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# TM 28-410

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army

## PROJECTIONIST'S MANUAL:

ARMY  
MOTION PICTURE  
SERVICE



WAR DEPARTMENT • AUGUST 1945



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OFFICIAL:

G. C. MARSHALL  
*Chief of Staff*

EDWARD F. WITSELL  
*Major General*  
*Acting The Adjutant General*

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# SECTION I

## GENERAL

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### 1. Introduction

*a.* Visual and sound projection are the most important phases of the business of exhibiting motion pictures. The high standards of operation consistently maintained by the projectionists of the Army theater circuit have been responsible in a major degree for the success of the Service. This manual is intended as an aid in the preservation of these standards.

*b.* The successful operation of the projection and sound equipment depends largely upon the care it receives from the projectionist. This manual describes the nature and extent of the minimum care required. Careful adherence to its instructions will produce the maximum efficiency of operation.

*c.* The chief projectionist is responsible for the cleanliness and order of the projection and sound equipment, the projection room, the screen, and the stage speaker system and all miscellaneous stage equipment. The equipment will be maintained by the projectionists as required in this manual.

*d.* In case of trouble that cannot be corrected locally, the appropriate service command will be notified by wire or other appropriate means. A complete description will be given stating the particular piece of equipment involved in order that proper steps may be taken for correction of the trouble and for shipment of necessary replacement parts. The manufacturers' catalog will be used as reference so that correct name and part number may be given, when replacement is necessary.

### 2. Fire and Noise Safeguards

*a.* Two projectionists will be on duty in the projection room during the period when films are being projected before an audience. A projectionist will be in attendance alongside each projector at all times during its operation.

*b.* Smoking will not be permitted within the projection room or in any place where films are located.

*c.* Access to the projection room will be restricted to those whose duties require their presence.

*d.* Dust cloths and other necessary inflammable materials will be stored in a closed metal container.

*e.* The enjoyment by an audience of sound reproduction is seriously marred by projection room noises. Projection equipment noise will be prevented from reaching the auditorium by the use of glass in the observation and projection ports. No loud or unnecessary talking will be engaged in by projectionists during a show. The monitor loudspeaker will be operated at the lowest possible volume setting that will permit projectionists to hear sound reproduction.

*f.* Glass is essential in all ports to prevent drafts which may spread fires if the drop shutters do not close immediately.

### **3. Electrical Circuits**

The projectionists should possess a thorough knowledge in regard to all electrical circuits, the proper fusing of them, and location of the control switches in distribution panels. See plan of equipment for proper fusing.

### **4. Starting Projector**

After equipment has been standing idle for several hours, the projectors will be turned by hand before power is applied. Where projectors are grease packed and located in cold climates, the motor will be turned by hand for about 3 minutes to permit grease to work free. If, after turning motor by hand, the projector fails to start when the motor switch is turned on, turn switch off immediately. Failure to do so may burn out the starting winding of the motor, or unnecessarily blow the protective fuse. Allow projector to operate for at least 5 minutes before threading.

### **5. Operating Test**

Having completed lubricating, cleaning, and turning the projectors by hand, all of the equipment will be given a thorough operating test.

### **6. Tension, Magazine Shafts**

*a.* The tension of the take-up shaft in the lower magazine and the shaft in the upper magazine is carefully adjusted by the servicing engineer. These adjustments will not be altered unless for some reason the units fail to operate properly. Excessive tension will cause unnecessary wear on the sprocket and damage to film.

*b.* The tension on the clutch on the lower take-up will be such that a full reel of film can be taken up without the film back-slapping. The tension on the upper magazine shaft will be such that the emptied reel will make not less than three revolutions from the unreeling of the film.

### **7. Waste Carbons**

Waste carbons will be deposited in the closed metal container provided for that purpose and not in the lamphouse.

### **8. Conservation of Copper**

Projection lamp carbons used in the majority of Army theaters are the copper-coated type. When these carbons are burned, the copper coating melts and the drippings are collected in receptacles provided for that purpose in the lamphouses. These drippings in spite of their appearance are more than 90 percent pure copper. The copper coating can be removed from stubs by cutting the copper at an angle and gently peeling from the carbon. The copper drippings and coatings so salvaged will be disposed of through the post salvage agency, local motion picture supply houses or scrap dealers.

## SECTION II

### LUBRICATION

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#### 9. General

Proper lubrication is as vital to machinery as food is to a human being. Insufficient lubrication causes excessive wear and eventual breakage. Excessive lubrication increases the tendency for dust to collect. Excessive lubrication of projectors invariably results in the seepage of oil into the sound optical system, the photo cell transformer, and to the wiring between the sound head and the amplifier. It is important that only the type of oil specified by the manufacturer or by the servicing engineer be used in any piece of equipment. The use of incorrect oil may cause serious damage. *Caution:* Never attempt to lubricate any machine while it is in operation.

