraped away with a copper coin; always dry the surface after cleaning. Scratches on this surface result in the accumulation of dirt and emulsion and lead to scratched and noisy film. Furthermore, emulsion patches may hold the film away from the pad surface and destroy the focus of the light on the sound track. This will affect the quality of the reproduced sound. Therefore, keep the sound aperture plate clean.

Light Shield and Gate: The sound gate must be kept closed when operating. Be sure that the lever-type locking screw holds the gate securely in position and that the pressure pads operate freely. Keep the polished surfaces of the pads perfectly clean.

2.4 Photoelectric Cell

Installing: Mount the photoelectric cell firmly in its holder with its window or bulb exactly framed by the wall opening in front of the sound gate. Connect the two leads securely to their respective binding posts in the compartment. Use a screw driver inserted from beneath when connecting the anode wire (short wire associated with the semi-cylindrical plate) to the rear (flexible) post.

Do not let the anode wire rest against or hang close to the metal compartment and do not touch this wire while operating the system as it will cause a loud report in the auditorium.

In the 3-A Photoelectric Cell, the light sensitive material is coated on the surface of a semi-cylindrical metal plate. It is important that the cell, when mounted between the holding clip and the window of the compartment, be placed so that the plane formed by the front edges of this plate is parallel with the face of the window. Inspect cells every day or two to insure clean windows, tight terminals, and straight and secure mounting.

2.5 Film (PEC) Amplifier

Grid Leaks & Tubes: This amplifier (49 type) is equipped with two resistors of the grid leak type (in Clips R1 and R2) which are used in coupling the PEC to the first vacuum tube. It is important that these re-

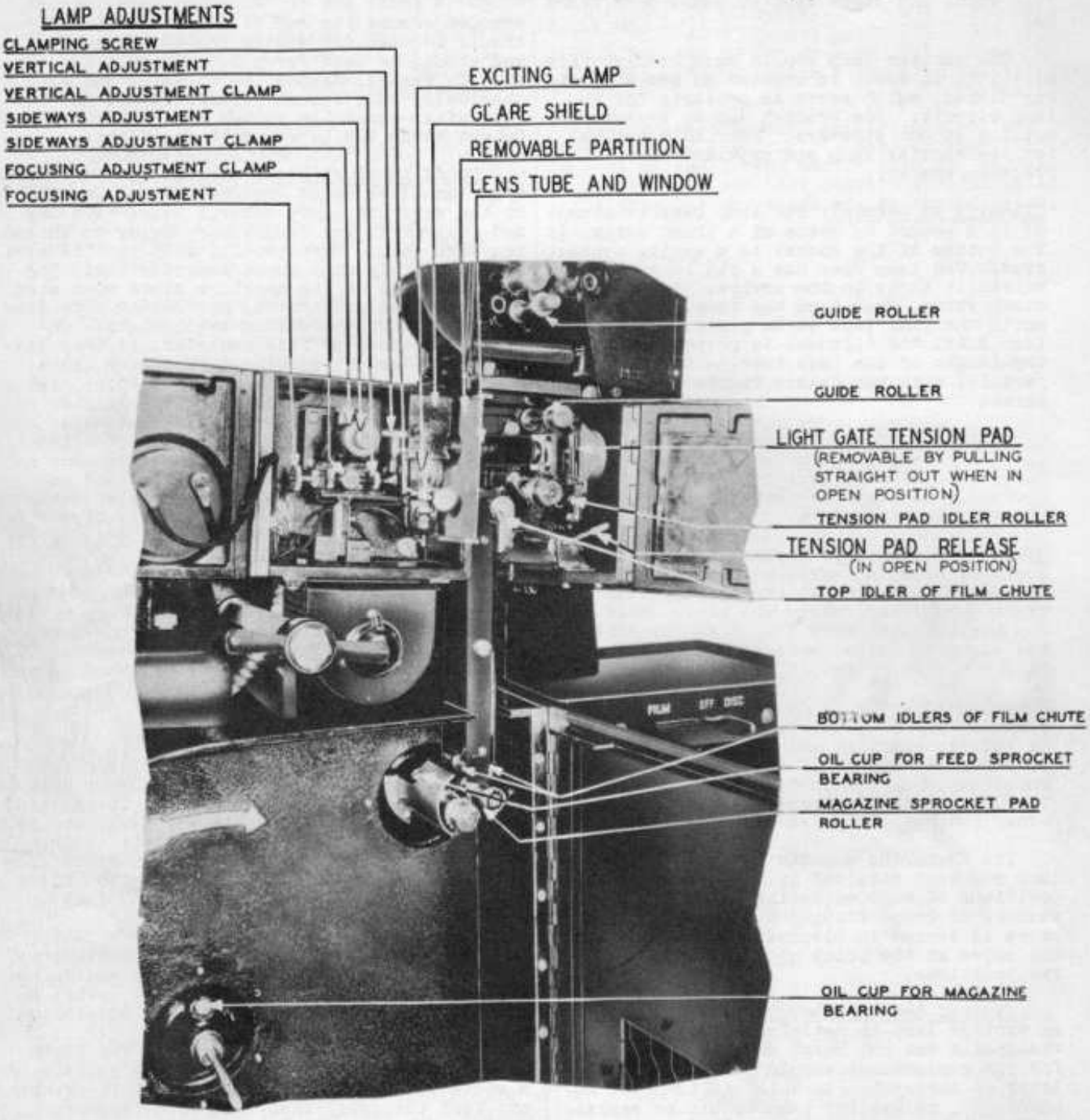


FIG. 6
REPRODUCER SET
EXCITER LAMP AND FILM COMPARTMENTS

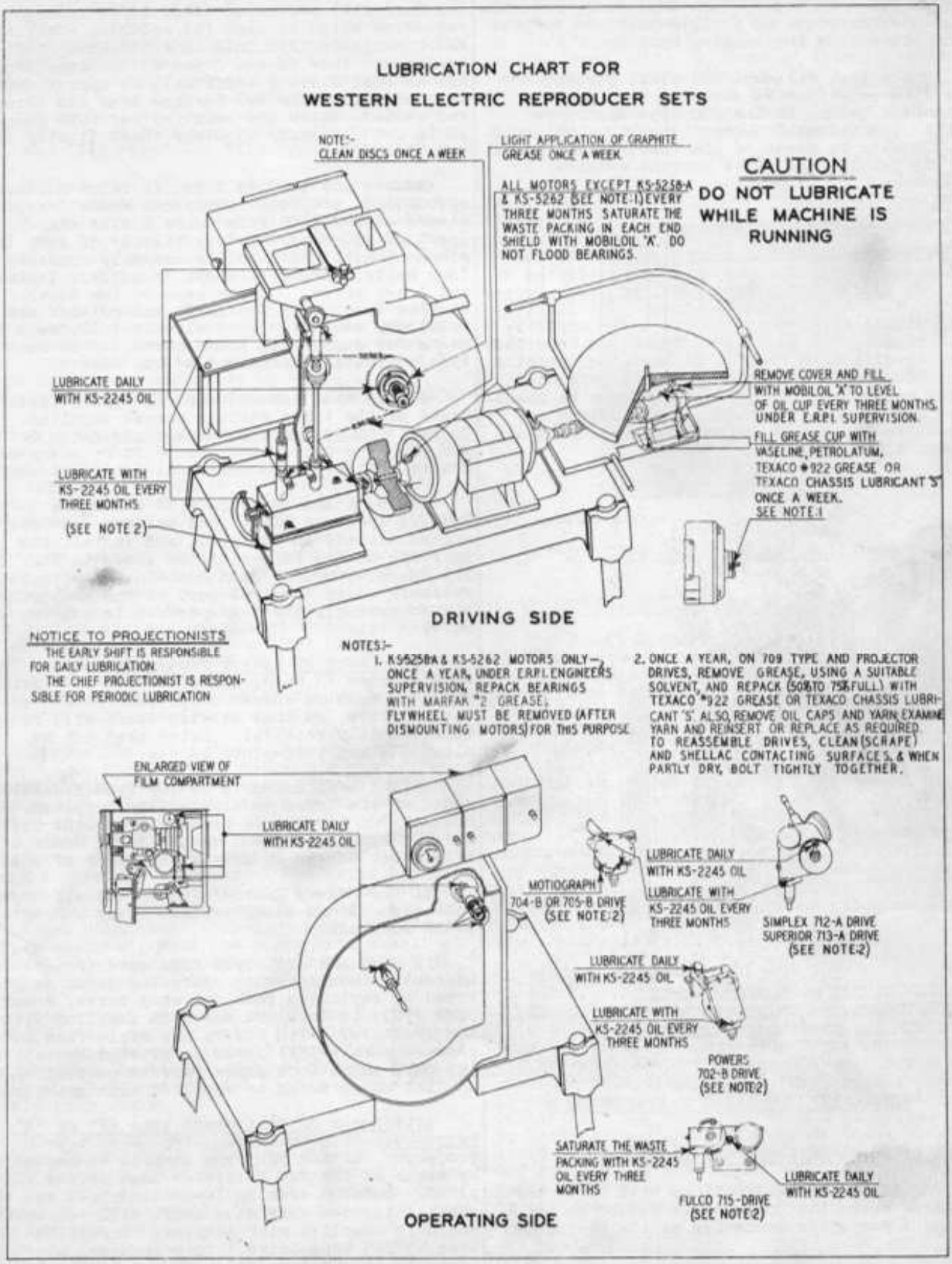


FIG. 7
REPRODUCER SET - LUBRICATION

sistances be not interchanged. When inserting vacuum tubes in the 49 type Amplifier, hold the suspended carriage in a rigid position to prevent distorting the hanging springs.

Operation: Filament and plate current for the film amplifier is obtained through the Film-Disc Switch in the 700 type Apparatus Unit. The filament current should be adjusted to 300 mils by means of the rheostat and meter on the panel. The plate current requires no adjustment.

2.6 Lubrication

The Reproducer Set mechanism must be carefully and regularly lubricated as specified on Fig. 7. Avoid using more lubricant than necessary. The parts requiring infrequent lubrication should be attended to under the supervision of the ERPI Engineer. These are nevertheless specified in Fig. 7, so that the operator may check their condition. If oil gets on a motor commutator, wipe it off as soon as possible. If the oil has become burnt, clean out the slots between the commutator bars with a wooden toothpick.

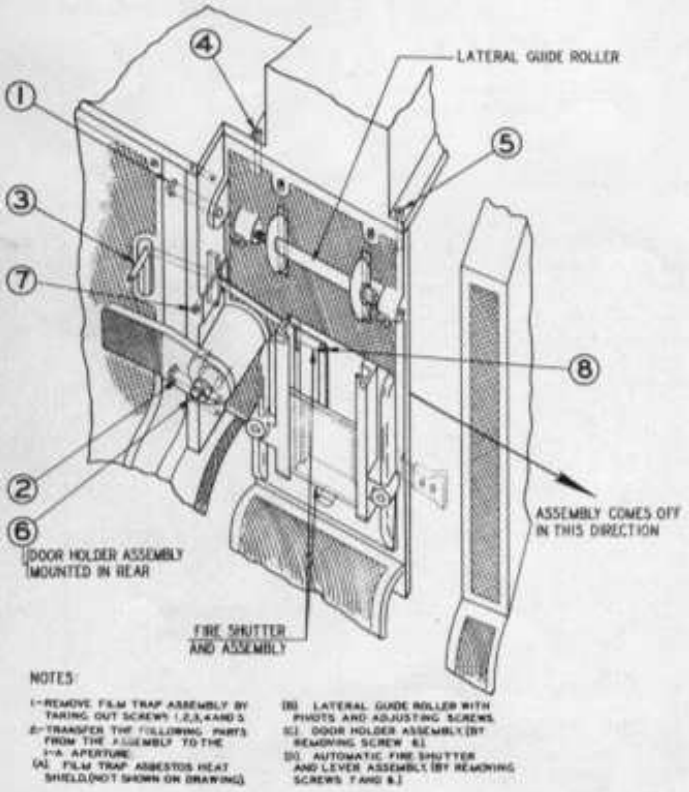


FIG. 6
METHOD OF INSTALLING 1-A APERTURE

2.7 Attachment of Projector Mechanisms

The following instructions will be of use in cases where the operator is called on to change a projector mechanism on the Reproducer Set.

Attachment of Simplex (or Sure-Fit) Projector: With Simplex (or Sure-fit) projector, first screw 700 type Adapter to projector mechanism, using the two fillister head screws supplied. Next, insert 712 type Drive in Simplex (or Sure-fit) mechanism after first removing set screw which is used for securing shaft and which projects into hole in which this shaft is inserted. Then fasten Drive to 700 type Adapter, so that driving shaft will be approximately vertical, with the two hexagon head cap screws and washers which are supplied for this purpose. It is not necessary to clamp these tightly as yet.

Remove nut located directly below holdback sprocket on projector head, and screw hexagonal sleeve of P-233505 Film Guide Roller Assembly (part of 700 type Adapter) tightly on stud in place of nut. This roller assembly consists of four parts, namely: 1 shaft, 1 roller, 1 sleeve and 1 set screw. In the case of the Super-Simplex Head, only the shaft and rollers are required, since the head already includes a means for supporting these parts, - the function ordinarily performed by the sleeve.

Attach head assembly to 703 type Bracket by means of the three machine screws supplied. Connect 702 type Shaft between projector drive and 709 type Drive, and secure it by means of Bristo Set Screws on universal joints of shaft.

Equip a 1-A Aperture with a Simplex P-527-E Aperture Plate (new uniform aperture), unless already so equipped, and install the 1-A Aperture on the projectors as shown in Fig. 8. The "Super-Simplex" Head contains an adjustable aperture as an integral part of the mechanism, and accordingly the 1-A Aperture is not required with it.

Attachment of Powers Projector: Attach 701 type Adapter to head, using the two 1/4" hexagon head machine screws supplied. Remove existing Drive, so that driving shaft will be approximately vertical. Drive need not be clamped tightly in place as yet.

Attach head assembly to 703 type Bracket by means of the three machine screws supplied. Connect 702 type Shaft between projector drive and 709 type Drive, and secure it by means of Bristo Set Screws on universal joints of shaft.

If the Powers Aperture is of the old type (not new uniform size) replace it by a Powers #4420 Aperture.

If head has old style film gate (Powers "K" assembly) then Aperture operating lever is pivoted by replacing lock nut stop screw, Powers part #729, by lock nut which is supplied with the Aperture. With Powers new style film gate (Powers part #4381) lever is pivoted by replacing gate latch lock screw (Powers part #128), by special screw which is supplied with aperture.

Attachment of Motiograph type "F" or "H" Projector: With Motiograph type F or type H Projector, attach 702 type Adapter to mechanism by means of the two fillister head screws supplied. Between framing lever handwheel and its shaft interpose extension shaft with set screw, which is supplied with Adapter. Insert 704 type or 705 type Drive into mechanism, mount assembly on 703 type Bracket, and secure link to bracket so that driving shaft is approximately vertical. Link need not be clamped tightly as yet. Connect 702 type Shaft between 704 type or 705 type Drive, and 709 type Drive and

secure it by means of Bristo Set Screws on Universal Joints of shaft.

Attachment of Superior Projector Head: The following procedure applies to the Superior types MV or U type mechanisms as manufactured, and to the type X, M or R after modification. If the mechanism in question is the Superior "U" type, read "700 type" for "703 type" Adapter, and "712 type" for "713 type" Drive.

Attach the 703 type Adapter to the head, using the machine screws supplied. Remove the existing drive from the head and attach the 713 type Drive so that driving shaft will be approximately vertical. The drive need not be clamped tightly in place as yet.

Attach head assembly to 703 type Bracket by means of the two hex. head cap screws, and the stud, nut and washers supplied. Connect 702 type Shaft between projector drive and 709 type Drive, and secure it by means of the Bristo Set Screws on universal joints of shaft.

Attachment of Fulco Projector Head: The Fulco Projector is mounted by means of the 705 type Adapter and 715 type Drive. Mount the 705 type Adapter on the 703 type Bracket by means of the three cap screws supplied with the bracket.

Next, center the projector head on the four studs on the adapter and secure it by means of the washers and nuts supplied with the adapter. Due to the limited space between the top of the projector feet and the adjacent structure on the projector head it may be found difficult to start the nuts on the two studs nearest the sound unit. In this event, raise the projector slightly to provide more space at this point when starting the nuts.

Remove the cover guard from the mounting casting of the 715 type Drive and mount the Drive on the adapter by means of the two cap screws and washers supplied with the adapter.

Before finally securing the drive to the adapter, adjust its position so that the fabric intermediate gear of the drive and the bronze gear on the drive shaft of the projector will have a slight amount of backlash and will not bind when rotated by hand. When properly adjusted, swab the gears with small amount of grease, secure the drive firmly in place, and replace the cover guard.

The spiral gear unit must then be loosened slightly and rotated until the shaft extension which connects with the 702 type Shaft is approximately vertical. Make this adjustment with the 703 type Bracket tilted to the proper projection angle.

When the entire assembly is mounted securely in its final position, loosen the two screws securing the film guide, which is part of the adapter, and adjust its position so as to centrally locate it between the sound unit and the projector.

Alignment of Projector Head: In attaching the projector heads as noted above, carefully observe the alignment of the lower sprocket in the projector with the upper guide roller in the Sound Unit. A piece of film threaded through these parts over the 707 type Drive sprocket will reveal any lack of alignment. The wear on the upper guide roller of the Sound Unit will be excessive unless good alignment is obtained.

FIG. 9
702 TYPE CONTROL CABINET (FADER)

3. VOLUME CONTROL CABINET (FADER)

The 702 type Control Cabinet (Fig. 9) consists of a double potentiometer, providing a means for varying the input to the main amplifier system from 0 to maximum in 3 db steps. The "fading in" of the other is accomplished simultaneously with the picture changeover, by turning a knob with pointer over a dial. Keys permit (1) the use of the control cabinet to control the output of a third reproducer set, and (2) the substitution of a fixed resistance pad for either side of the potentiometer in case of trouble therein. Clean the contact surfaces of the brushes occasionally by placing a piece of heavy bond paper between them and the studs and plate, and moving the brushes back and forth over the paper several times. A thin coating of vaseline on the studs and plate will prevent undue wear.

4. 90V PEC SUPPLY

The polarizing voltage for the photoelectric cells, and the plate voltage for the 49 type Amplifiers, is supplied by either four 45V Eveready Batteries (one 90V unit for each machine) or by a small filter (D-96101) which is supplied with rectified AC from the main amplifier. The batteries should be replaced at least once every six months. Check the individual voltage of the cells every few weeks and replace any units that show less than 45 volts. The filter requires no maintenance by the operators.

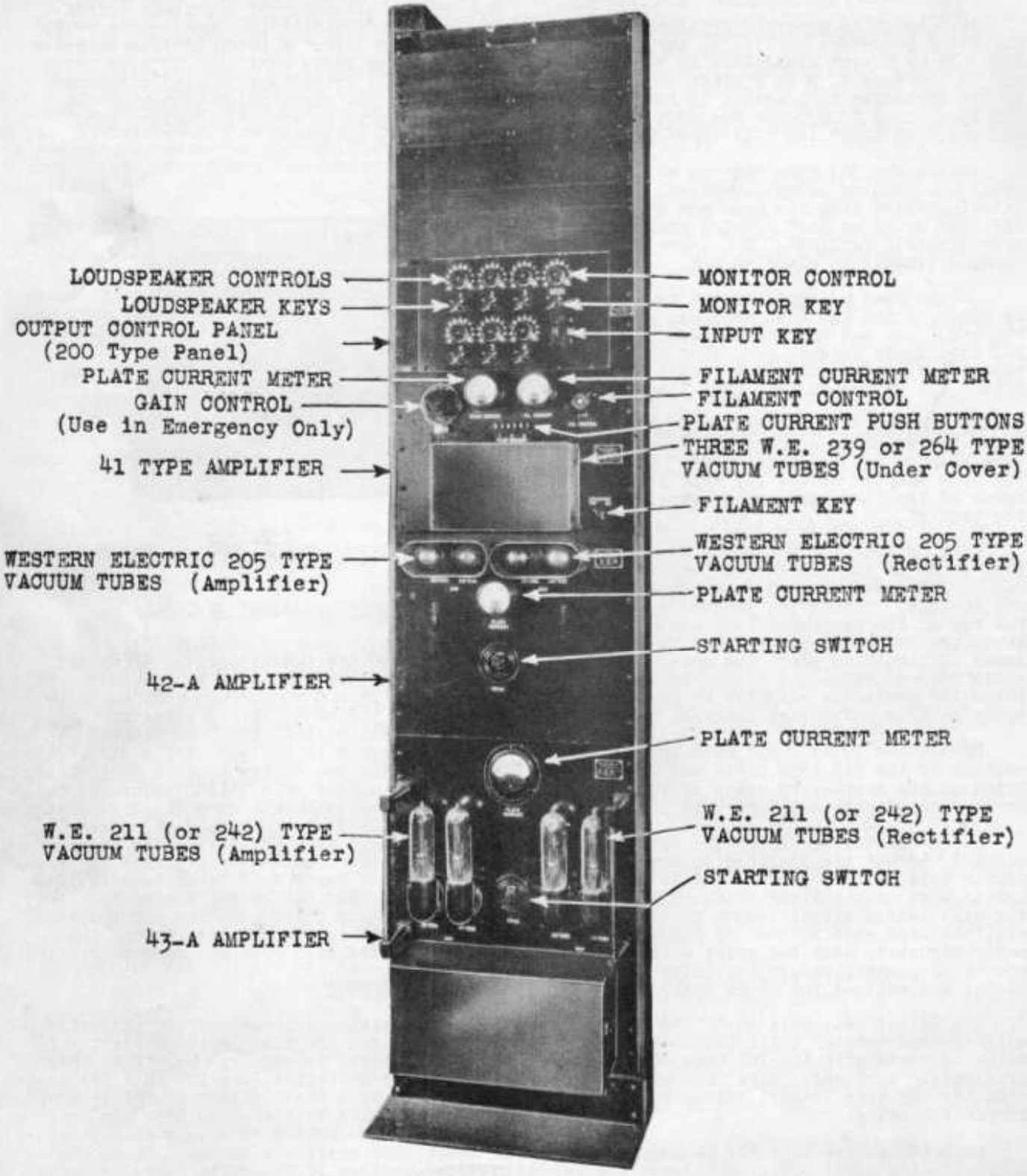


FIG. 10
41, 42, AND 43 TYPE AMPLIFIERS, AND
OUTPUT PANEL, ON RACK

1. GENERAL

The main amplifier serves to amplify the output of the pick-up equipment to a satisfactory level for the operation of the loudspeakers. In the different "U" type Systems, the main amplifier equipment consists of one of the following combinations:

One 46 type Amplifier

One 46 type Amplifier)
One 43 type Amplifier)

One 41 type Amplifier)
One 42 type Amplifier)

One 41 type Amplifier)
One 42 type Amplifier)
One 43 type Amplifier)

One 41 type Amplifier)
One 42 type Amplifier)
Two 43 type Amplifiers)

2. 46 TYPE AMPLIFIER (FIG. 11)

Internal: The 46 type Amplifier has a total of three stages, two preliminary stages using 264 type Vacuum Tubes and a power stage using two 205 type Vacuum Tubes in push-pull. The filaments of the first two stages are in series and require a 12 volt D.C. supply. The filaments of the third stage and the plate circuits of all stages are supplied from a rectifier contained within the amplifier, and which operates from 110V 50-60 cycles A.C. Two additional 205 type Vacuum Tubes are used in the rectifier, which is of the full wave type. Vacuum Tubes which have been used once in the rectifier sockets should not be used thereafter in the amplifier sockets. When the inner door of the amplifier is open, the power circuit is automatically disconnected by means of a safety switch actuated by the door. 2 ampere plug fuses are required in the fuse sockets.

External: The starting switch on the front of the amplifier controls both the 12V and 110V supply circuits. The meters on the left and in the center indicate the plate current in the first and second stages respectively. The meter on the right indicates the total plate current in the two tubes of the first stage when the meter key is pressed. If this key is not pressed, the right meter shows the filament current through the first and second stages. The "FILAMENT CONTROL" rheostat serves for adjusting the filament current in the first and second stages. The "OUTPUT" key switches the sound output on and off. The "MON.VOL.CONTROL" provides means for regulating the loudness of the monitor horn.

Meter Readings: The filament and plate currents for stages 1 and 2 should read:

Filament 300 mils.
Plate 1 - .75 to 1.05 mils.
Plate 2 - 1.20 to 1.50 mils.

The filament current for tubes 3 and 4 in the power stage is not adjustable and is not indicated on any meter; however, the plate current total for these tubes should read between 50 and 65 mils.

3. 41 TYPE AMPLIFIER (FIG. 10)

Internal: This is a three stage amplifier. It feeds into the 42 type Amplifier, from which it receives its plate current supply. The filaments of its three 264 type Vacuum Tubes are in series and require a D.C. supply of 12 volts. No internal adjustment or maintenance on the part of the operator is ordinarily required.

External: Three 264 type Vacuum Tubes are required in the sockets in the compartment on the front of the panel. The filament current is controlled by means of the "STARTING" key and "FIL.CONTROL" rheostat and may be observed on the meter marked "FIL.CURRENT."