#### 10. Effect on Sound Units

Oil in the sound optical system impairs the quality of the reproduction and may even cause a complete outage of sound. Oil seeping into the photo cell transformer results in damage to the windings and eventually in the complete breakdown of that unit.

#### 11. Care in Oiling

In oiling the equipment, any excess oil that may be accidentally deposited on a given part will be carefully wiped off. Many shafts have oil grooves spiraled to pump oil in from the ends of the shafts. If such a machine is either new or has not been run for a time, it is advisable to lubricate it and then turn it backwards by hand. The spiral will then pump oil out to the ends of the shaft.

#### 12. Seepage of Oil

Even with the exercise of the utmost care in lubricating the equipment, there is a natural seepage of oil from the working parts. Every precaution will be taken to prevent this seepage from reaching the sound optical system and the wiring. A properly lubricated bearing or shaft must receive lubrication throughout its entire length. Some oil must be in evidence at the end of a bearing or its shaft. Such a condition is not an oil leak.

#### 13. Excessive Lubrication

Excessive lubrication of motor bearings results in seepage of oil into the motor windings, brushes, or the centrifugal switch of an alternating current motor. A collection of oil and dust in the centrifugal switch may cause failure of a motor to operate properly. Carbon dust is particularly objectionable in this connection. The oil saturation of motor and generator windings plus carbon dust eventually results in breaking down of the insulation, causing the unit to burn out.

#### **14. Motor Bearings**

Under ordinary circumstances, two drops of oil per week is sufficient for each bearing of an oil lubricated motor having waste packed bearings. Where oil reservoirs are present, the oil should be kept at the point indicated by the gauge or oil cup. Grease lubricated motors having grease cups require no more than one-half turn of the grease cup cap per month. Those not so equipped require inspection at 6-month or yearly periods, depending on type of operation. Grease lubricated ball bearings must not be overlubricated, as this will result in overheating and eventually bearing failure.

#### **15. Arc Generator Set**

As there are several types and makes of generators in use, no definite instructions regarding their lubrication will be given herein. The detailed instructions which accompany each individual generator set will be followed, keeping in mind at all times the danger of excessive lubrication. Motor generator sets that are of the grease packed ball bearing type will normally be greased by the servicing engineer. On generators having oil reservoirs the proper oil level will be maintained by adding oil when necessary.

#### **16. Arc Lamphouse**

With the exception of the automatic feed unit, the moving parts of the arc lamp are not to be oiled except where a special lubricant is provided for this purpose. The lamp manufacturer's instructions as to oiling will be followed, and, if such instructions are not available, the servicing engineer will be consulted. The tremendous heat generated by the burning of the carbons causes oil to decompose. The residue under such a condition is a gumlike carbon deposit which causes stiff operation and excessive wear of the lamphouse parts.

#### **17. Arc Control Motor**

The bearings located in the unit composing the automatic feed will be given one drop of oil per bearing per week under normal operating conditions. The bearings of the small motor that operates the units feeding the arc will be given one drop of oil per week. Excessive lubrication leads to eventual damage of the motor through the collection of oil and carbon dust on the commutator. A collection of oil and carbon dust on the commutator causes erratic operation of the motor.

#### **18. Quantities, Projection and Sound Head**

Experience has indicated that one to four drops of oil for each bearing, shaft and gear in the projector mechanism and sound head, for each 4 hours of operation, is ample. The amount of oil used by the intermittent movement of the projector mechanism varies, and it will therefore be regularly inspected. Oil will be maintained at the level indicated on the windows in the side of both the intermittent movement housing oil gauge.

and the sound head oil gauge. Specific instructions for various equipment are given below.

## 19. Simplex E-7 Projector Mechanism

*a. MECHANISM.* Depress the oil pump handle daily before operating mechanism. It should rise slowly. If it rises rapidly, air is present in the oil lines, and the pump must be operated until oil reaches the bearings. Oil will be kept at a level visible in the glass of the oil reservoir.

*b. MAGAZINE ROLLERS.* A drop of oil will be applied weekly to the shafts of the upper and lower magazine rollers.

*c. MAGAZINE SHAFTS.* Apply a drop of oil to each shaft bearing daily.

*d. PAD ROLLERS.* A drop of oil will be applied to each pad roller once a week. The pad roller has a small opening in the sleeve for oiling.