Meter Readings: Adjust the filament current to 300 mils for 264 type Vacuum Tubes. The plate supply is connected when the sequence switch of the associated 42 type Amplifier is turned to the "PLATE" position. The plate current meter should read:

1.35 - 1.55 Mils.

when the corresponding "PLATE CURRENT" button is depressed. If a reading is outside of these limits the vacuum tube should be set aside for further test.

Volume Control is provided for on the 41 type Amplifier by means of the potentiometer in the upper left corner of the panel. However, the setting of this potentiometer is fixed at the time of installation and should require no further attention.

4. 42 TYPE AMPLIFIER (FIG. 10)

Internal: This is a single stage push-pull amplifier. Its filament and plate supplies are derived from the 110V 50-60 cycles A.C. supply through a current supply system contained within the amplifier. This current supply system also provides the plate current for the associated 41 type Amplifier. No internal adjustment or maintenance is required.

External: Two 205 type Vacuum Tubes are required in the "AMP." sockets and two 205 type Vacuum Tubes in the "RECT." sockets. The 110V supply is controlled by means of the 110V A.C. snap switch which has three positions, "FIL.", "PLATE" and "OFF". Tubes which have been used once in the rectifier sockets should not be used in the amplifier sockets thereafter. The 42-A Amplifier should be externally fused at 2 amperes.

Meter Readings: The total amplifier plate current should be between 50-65 mils. as indicated by the red mark on the meter. Assuming a line voltage of 105-115, failure of the meter needle to remain on the red mark indicates that one or more of the vacuum tubes should be set aside for test.

5. 43 TYPE AMPLIFIER (FIG. 10)

Internal: This is a single stage amplifier operating from 110V A.C. supply and used either singly or in parallel as the power amplifier in all "U" type Systems except the smallest. Its filament and plate supplies are obtained from the 110V 50-60 cycle A.C. supply through a current supply system contained within the amplifier. No internal adjustment or maintenance is required.

External: The 110V A.C. supply is controlled by sequence switch marked "FIL", "PLATE" and "OFF" which successively closes the filament and plate circuits. Also the 110V circuit is opened whenever the back or front (filter condenser compartment) covers are removed. Each of the four sockets (2 amplifier and 2 rectifier) requires a 211 (or 242) type Vacuum Tube. Tubes which have once been used in the rectifier sockets are thereafter unsuitable for use in the amplifier sockets. When starting, allow the tubes to become hot before advancing the starting switch to the "PLATE" position. Each 43 type Amplifier should be fused externally at 5 amperes.

Meter Readings: The total amplifier plate current should be 105-150 mils. as indicated by the red mark on the plate current meter.

Assuming a line voltage of 105-115, failure of the meter needle to remain on the red mark indicates the need for further test of one or more of the vacuum tubes. It is desirable that the amplifier and rectifier tubes be paired, i.e., that tubes having practically identical characteristics should be selected for the two amplifier sockets and similarly for the two rectifier sockets. This will result in each tube assuming its share of the load. The selection may be made by withdrawing tubes one at a time, and observing the corresponding decrease in the meter reading. If the decrease is the same for either of the two tubes it indicates that their characteristics are the same. BOTH amplifier tubes, or BOTH rectifier tubes should never be removed during operation; such removal should be limited to one at a time.

WIDTH - 19 7/8"
DEPTH - 12"
HEIGHT - 16 1/2"
WEIGHT - 113 LBS.

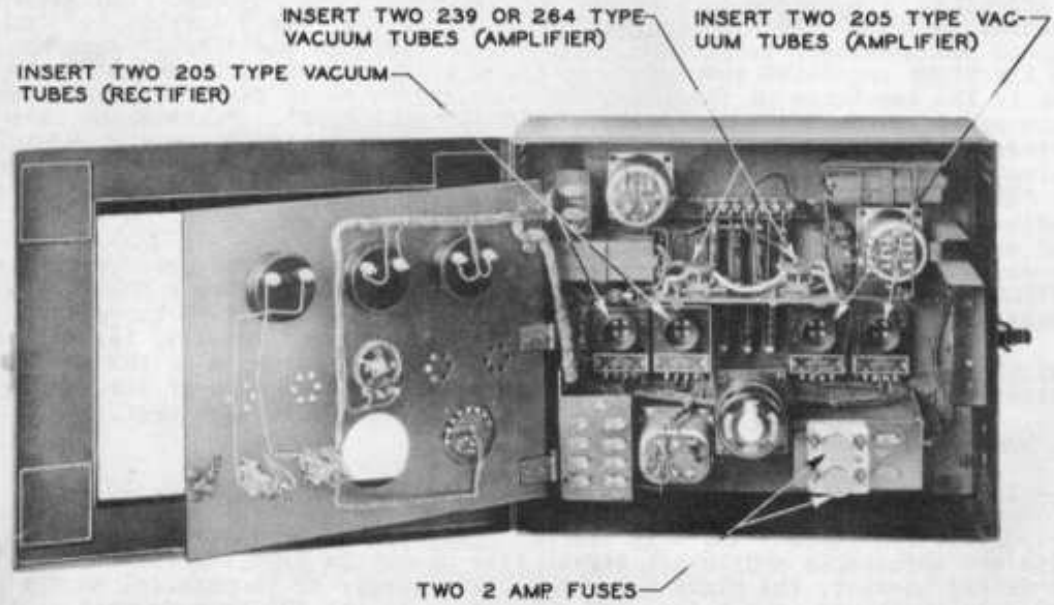


FIG. 11
46 TYPE AMPLIFIER

1. GENERAL

For standard "U" type Systems, the stage loudspeaker equipment consists of one or more 16 or 17 type Horns equipped with #555 Receivers. For Wide Range Systems, a combination of low frequency units (TA-4151 or TA-4153 Loudspeaking Telephones) and high frequency units (597-A Loudspeaking Telephone) on a baffle, is used in addition to the horns, which in this case are used to project the middle frequency range only.

2. HORNS

The 16 (Fig. 12) and 17 type Horns are both of the exponential type, and are similar in efficiency and performance. The 16 type requires two or four 555 Receivers and takes about three feet of stage depth. The 17 type Horn requires one or two receivers, and about five feet of depth. The stage conditions determine the type supplied. The position and direction of the horns is determined at the time of installation, and should not be changed except under the ERPI Engineer's supervision.

3. RECEIVERS, 555 TYPE

These receivers are enclosed dynamic units for use with the 16 and 17 type Horns. They consist essentially of a clamped duralumin diaphragm to which is attached a coil of flat aluminum ribbon (speech coil) located between the pole pieces of an electro-magnet. Each receiver requires 1.5 amps. field current (7 volts at terminals) supplied from the low voltage source. All receivers must be tightly mounted and all connections securely made. Before shipment, the throat of each receiver is provided with a screw cap to protect the diaphragm and keep out dirt. This cap should not be removed until the receiver is to be mounted on a horn, and should be replaced immediately when dismounted. When mounting a receiver, it is essential that the coupling nut on the horn be drawn tightly to prevent air leakage from the throat.

4. LOUDSPEAKERS, 597 TYPE

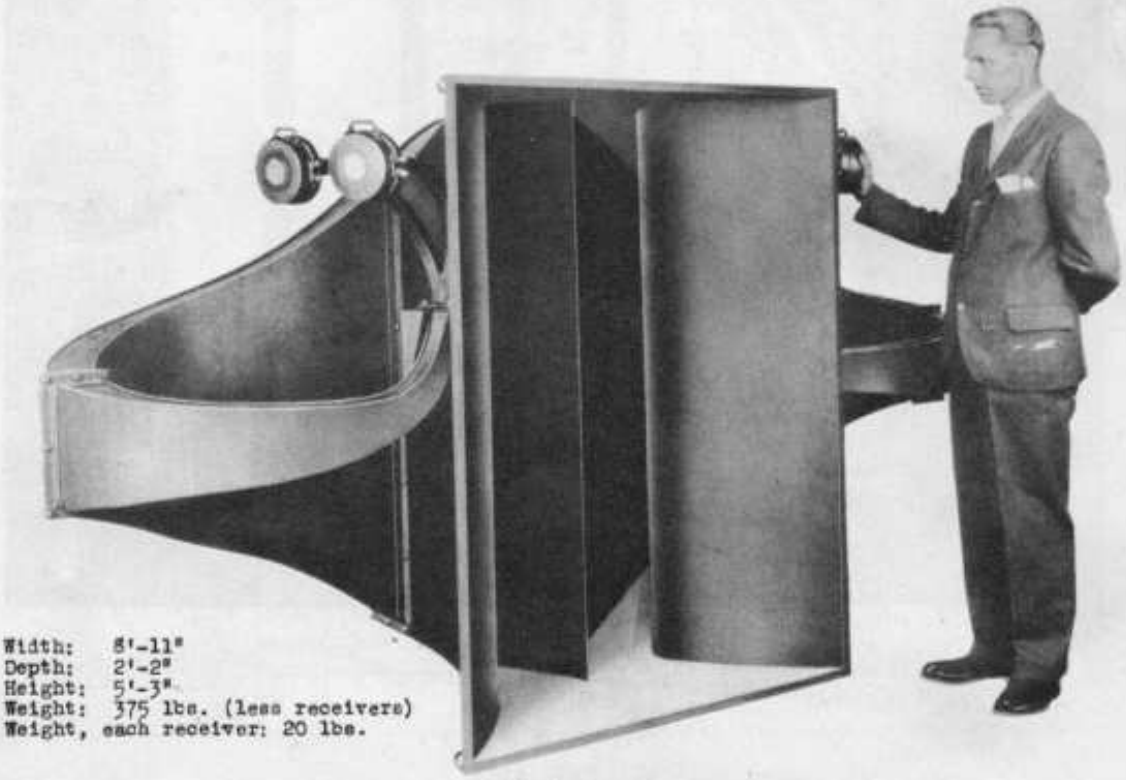
These units (Fig. 13) are of the moving coil type and are similar in construction to the 555 Receivers except that they are smaller and include a short exponential horn. Each unit requires a D.C. supply of 7 volts and 1 ampere for field excitation.

5. LOUDSPEAKERS, TA-4151 and TA-4153 TYPE

These units (Fig. 13) are similar in design to the conventional type of dynamic speaker, and are for operation from supplies of 110V AC (TA-4151, 60 watts), and 110V DC (TA-4153, 35 watts). The TA-4151 Unit has a self-contained rectifier using a 274-A Vacuum Tube.

6. LOUDSPEAKER CONTROLS AND CIRCUITS

The method of connecting the loudspeakers to the main amplifier depends on the amplifier output impedance, and on whether or not the system has been converted to Wide Range. In Wide Range Systems the amplifier output is fed into a network which in turn supplies a separate output to each of the loudspeaker groups. Figure 14 shows several arrangements.



Width: 5'-11"
Depth: 2'-2"
Height: 5'-3"
Weight: 375 lbs. (less receivers)
Weight, each receiver: 20 lbs.

FIG. 12
16 TYPE HORN, EQUIPPED WITH #555 RECEIVERS

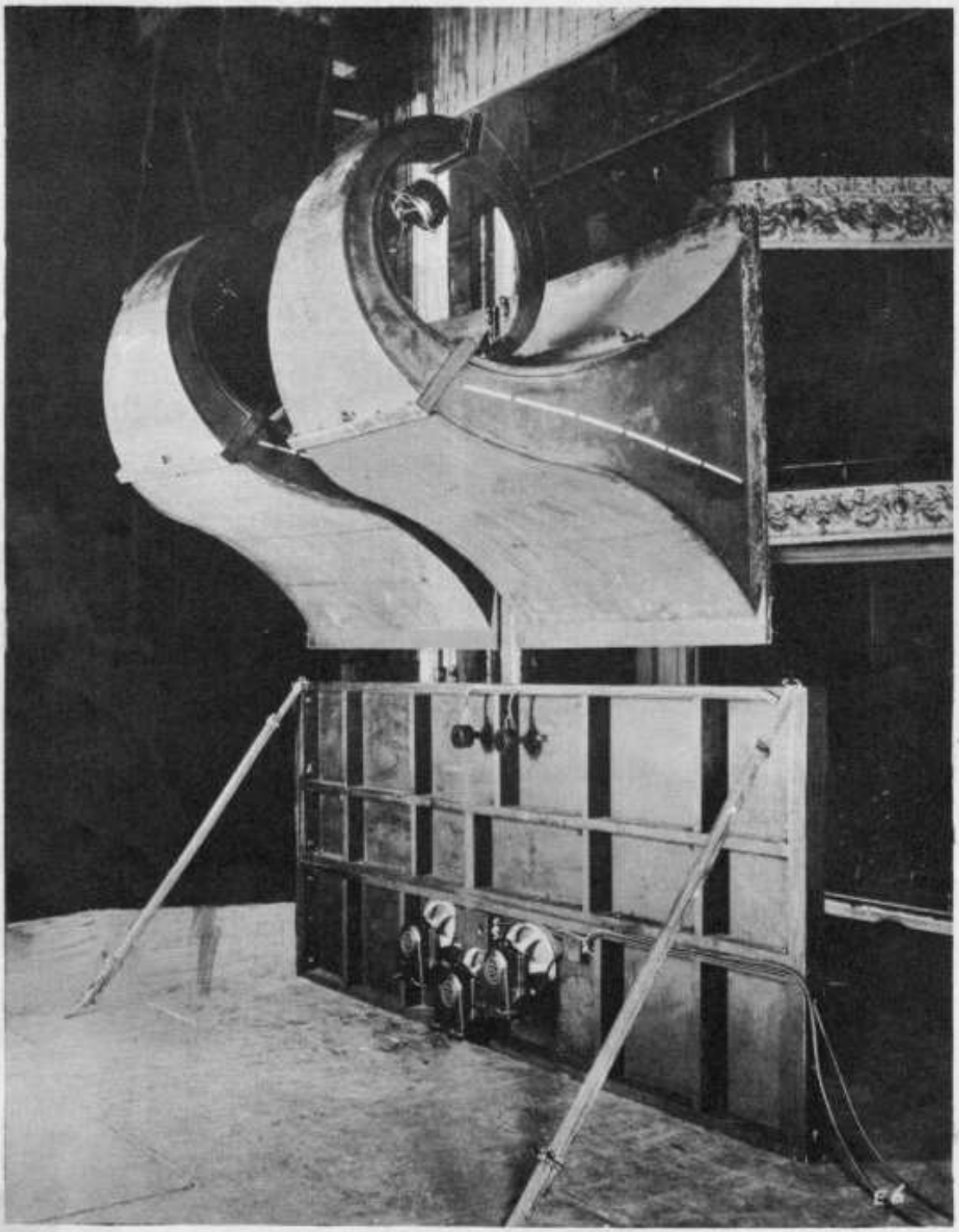


FIG. 13
LOUDSPEAKER INSTALLATION - WIDE RANGE SYSTEM

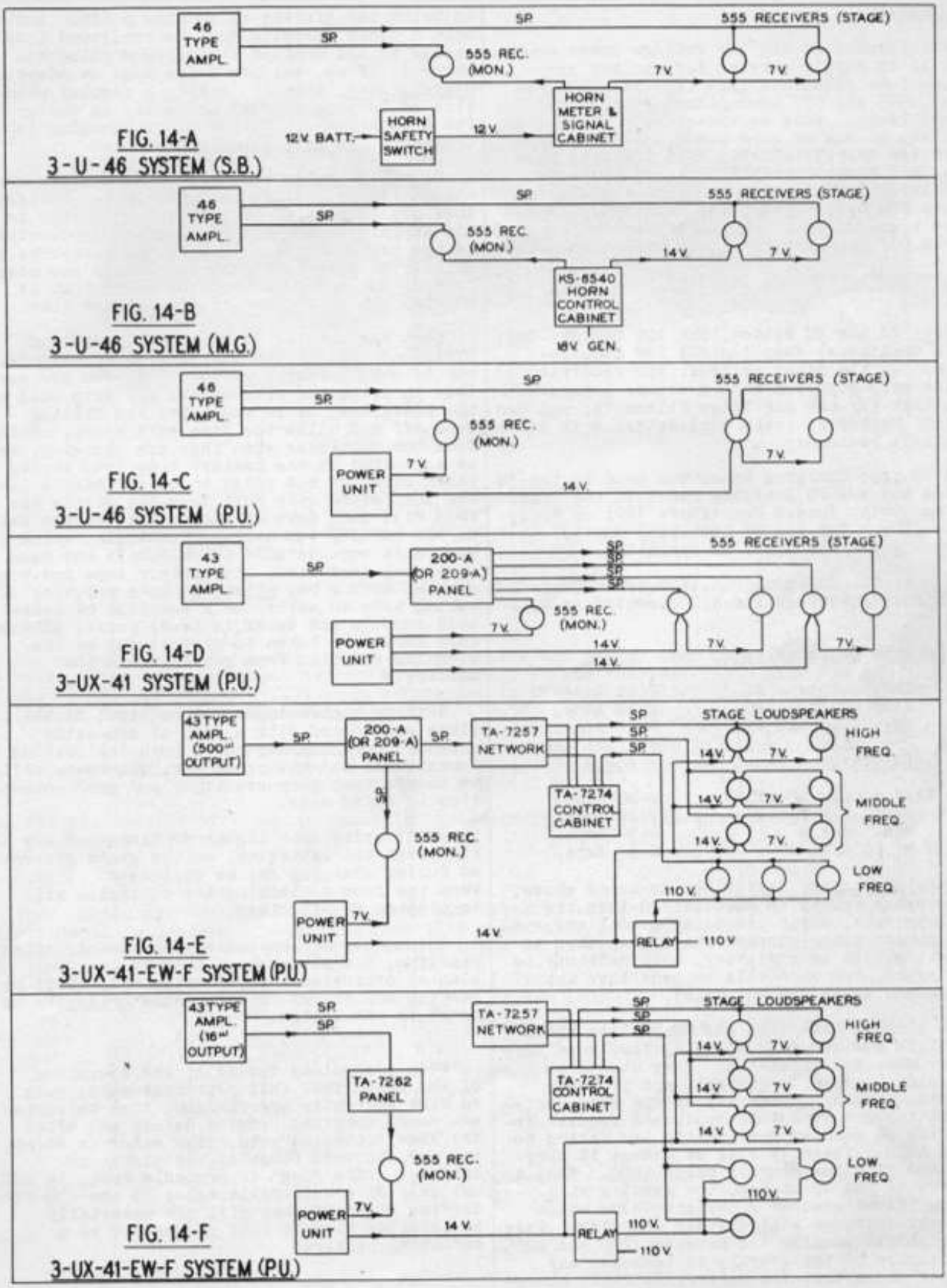


FIG. 14
LOUDSPEAKER CONNECTIONS FOR
VARIOUS COMBINATIONS OF EQUIPMENT

1. GENERAL

The purpose of the low voltage power equipment is to supply current for exciter lamps, vacuum tube filaments (264 type Vacuum Tubes only), 555 and 597 Loudspeaker fields, and signal lamps. This equipment as now supplied consists of one or more power units; storage batteries were originally used for this purpose, and a motor generator (KS-5259) with associated filters were standard for this use before the power units were developed. The three types of power equipment will be covered herein, in the order of their standardization.

2. STORAGE BATTERIES, CHARGING PANEL, AND FUSES

Use: In the 3U System, one 12V Battery Set (with duplicate) supplied all 12V requirements. In the other systems, the receiver fields were supplied from a source separate from that for the amplifier filaments, and two 12 volt batteries (with duplicates) were accordingly necessary.

A 40 type Charging Panel was used in the 3U System and a 1-FD Charging Panel in the other systems, with Tungar Rectifiers (AC) or Rheostats (DC). One set of batteries may be charged while the other is operating.

Fuses: The Charging Panels contain cartridge fuse positions for all circuits as follows:

40 type Charging Panel	Fuses
110V supply - AC	2-10 Amps.
110V supply - DC	2-10 Amps.
+R_1, +R_2, +A, +H	4-6 Amps.

1-FD Charging Panel	Fuses
110V supply AC or DC	2-20 Amps.
- Ampl. & - Horns	2-15 Amps.
+ Mon. & + A	2-3 Amps.
+ R_1, & + R_2	2-6 Amps.

Care of Storage Batteries: As noted above, the storage batteries are divided into two complete sets, which are to be used alternately, one set being charged while the other is operating. In an emergency, both sets may be discharged, but when this happens they should be charged again without delay.

If storage batteries are to realize their full life and cause no trouble, they must have proper care and attention. They should be kept clean, properly charged, and properly watered. Storage batteries of the type recommended for use with this equipment require recharging as soon as the gravity has fallen to about 1210. There is risk of damage if they are used with the gravity below 1200. When a battery is put on charge, the gravity will rise until it reaches a certain value which does not increase with further charging. This point should usually lie between 1270 and 1285. The failure of the gravity to increase any further shows that the battery is fully charged. However, it is not generally necessary to keep on charging until it is evident that the gravity is not increasing; it is sufficient to make a note of the maximum value reached and then in the future merely charge long enough to bring the gravity up to this point. About once a month charging must be continued long enough to see whether the maximum value has changed; if so, the new value must be adopted. Overcharging, that is, making a regular practice of keeping storage batteries on charge for a considerable period after charging is completed, is very injurious to them.

Distilled water only should be used in storage batteries. Since the acid in the battery does not evaporate, it is never necessary to add anything but water to keep the electrolyte at the proper level. Inspect the batteries regularly to ascertain that the plates are always covered but never add so much water that it touches the bottom end of the filling tube.

Keep the outside of the battery dry and clean, not merely for the sake of appearance, but to obtain proper service. If you are careless in using the hydrometer, and drip acid on the batteries, or if you leave the filling caps off and allow the fine acid spray, coming from the batteries when they are charging, to be deposited on the battery tops, you invite short circuits and noise in operation. A little acid mixed with dust from the air in the room will soon form an electrical leakage path on the battery top between terminals, which may cause considerable trouble. In any case once each week clean the battery tops and connectors with a rag moistened in a solution of baking soda in water, or a solution of household ammonia and water in equal parts. Extreme care should be taken to prevent any of the cleaning solution from getting into the battery.

Battery connections must be tight at all times and coated with a film of non-oxide grease. Occasionally check both the outside connections and the cross straps between cells to insure that they are tight and good connection is being made.

Never bring open lights or flames of any kind near the batteries, as the gases generated during charging may be explosive. Also keep the room containing the batteries will ventilated at all times.

Do not use the batteries immediately after charging, but allow about half an hour to elapse; otherwise the batteries will still be gassing and therefore will cause noises to be heard in the system.

Keep a complete record of the operation of the batteries. All pertinent data, such as time batteries are charged, time batteries are used, specific gravity before and after the show, charging rate, time water is added, and any abnormal behavior, should be recorded. This "log" if properly kept, is not only of considerable value to the Service Engineer, but will aid materially in locating trouble that may be due to a defective battery.

3. MOTOR GENERATOR, FILTERS AND FUSES

The KS-5259 Motor Generator (Fig. 15) was furnished for operation on any of the following power supplies:

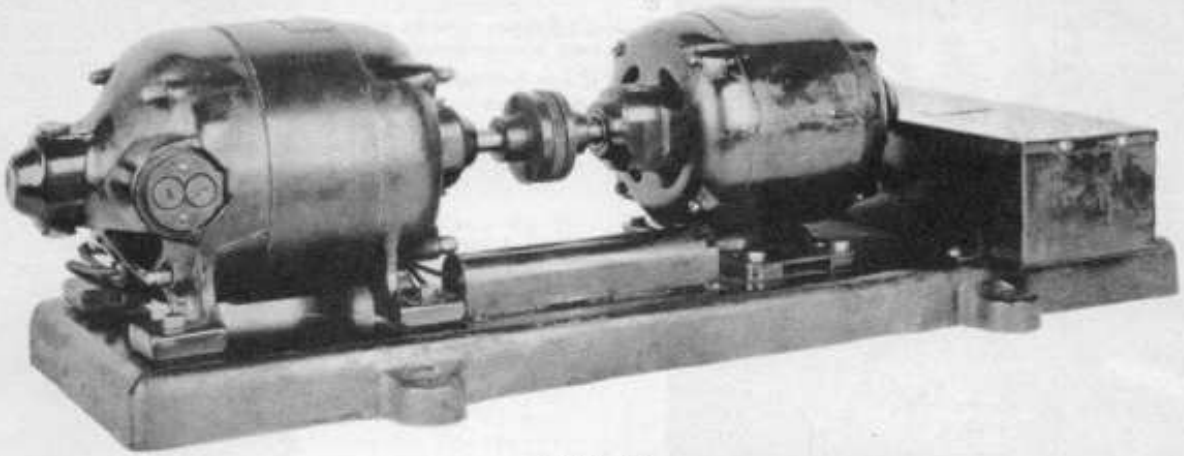


FIG. 15
KS-5259 (18V) MOTOR GENERATOR SET

List #A1: 115V A.C. 60 Cycles, 1 Phase - 15 Amp. Fuses
#A3: 230V A.C. 60 Cycles, 3 Phase - 10 Amp. Fuses
#D8: 115V A.C. 50 Cycles, 1 Phase - 15 Amp. Fuses
#C7: 115V D.C. - - - - 15 Amp. Fuses

The fuses are located in the safety switch associated with the sets. This switch is the only starting equipment required for the A1, A3, and D8 Sets, but the C7 Set (DC) requires a Starting Box.

The motor is of 1 H.P. rating, and the generator has a full load capacity of 21 amperes at 18 volts. The 18 volt output is supplied directly to the receiver field circuits and the 18V signal lamps. It requires filtering before use in the exciter lamp and vacuum tube filament circuits. This is accomplished by the

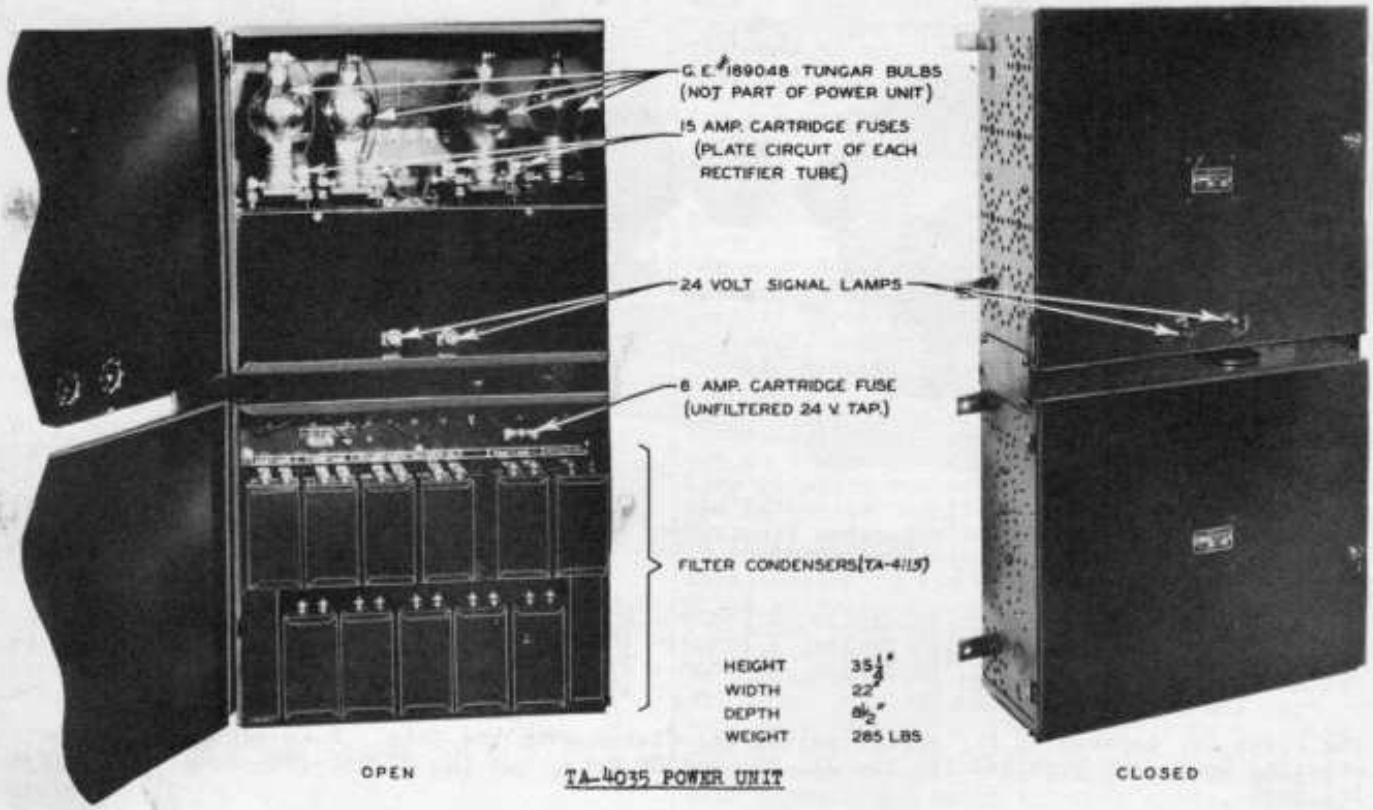
701-A Filter, for two exciter lamps and two 49 type Amplifier Filament circuits.
702-A Filter, for one or two 41 type Amplifier filament circuits.
702-B Filter, for announcing microphone circuit.

The filters consist of retardation coils, condensers and resistances enclosed in metal boxes, and require no attention.

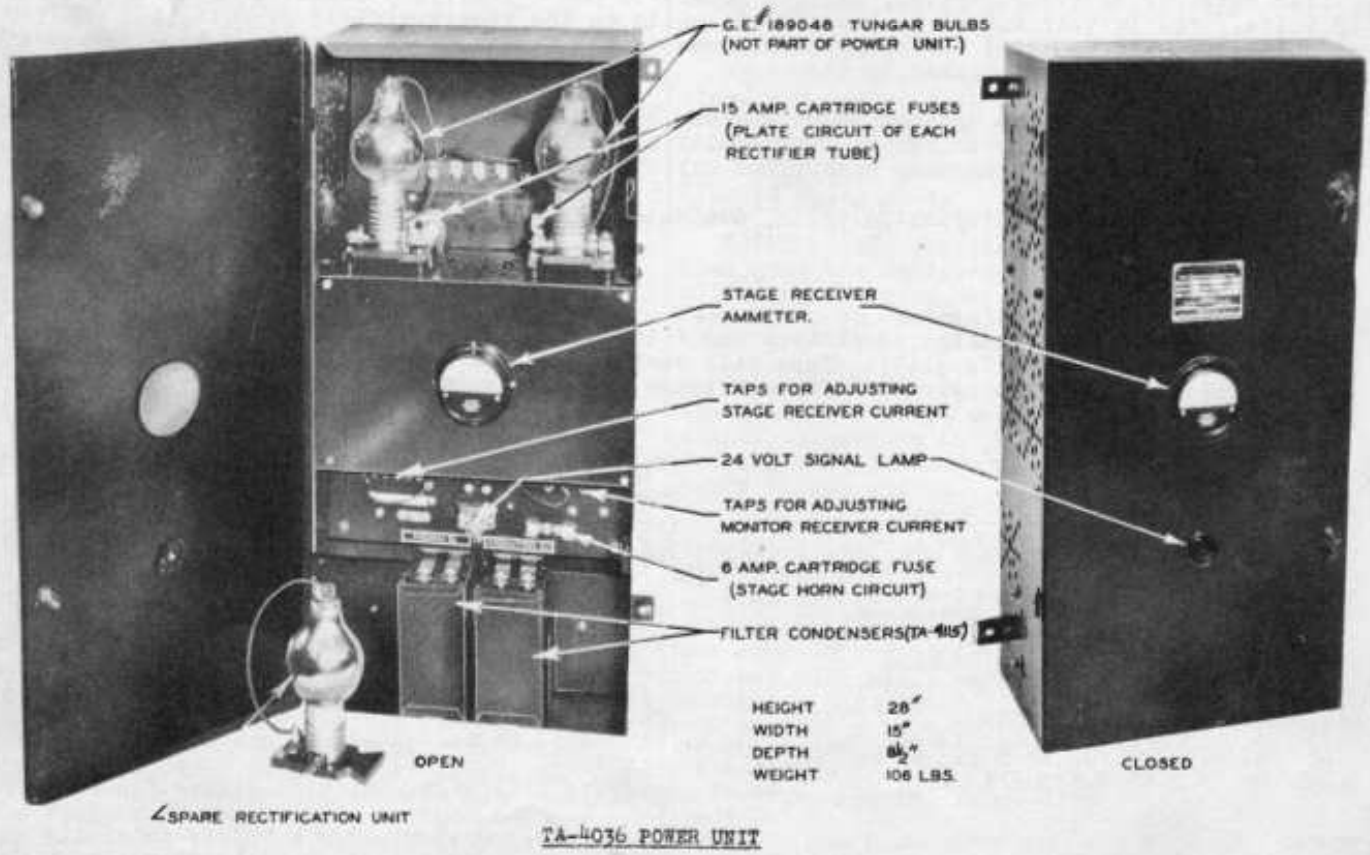
4. POWER UNITS

These units are combination rectifiers and filters, using Tungar #189048 Bulbs, and dry electrolytic condensers (TA-4115). They will operate on A.C. supplies of 100-125 volts, 50-62½ cycles. There are several different types in use, as shown in the following table, and in Figure 16.

Power Unit		Capacity	Max. Line Drain (Nameplate Data)	Size & Weight	No. of #189048 Tungar Bulbs	TA-4115 Condensers	Fuses
TA-4033 &) TA-4033-A)	1 1	Exec. Lamp, 4 Amps., 12V. PEC Ampl., 0.30 Amps., 14V. Unfiltered Oct., 1.0 Amps., 24V.	2.8 Amps. 280 Watts	28"Hx15"Wx 8-1/2"D 122 lbs.	2	4	2, 15A
TA-4035 &) TA-4035-A)	2 2 1 1	Exc. Lamps, 4 Amps. ea., 12V. PEC Ampls., 0.30 Amp. ea., 14V. B-B Ampl., 2.5 Amps., 12V., or, 41 or 46 type Ampl., 0.30 Amp., 14V. Signal Oct., 2.0 Amps., 24V. Unfiltered Oct. 1.0 Amp., 24V.	7 Amps. 720 Watts	35-1/4"Hx22"W x8-1/2"D - 235 lbs.	4	11	4, 15A 1, 6A
TA-4036 &) TA-4036-A)	1 1	Stage Rec. Field Supply Oct., 4.5 Amps., 18V. Monitor Rec., 1.5 Amps. 7V. Unfiltered Oct., 1.0 Amp., 24V.	3.2 Amps. 330 Watts	28"Hx15"Wx 8-1/2"D 106 lbs.	2	2	2, 15A 1, 6A
TA-4038	1	B-B Ampl., 2.5 Amps., 12V. Unfiltered Oct., 1.0 Amp., 24V.	2.5 Amps. 250 Watts	22"Hx15"Wx 8-1/2"D 100 lbs.	2	3	2, 15A
TA-4144		Rec. Fld. Supply Oct., 8 Amps., 32V. Unfiltered Oct., 1.0 Amp., 32V.	5 Amps. 500 Watts	32"Hx14"Wx6"D 125 lbs.	2	2	2, 15A 1, 6A or 10A
TA-7276	2 2 1	Exc. Lamps., 2 Amps. ea., 12V. PEC Ampls., 0.30 Amps. ea., 12V. 41 or 46 Ampl., 0.30 Amps. ea., 12V. Rec.Fld.Exc.Oct., 4.5 Amps., 24V. Unfiltered Oct., 1.0 Amp., 24V.	5.2 Amps. 530 Watts	36"Hx16"Wx9"D 175 lbs.	2	6	2, 15A 1, 6A



TA-4035 POWER UNIT



TA-4036 POWER UNIT

FIG. 16
TA-4035 AND TA-4036 POWER UNITS

1. GENERAL

The operating routine varies considerably for the various combinations of equipment classified under "U" type Systems. The type of low voltage supply, the conversion of the system to Wide Range, etc., determine the routine to be followed, and only the general requirements will be given here.

2. STARTING

First, turn on the low voltage power equipment (power units, motor generator, or storage batteries), and adjust rheostats and switches in low voltage circuits for normal current values. If the auditorium is occupied, turn off the horn panel keys (or output key on 46 type Amplifier) before testing on the monitor. Then close the amplifier power safety switch, and turn the starting switches on the 42 and 43 type Amplifiers to "Fil" (or to "Operate", in the case of the 46 type Amplifier). Allow the 205 and 211 (or 242) type Tubes to become warm before proceeding; then turn 42 and 43 type Amplifier starting switches to "Plate". Check all meter readings, and readjust, if necessary. Also check exciter lamps for proper focus. Turn the fader to its normal setting and test each machine by intercepting the light beam to the photoelectric cell with a card.

3. THREADING FILM, AND SETTING UP DISC

Film Reproduction: Set the volume control (fader) at zero or at the proper operating position for the other reproducer set, if being used. Then proceed as follows:-

(1) On Projector Mechanism
Place aperture mask in position.
Place framing lever in central position. Move projector mechanism by turning the motor handwheel so that shutter blade is uppermost, lens is open and intermittent has just ceased moving.
(2) Thread projector and Sound Unit as specified in Figure 17.
(3) Release sound gate tension pad after film has been properly placed on the sound unit sprocket, so that it bears on film and holds it close against aperture plate in front of lens tube.
(4) Run off as much film as necessary to bring end of "Part No" leader approximately up to projector aperture.

Disc Reproduction: To set up the record and film ready for operation, first set the volume control (fader) at zero, or at the proper operating position for the other reproducer set, if being used.

(1) See that reproducer is in its rest. Install new needle.
(2) Select film and record to be used, and be sure to check number on record against number on film. Mark record on label to show number of times used, counting this run.
(3) On projector, place framing lever in central position. Move projector mechanism by turning the motor handwheel so that shutter cut-off blade is uppermost, lens is open, and intermittent has just ceased moving. Thread projector and sound unit with film in same manner as just described for film reproduction, placing frame marked "START" in front of picture aperture.
(4) Set record on turntable, and set reproducer needle at starting point of record.
(5) Turn over mechanism by handwheel until turntable and record have revolved about half a turn. See that needle tracks properly and film travels free.
(6) On synchronized feature pictures, by starting and stopping motor with starting switch, run off as much film as necessary to bring end of "Part No" leader approximately up to projector aperture.

4. FILM INSPECTION AND REHEARSAL

Procedure: This involves careful inspection of the film and records to insure against breakage and dirty condition, and a trial operation to locate change-over points and to ascertain proper volume control settings for recording on cue card. The House Manager should attend rehearsals and should have a means of communicating with the projection booth so as to advise the projectionist on changes in the volume settings.

Care of Film: Dirt, dust, oil, finger marks, scratches or sprocket hole cracks on the sound track of the film will cause noisy sound reproduction.

Sprocket hole cracks can result from operating the film under conditions of improper tension, worn sprockets, poorly aligned guides or bad splicing. Such cracks cannot be removed and therefore require that the projector mechanism through which they are run, be particularly clean and well adjusted to avoid further damage or trouble.

Scratches increase the abrasiveness of the film against the tension pads and sprockets and encourage accumulation of emulsion or dirt on such parts. Lateral scratches on the sound track may cause a sharp report from the horns and in such event can be painted out in the manner described for splices.

Dirt, dust, oil and finger marks on the film track or disc record, can noticeably impair the quality of sound reproduction and should therefore be removed.

The film should be kept in first class condition, and the parts of the mechanism coming in contact with the film should be cleaned at least once every day as directed.

Splicing Sound Film: In case film carrying a sound track becomes broken, cut out as few frames as possible when making the splice. A break in the sound track is usually more noticeable to the audience than a break in the picture. However, do not go to the extreme of saving weak film that will cause trouble later.

A plain splice, no matter how carefully made, will cause a click to be heard from the sound projector as it passes through the reproducer set sound gate because the two edges and the overlap disturb the uniformity of the sound track and produce the same effect as though noises actually had been recorded on

Was a Special Laquer Blask - No Patch would not make noise

Put that on with a brush

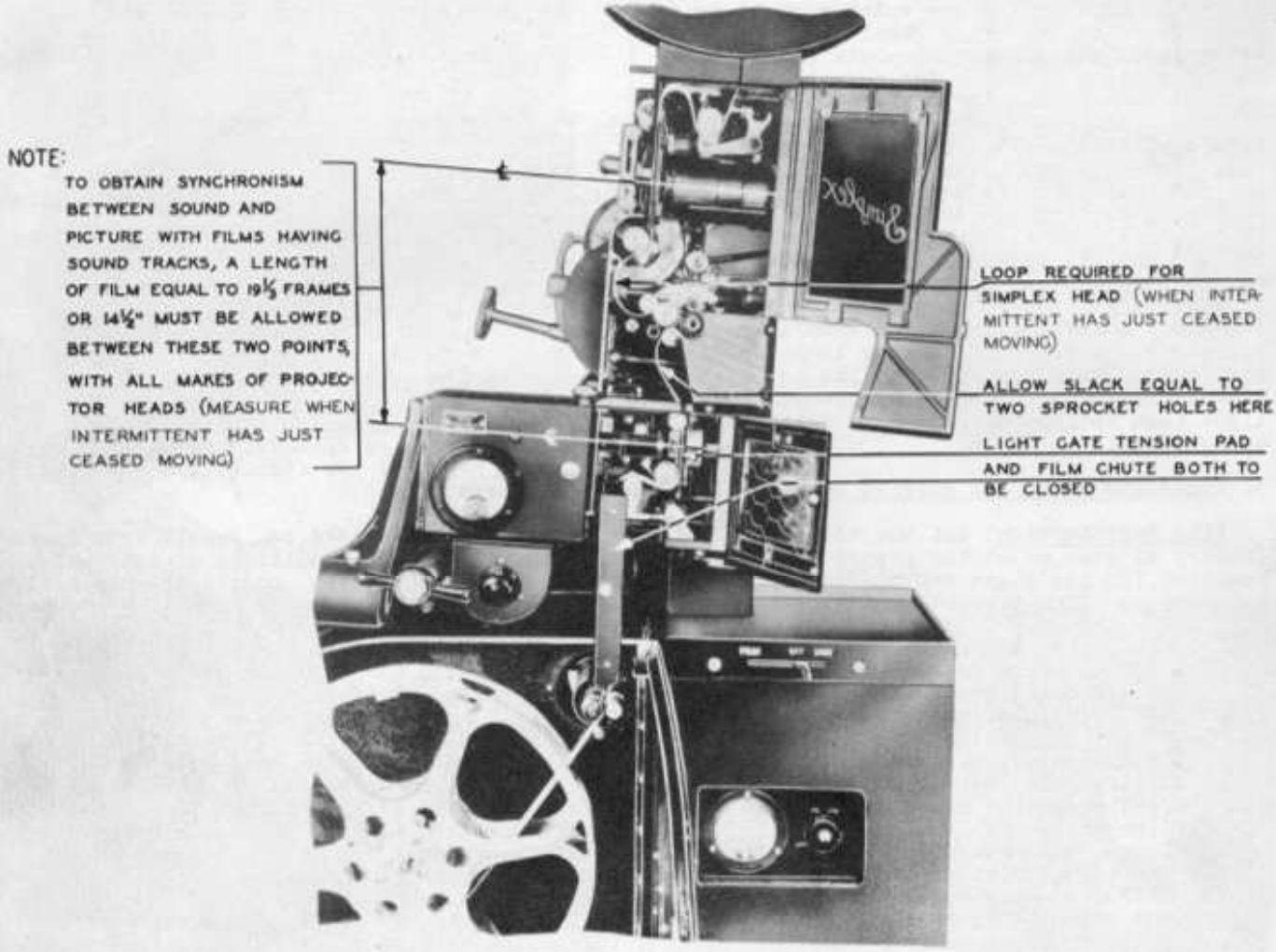


FIG. 17
PROJECTOR AND REPRODUCER SET - THREADING

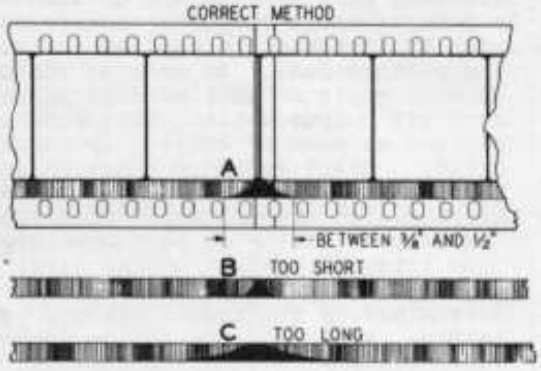


FIG. 18
SPLICING SOUND FILM

the track. In dealing with film of this type therefore, first make a splice in the usual manner and then paint over this splice in black, as shown at "A" on Figure 18. The painted mark on the sound track should be roughly triangular in shape, with a blunted apex, and between 3/8" and 1/2" wide at the base. If the splice is painted in this manner it will be almost inaudible when passing through the reproducing attachment, as the change in the light intensity which it causes will be at a low frequency, below the audible range. If the mark is made too short, as shown at "B", the click will be very pronounced; if it is made too long, as at "C", there will not be a click but there will be a noticeable pause in the sound owing to so much of the sound track being obliterated.

For opaqueing splices, the use of Zapon Concentrated Black Lacquer #2002-2 is recommended. It is made by the Zapon Company, Stamford, Connecticut. When a thinner is necessary, Zapon thinner #20 is recommended. The lacquer should be applied to the shiny, or celluloid side of the film and not to the emulsion side. It dries almost instantaneously, adheres tightly and is more satisfactory than India ink or other substances. If for any reason it should become necessary to remove it, a rag soaked in lacquer thinner will be effective.

Splices in the negative in making up subjects sent out by the producers are taken care of in the printing and may be observed by the triangular marks along the sound track near changes of scene.

Splicing Film Synchronized with Sound on Disc: In case film which is synchronized with sound on disc record becomes broken it is necessary to splice in a length of blank film equal to the length of film removed due to the break in order to prevent the sound from getting out of synchronism with the picture. In any case, cut out as few frames as possible in making the splice.

5. RUNNING THE SHOW

General Comments: Before listing the steps to be followed in running the show, some general points will be touched on. Keep the volume control cabinet (fader) at zero when the auditorium is open except when testing with the stage loudspeakers, or when the motor is up to speed and film is being run for exhibition. This is necessary in order to avoid sound track noise, and noise from the reproducer while the film is being threaded, from being heard in the auditorium. It will also prevent voice or music in distorted form being heard in the auditorium when the motor is speeding up or slowing down. Under such conditions the sound is changing pitch and a very undesirable effect is produced. Before running any film, be sure that it has been put in as good condition as possible and that mechanisms are clean and in proper adjustment.

Volume Control: At all times special care must be taken to maintain the sound at the right degree of loudness. There is usually a tendency to make the sound too loud; this should be avoided as it causes the voices to sound unnatural and gives the performance a mechanical effect. It also emphasizes the ground noise during the interval between speech or music, and brings discomfort to many members of the audience. The ideal volume of sound is that which is just sufficient to enable a person with normal hearing to understand the reproduced speech clearly, without effort. A contributing cause of excessive loudness is the habit of trying to regulate sound volume by starting with the volume control at a higher setting than necessary, and then lowering it until the volume is thought to be satisfactory. This procedure is wrong, because the excessive initial volume deadens the ear and causes it to demand a volume that is really too high. The right way to regulate volume is to start with the volume control at a low setting, and then increase it until the sound reaches the proper volume as defined above. Another thing that prevents entirely satisfactory reproduction is the tendency to adjust sound volume to meet the requirements of the poorest seats in the house, instead of the best. If the theatre has structural features that make it hard to obtain proper volume at certain spots, such as the rear of the balcony, then if the volume is made sufficient for such location it will be excessive in the better locations. It is necessary in such cases to make a resonable compromise and keep the loudness such that agreeable volume is obtained for the majority of seats. In the foregoing discussion it is assumed, of course, that the house is reasonably quiet. First class results cannot be obtained if there is noise from ventilating systems, etc., or if the audience does not cooperate in maintaining quiet. A member of the staff designated by the management should remain in the auditorium during the performance, so that the projectionist may have immediate and proper notification in case any part of the show is not being presented as it should be. This observer should be competent to judge the quality of reproduction, synchronism, etc., and he should have a means of communicating with the projectionist, and be given the responsibility of notifying the latter immediately if the performance is not satisfactory. His hearing must of course, be normal, and as pointed out above he should make his observation in parts of the house where listening conditions are average. It is important to note that when a house has a full audience, more electrical energy must be supplied to the stage loudspeakers than when the house has only a small audience, if the loudness of the sound is to remain the same. This

is because a certain proportion of the sound is absorbed by the bodies and clothing of the audience. With a large audience, more sound is absorbed than would otherwise be the case. At times when the size of the audience is changing, the observer must, therefore, watch this point. One or two steps on the volume control are usually sufficient to compensate for the difference between having the house empty or with a very small audience, and having it full. The volume control setting determined at rehearsal is, of course, the empty house setting.

Procedure: The procedure in running sound films, is as follows:-

(1) Follow out starting procedure, and set up first two synchronized reels in the two machines to be used, as described in preceding paragraphs.
(2) Strike arc on first projector in usual manner.
(3) When lamp is in operating condition and show is ready to proceed start motor on first projector.
(4) When motor is up to speed open douser.
(5) Turn volume control cabinet (fader) to number one machine just before voice or music begins.
Rehearsal is needed to insure that the output switch will be operated at exactly the right time. If operated too late the opening words or notes will, of course, be missed. If too soon, the sound track noise will be emphasized by being heard by itself for a few seconds.
(6) In running feature pictures, observe operation by listening to monitor and by watching picture cues. As soon as voice or music from outgoing machine is finished, turn volume control (fader) from outgoing machine to incoming machine, so that there will be no break in the sound (this needs rehearsing). Stop outgoing machine, kill arc and set up third reel.
(7) In running short subjects observe operation by listening to monitor and watching picture cues. As soon as the last note of music or last word is heard, turn off output switch, then fade out picture as soon as subject matter requires. Start second machine in same manner as already described for first machine. The proper instant for starting second machine so as to get right time interval between end of first subject and beginning of second must be determined by rehearsal. Stop outgoing machine, kill arc, and set up for next reel of film.
(8) When sound presentations are finished, shut down amplifier and power equipment. Rewind films and examine for defects.
(9) After running each reel of sound film wipe off sound aperture and film tracks of aperture plate and tension pad in reproducing attachment with a soft white cloth, so as to guard against possibility of dirt accumulating and obstructing light beam or scratching film.

6. SHUTTING DOWN PROCEDURE

Proceed as follows and always in the order given here:

(1) Turn off output key on 46 type Amplifier, or the individual horn switches on the 200 type or 209 type Panel.
(2) If using motor generator, open motor switch.
(3) Open Amplifier power safety switch.
(4) Turn starting switches on 42 and 43 type Amplifiers (if any), to "OFF".
(5) If using storage batteries, first open horn safety switch; next open battery switch. Never open the battery switch first as the resulting inductive effects might cause circuit damage.

NOTE: 1

NOTE: 2

4-C OR TA-7280 APERTURE

3A PHOTOELECTRIC CELL

EXCITER LAMP

1 TYPE SOUND UNIT

700 TYPE APPARATUS UNIT

49 TYPE AMPLIFIER

LAMP HOUSE ADAPTER TA-7007

WESTERN ELECTRIC 264 TYPE VACUUM TUBES

711-B DRIVE

701-B APPARATUS UNIT

1001-A BASE

OPTICAL CENTER OF FILM PROJECTOR

707-A OR B DRIVE

708-A DRIVE

705-A SHAFT

104-A REPRODUCER

708-A SHAFT

1003-A TURNTABLE

78 LINK CHAIN PER DET. 7-A ESO-320857

TA-4148 COUPLING

TABLE "A"

PROJECTOR	DIMENSION "Y"
SIMPLEX	7'-0"
POWERS	7'-1"
MOTIOGRAPH	6'-9"
SUPERSIMPLEX	7'-0"
FILLIS	6'-9"

WESTERN ELECTRIC REPRODUCER SET

FIGURE 5

1. GENERAL

Procedure and Analysis: Whenever trouble occurs, endeavor to locate and remedy it, by following the instructions given here, in order that you may conduct the show with the minimum interruption. Familarize yourself with the information so that if occasion arises to communicate with the ERPI representative, you will be able to discuss it in a helpful way.

Power Failure: In the event of power failure during the show, turn off the stage horns and shut down the entire system immediately. This will keep disturbing noises from the audience and protect the equipment against the resumption of power. However, leave the power safety switch "on" so that the signal lamp will indicate when the power is resumed. Be sure that one of the main fuses in the building has not blown, as such fuses are often located in basements or places remote from the projection room. It is well to keep spare fuses of the proper capacity at all power fuse locations. In buildings supplied with three phase power, the lights, motors, and sound equipment may be connected to separate phases; therefore, the projectionist should be familiar with the position, size, and purpose of all power fuses associated with the projection room circuits. When the service is restored, turn on the system switches in their normal sequence.

Repair: While you are expected to do simple repair work on the apparatus, such as soldering broken connections, replacing defective tubes and fuses, tightening loose parts, etc., you should not experiment with the equipment, because to do so is dangerous and may render the system inoperative.

2. NO SOUND REPRODUCTION

Procedure to Locate Trouble: Whenever trouble occurs which results in "NO SOUND", attempt to locate the source by systematic analysis. First be sure that the volume control is properly set, that the sound gate is closed, that the sound aperture is clear of film chips or dirt, and that the "Film-Disc" transfer switch is in the proper position. Then check all other switches, and rheostats to assure their proper position, check all meters to assure proper reading, and check all signal lamps to assure the continuity of the power circuit. Assuming that all switches are in the proper position, refer to Figs. 19 & 20 (depending upon whether batteries, motor generator, or power units are used for the low voltage power supply) for probable defects indicated by zero meter readings.

If all meters and signal lamps are normal and all switches are in the proper position, check for sound from the various sources, i.e., film from all projectors, disc (if used) from all projectors, non-synchronous equipment, and announcing. If sound is obtained from all sources except one disc, the trouble may be due to a defective disc reproducer, to a loose connection or short circuit at the connecting block or the 700 type Apparatus Unit, or to a defective "Film-Disc" transfer switch. If sound is obtained from all sources except from one film, the trouble may be due to the 1-Ampere 90 Volt fuse in the dry battery box being blown, to a defective photoelectric cell, to a loose connection or a short circuit in the film amplifier or 700 type Apparatus Unit, or to a defective "Film-Disc" transfer switch. If sound is not obtained from film or disc of one projector, but from all other sources, the trouble is probably due to a defect in the volume control cabinet (fader) or the 700 type Apparatus Unit of the projector affected.

If sound is obtained from the stage loudspeakers but not from the monitor horn inspect the monitor horn field fuse in the Battery Charging Panel (SB Systems) or in the cutout box mounted near the KS-6540 Control Cabinet (MG Systems). If sound is obtained from the monitor horn but not from the stage loudspeakers, the trouble may be due to a defective output switch, a loose connection in the stage horn speech leads at the amplifier, at the "B" Box, or at the receivers, or an open circuit in the speech windings of all stage receivers. If the above procedure does not reveal the source of trouble and all conditions appear normal, the indications are that a break or short circuit exists somewhere in the sound circuit. In this case, run a film or disc and listen in with head set along the sound circuit, starting at the film amplifier or the disc reproducer and working along toward the loudspeakers until the location of the fault is shown by coming to a point beyond which nothing is heard.

3. NOISY REPRODUCTION

Explanation and Classification: If noisy reproduction should occur, determine whether the noise is a crackle, a scratchiness or a hum and then endeavor to locate its source by checking with the proper one of the following lists of causes. Some kinds of noise can be identified readily as coming from a definite source, such as the sound gate, while others like faint hums or squeals may be difficult to explain without careful study. Low fluctuating noises called "flutters" are liable to give the impression of poor quality and mislead your analysis of a difficulty. "Flutters" usually result from an improper mechanical adjustment of the mechanism whereas poor quality is liable to be caused by incorrect current values or electrically defective equipment.

If a visual inspection does not reveal the source of the noise use a head set to listen in along the sound circuit, starting at the receivers and working along toward the reproducers until the location of the fault is shown by coming to a point where the noise is not heard.

Crackles, rattles, or scratchiness may be due to any of the following:

Film Sprocket holes or frame lines overlapping sound gate.
Dirt at light gate or pressure pad.
Dirty or scratched film sound track.
Intermittent ground on P.E.C. lead.
Defective P.E.C. 90 Volt Batteries.
Defective P.E.C. 90 Volt battery fuse.

FIG. 19

(FOR SYSTEMS USING STORAGE BATTERIES)

TROUBLES INDICATED BY ZERO METER READING

METER	INDICATION	PROBABLE TROUBLE
Exciter Lamp Meters on Sound Units.	No reading on one but normal on the other.	Exciter lamp burned out. 6 Ampere Fuse, R-1 or R-2, in battery panel blown. Defective Rheostat. Defective film-disc switch. Loose connection at sound unit, 700 type Apparatus Unit, or battery panel.
	No reading on either.	Loose connection or short circuit in battery panel. Battery switches not in proper position.
Filament meter on 49 type Amplifiers.	No reading on one but normal on the other.	Filament of one of the amplifier tubes open. 6 Ampere fuse, R-1 or R-2, in battery panel blown. Defective Rheostat. Defective film-disc switch. Loose connection at tube socket, 700 type Apparatus Unit, or battery panel.
	No reading on either.	Loose connection or short circuit in battery panel. Battery switches not in proper position.
Filament meter on 41 type Amplifier.	No reading, but exciter lamp and 49 type Amplifier meters normal.	Filament of one of the amplifier tubes open. 1 ampere fuse, A+, in battery panel blown. Defective filament rheostat. Defective filament "ON"-"OFF" switch. Loose connections at amplifier tube sockets, amplifier 12-volt terminals or battery panel.
Plate meter on 41 type Amplifier.	No reading, but filament meter and meter on 42 type Amplifier normal.	Defective plate meter key. Loose connection at tube socket or at 390 volt terminal on the 41 or 42 type Amplifier.
Plate meter on 42 type Amplifier.	No reading.	Fuse in power supply circuit blown. Plate transformer open. Back cover not closed tightly. Defective plate-filament switch.
Plate meter on 43 type Amplifier.	No reading.	Fuse in power supply circuit blown. Plate transformer open. Cover on front or back not closed tightly. Defective plate-filament switch.
Filament meter on 46 type Amplifier.	No reading, but exciter lamp and 49 type Amplifier meters normal.	Filament of one of the tubes, V-1 or V-2, open. 1 Ampere fuse, A+, in battery panel blown. Defective filament rheostat. Defective filament plate switch. Loose connection at amplifier tube sockets, amplifier 12-volt terminals, or battery panel.
Plate meters M-1, M-2 and M-3 on 46 type Amplifier.	No reading, but filament meter normal.	Fuse in power supply circuit or 110-volt plug fuse, F-1 or F-2, in amplifier blown. Plate transformer open. Front not closed tightly. Defective "OPERATE" switch.
Meter on horn meter and signal cabinet.	No reading.	6 Ampere fuse, H+, in battery panel blown. Defective field rheostat in Horn meter and signal cabinet. Field of stage receivers open. Loose connection at stage receivers, "B" Box, horn meter and signal cabinet or battery panel. Battery panel switches in wrong position.

FIG. 20

(FOR SYSTEMS USING 18-VOLT MOTOR GENERATOR, OR POWER UNITS)

TROUBLES INDICATED BY ZERO METER READING

METER	INDICATION	PROBABLE TROUBLE
Exciter Lamp meters on Sound Units.	No reading on one, but normal on the other.	Exciter lamp burned out. Defective Rheostat. Defective film-disc switch. Loose connection at Sound Unit, 700 type Apparatus Unit, or 701 type Filter.
	No reading on either.	Motor Generator or Power Unit not operating due to power failure or blown fuse. Motor Generator or Power Unit fails to generate. Loose connections or short circuit at Motor Generator, Filters or Power Unit
Filament meter on 49 type Amplifiers.	No reading on one, but normal on the other.	Filament of one of the Amplifier tubes open. Defective Rheostat. Defective film-disc switch. Loose connection at tube sockets, 700 type Apparatus Unit, or 701 type Filter.
	No reading on either.	Motor Generator or Power Unit not operating due to power failure or blown fuse. Generator or Power Unit fails to operate. Loose connections or short circuit at Motor Generator, Filters or Power Unit.
Filament meter on 41 type Amplifier.	No reading, but exciter lamp and 49 type Amplifier meters normal.	Filament of one of the amplifier tubes open. Defective Filament Rheostat. Defective Filament "ON"-"OFF" Key. Loose connection at amplifier tube sockets, amplifier 12-volt terminals, 702 type Filter, or Power Unit.
Plate Meter on 41 type Amplifier.	No reading, but filament meter normal and meter on 42 type Amplifier normal.	Defective plate meter key. Loose connection at tube socket, or at 390 volt terminal of 41 or 42 type Amplifier.
Plate Meter on 42 type Amplifier.	No reading.	Fuse in power supply circuit blown. Plate transformer open. Cover on back not closed tightly. Defective plate-filament switch.
Plate meter on 43 type Amplifier.	No reading.	Fuse in power supply circuit blown. Plate transformer open. Cover on back or on front not closed tightly. Defective plate-filament switch.
Filament meter on 46 type Amplifier.	No reading, but exciter lamp and 49 type Amplifier meters normal.	Filament of one of the tubes V-1 or V-2 open. Defective Filament Rheostat. Defective "Operate" Switch. Loose connection at amplifier tube sockets, amplifier 12-volt terminals, 702 type Filter, or Power Unit.
Plate meters M-1, M-2 and M-3 on 46 type Amplifiers.	No reading, but filament meter normal.	Fuse in power supply circuit or 110-volt plug fuse, F-1 or F-2, in Amplifier blown. Plate transformer open. Front not closed tightly. Defective "OPERATE" switch.
Meter on KS-6540 Control Cabinet	No reading, but exciter lamp and 49 type Amplifier meters normal.	Horn fuse in fuse box near control cabinet or in "B" Box on stage blown. Defective field rheostat in KS-6540 Control Cabinet. Field of stage receivers open. Loose connection at stage receiver, "B" Box, or KS-6540 Control Cabinet.

P.E.C. polarizing resistor in film amplifier broken or loose.
Open grid in vacuum tube. This will give no noise if reproducer is run without film.
Dirty or loose vacuum tube contacts.
Loose or dirty rheostat contact.
Loose or poorly soldered connection in battery, generator, or sound circuits.
Inductive pick-up from automatic arc feed or from sparking motor brushes.
Dirty or scratched disc records.

Hums, squeals, or flutters may be due to any of the following:

Film sprocket holes or frame line overlapping sound gate ("motor-boating")
Improperly adjusted tension pad.
Work sound sprocket.
Inductive pick-up from A.C. circuits.
P.E.C. lead too long and vibrating, touching sides of chute, or oiled soaked.
Exciter lamp not properly adjusted.
Dirty commutator on motor-generator.
Improper adjustment of 706 type Shaft connecting disc turntable to motor.

4. POOR QUALITY REPRODUCTION

Analysis to Determine Source: Whenever poor quality reproduction occurs endeavor to locate the cause of the trouble and segregate it:

(a) By operating the unsatisfactory film or disc record on alternate reproducers. If both give equally unsatisfactory reproduction, the trouble lies at some point in the sound system beyond the reproducers or else in the record itself.
(b) By alternately operating the unsatisfactory film or disc record and another record of known satisfactory quality on the same reproducer. If both records prove unsatisfactory, the trouble lies in the main amplifier or beyond. Otherwise, the cause lies in the condition of the film or disc record.
(c) By reproducing sound from a satisfactory film or disc record alternately through the various loudspeaker units separately. If this does not reveal the cause of the unsatisfactory quality, and the previous steps (a & b) have been carefully followed, the trouble lies in the main amplifier.

Causes at Different Sources: Poor quality should not be confused with noises, especially flutters, and may result from the following:

(a) In Film
Sound track dirty or worn.
Inferior recording or print.
(b) In Disc
Defective reproducer needle.
Warped or old disc record.
Inferior recording or pressing.
(c) In Reproducer Set
Sound Gate dirty.
Stray light reaches P.E.C.
P.E.C. deteriorated or out of frame.
Exciter lamp improperly focused.
Exciter lamp dark or dirty, giving low volume.
Exciter lamp filament distorted.
Film (P.E.C.) amplifier: Low filament current.
Film (P.E.C.) amplifier: Low plate (90V.) potential.
Film (P.E.C.) amplifier: Vacuum Tube deteriorated.
Film (P.E.C.) amplifier: P.E.C. polarizing resistance defective.
(d) In Loudspeaker System
Defective loudspeaker unit.
Polarity of field or speech leads reversed.
Throat of horn clogged with foreign material.
(e) In Main Amplifier
Insufficient filament current.
Insufficient or excessive plate potential. This may be caused by defective rectifier tubes or defective condensers in the rectifier filter circuit.
Vacuum Tubes deteriorated.
Amplifier overloaded by excessive input resulting from too high setting of volume control cabinet (fader). This condition will be verified if the plate meter-reading fluctuates simultaneously with loud signals.

5. MECHANICAL TROUBLES

Mechanical troubles will be manifested by noisy operation, excessive vibration or overheated bearings. By maintaining all set screws, bolts and adjusting parts in tight condition, and by maintaining proper lubrication in accordance with Figure 7, these conditions can usually be avoided. Proper adjustment of the take-up on the projectors is important and you should regularly inspect all meshing gears to detect "bottoming", poor alignment, or undue "back-lash".

1. ANNOUNCING AND VOICE REINFORCEMENT

General: The announcing attachment provides facilities for microphone input either from the manager's office or from the stage, amplification of the output of such microphone by the main amplifier of the sound system, and loudspeaker output either from the regular system loudspeakers or from separate loudspeakers. The arrangement using separate loudspeakers is frequently used on the stage, for "crooning" voice amplification. The equipment (Fig. 21) consists essentially of:

A 387 type Transmitter, suitably mounted
A 711 type Control Cabinet, in the announcing location
A 211 type Panel (or 712 type Control Cabinet) in the booth.
Additional loudspeakers, if required.

Operation: To use the announcing system, the projectionist operates the "announce" key on the 211 type Panel (or 712 type Control Cabinet) thereby connecting the main amplifier with the announcing circuit. This also gives a "Ready" signal to the announcer, who then depresses a key on his control cabinet (711 type) and proceeds to make his announcement.

Volume Control is obtained by a potentiometer in the announcer's control cabinet (711-A). This control should be set by each announcer to a position previously determined as most suitable for his type of voice.

Maintenance: The proper method of installing and connecting the #387 Transmitter in its mounting is shown in Fig. 21. The transmitter consists of a tightly stretched diaphragm on each side of which is a "button" filled with carbon granules. Current to the transmitter flows into each button, through the diaphragm to the ground connection. The currents through the buttons should be balanced as nearly as possible and should have a value between 20 and 45 milliamperes each. The amount of unbalance should not exceed 10 mils. This may be measured by plugging the meter (connected to cord and plug) supplied, into the jacks on the 711 type Cabinet. The balance of the currents through the buttons can often be improved by first turning off the current and then gently rotating the transmitter in alternate directions. Keep the transmitter in a dry place and protect it from severe blows or shocks. Do not touch it while announcing.

2. NON-SYNCHRONOUS

General: The non-synchronous attachment permits the reproduction of sound from commercial phonograph records. It consists essentially of a double turntable reproducer set (203 type) having two 4-A Reproducers and a volume control (fader)(Fig. 22), and a 712 type Control Cabinet for switching the NS circuit to the main amplifier input. The reproducer set motors operate from 110 volt 50 or 60 cycle power supply. Signal lights are provided on both the reproducer set and the control cabinet. The non-synchronous attachment includes record cabinets and other accessories to facilitate operation. A lifting device and guide scale are associated with each reproducer arm, enabling the operator to lower or raise the reproducer needle at any desired point on the record.

FIG. 21
ANNOUNCING EQUIPMENT

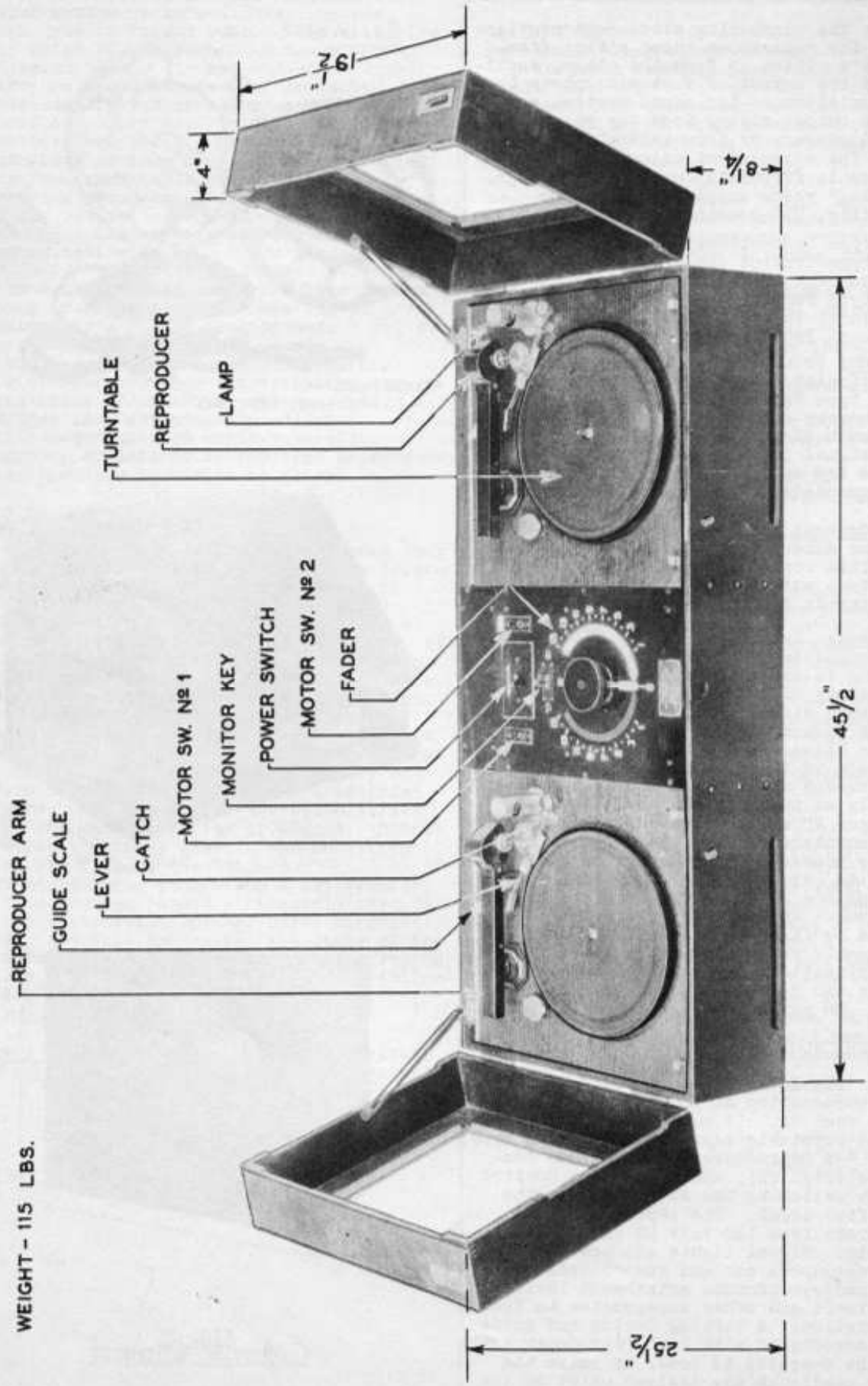


FIG. 22
NON-SYNCHRONOUS REPRODUCER SET

Operation: Unless commercial cue sheets, especially prepared for the picture to be shown, are to be used, a rehearsal of the records is always necessary. After the main amplifier system and stage loudspeakers have been started in the regular manner, and the time arrives for the non-synchronous operation, the 203 type Reproducer Set should be connected to the main amplifier by the switching key on the 712 type Control Cabinet. The operation of this key causes signals to light on the cabinet and at the non-synchronous reproducer set. The operator of the set should keep the volume control (fader) at zero at all times a record is not being played, as otherwise the least disturbance (changing needle, etc.) will cause noise from the stage loudspeakers. Keep the reproducers in their rests when not in use. After receiving the "Ready" signal, proceed to operate the set as follows:

(1) Turn on power switch at turntable cabinet.
(2) On one turntable put first record to be played and on other turntable put the next record.
(3) Put a new needle in each reproducer, making sure that it is properly tightened. Take a fresh needle for each record, and use only recommended types.
(4) Turn on motor switches for both turntables.
(5) If first record is to be played from the beginning, release reproducer knob, lift reproducer from its rest, holding it between thumb and forefinger of the right hand, and lower needle gently into first outside groove on record. If first record is to be started at some point other than beginning, keep reproducer knob depressed and slide reproducer out over record until index mark is opposite point on scale where it has been decided to start playing record. Then release reproducer knob and let it rise slowly so as to gently lower needle on to record.
(7) Turn fader pointer toward turntable which carried first record, and set it to give required volume of sound. Upon receipt of proper cue as the selection on first record is being concluded, put down the reproducer on record carried by second turntable and turn fader to the other side taking about two seconds for the movement. Set up third record on first turntable. Change needle and continue program, switching from one turntable to the other as described.

Always clean the records before using and do not permit any obstruction to alter the speed of the turntables as the quality of the sound will be affected.

Maintenance: The reproducer lifting mechanism on the double turntables should be so adjusted that when operated it lifts the needle point 1/16" above the surface of the record. This adjustment is made by moving the U-shaped piece of metal, which acts as a bearing surface, to the desired position. It is attached by two screws to the end of the reproducer lifting lever. When records are not to be used for a considerable period they should be stored on a flat surface in a horizontal position in a cool dry place.

Lubrication: Two oil cups are located on top of the motor for lubricating the top and bottom shaft bearings. Fill them with Mobiloil "A" at least once a month.

3. HEARING AID (HARD OF HEARING)

General: This attachment consists essentially of an auxiliary amplifier connected to head receivers, for use by hard-of-hearing patrons. It includes an arrangement through which a portion of the main amplifier output is fed to the auxiliary amplifier from which it is then distributed to a special double receptacle attached to every other seat in the section of the auditorium equipped for this service. A 6055 type Telephone Set consisting of a plug, cord, volume control and head receiver is furnished for each seat equipped, for use by the patron.

Operation: The hearing aid attachment is normally in operation at all times when the system is in use. A patron, on application is loaned the head set, cord, etc., and plugs same into receptacle on his seat. Volume is controlled by the slide-wire rheostat which he holds in his hand.

Maintenance: No special maintenance of the equipment is required. However, the head sets should be inspected occasionally to guard against loose or missing diaphragms, damage, broken cords, etc.