*e. GUIDE ROLLERS.* Same as pad rollers.

*f. INTERMITTENT.* Check oil level daily with sight glasses in a horizontal position. Add oil whenever necessary. Use only Simplex oil. Lubricate from either front or rear oil cup. The rear oiler is preferred since oil enters more readily and excess oil will drop onto gears on non-operating side of mechanism. The oil level can be readily observed by watching the line of bubbles that form as the mechanism coasts to a stop.

*g. APERTURE GATE CARRIER.* The two rods that carry the aperture gate will be lubricated with a drop of oil, together with the cam system, once daily, to prevent binding and sticking of aperture gate carrier.

*h. GUIDE SHOE ARM.* Lubricate once a week to prevent sticking.

*i. GUIDE ROLLER ARMS.* Lubricate weekly.

*j. SHUTTER SHAFTS.* Lubricate with four drops of special Simplex framing gear lubricant every 2 weeks.

*k. GEARS.* Lubricate all gears occasionally. Only a light film of oil is required on their surfaces. The internal gear of the main drive gear and the pinion driving the lower sprocket will be lubricated once per week with two or three drops of oil. This is accomplished by rotating the projector by hand until one of the large holes in the main drive gear is opposite the pinion, which leaves it accessible for oiling.

*l. DRIVE GEAR OIL CUP.* Lubricate with four drops daily.

## 20. Super Simplex Projector Mechanism

*a. MECHANISM LUBRICATION.* After opening the mechanism cover on the nonoperating side, six oil tubes will be readily seen. These six oil tubes will receive about two drops of oil each day. The oil tube on top of the projector, near the upper magazine, will also receive about two drops of oil each day.

*b. GEARS.* The governor and shutter shaft gears will be given a few drops of oil daily and, occasionally, a drop or two will be put on the other gears and all other sliding parts. The internal gear of the main drive gear, and the pinion gear driving the lower sprocket, will be lubricated once per week with about two or three drops of oil. This is accom-

plished by rotating the projector by hand until one of the large holes in the main drive gear is opposite the pinion gear.

*c.* FRAMING SHAFT. The framing shaft bearings will be oiled once per week by applying one drop to the oil tube just in front of the rear shutter.

*d.* INTERMITTENT MOVEMENT. By turning the framing handle until the intermittent movement is turned to its lowest position, an oil tube will be brought into view on the nonoperating side. Oil may be added to the intermittent movement through this oil tube. The oil level will be checked each day by setting the oil sight glasses on the operating side to a horizontal position. Oil will be maintained at the level indicated by the black arrow. The level can be readily determined by observing the line of bubbles that forms as the mechanism coasts to a stop. A small oil hole is provided in the casting that holds the intermittent sprocket. This may be seen from the operating side. One drop of oil will be applied to this oil hole each day.

*e.* ROLLERS, ETC. Guide rollers, fire trap rollers, etc., and other items not specifically covered in the oiling instructions for Super Simplex, are covered under Simplex E-7 instructions.

## 21. Holmes Projectors

*a.* DAILY. The projector will be lubricated at the following places before the show. Referring to illustrations "F" and "H" of the Holmes Manual, a few drops of oil will be applied to oiler cups on Sprocket #11 bearing; Intermittent Sprocket #17 front and rear; Sprocket #20 bearing; oil tube leading to Sprocket #26; and Sprocket #28 bearing.

*b.* WEEKLY. Referring to illustration "A," the following rollers will be lubricated weekly: #10, #12, #13, #18, #19, #21, #22, #29, the extra roller assembly between the intermittent and sound sprocket, all fire trap rollers in assemblies #9 and #31, framing roller #16 and framer arm assembly, bronze roller #30. The motor bearings are lubricated with four to six drops weekly. Upper and lower magazine shafts are lubricated with two to three drops weekly. Oiling of the above will be accomplished only with the oil recommended by the Army Motion Picture Service. After oiling all bearings and rollers, wipe off excess oil and clean immediately. Do not let oil accumulate, as this will gather dirt, causing rollers to stick.

*c.* Greasing of projector mechanism will normally be accomplished by servicing engineer on his regular visits.

## 22. Devry Projectors

*a.* INTERMITTENT MOVEMENT. Same as Super-Simplex.

*b.* FEED AND SOUND SPROCKET SHAFTS. Fill oil cup on top of mechanism daily.

*c.* CHAIN IDLER ROLLERS. One drop daily.

*d.* HOLDBACK SPROCKET. One drop daily.

*e.* SOUND ADJUSTMENT ROLLER. One drop daily.

- f.* PAD ROLLERS. One drop weekly.
- g.* DRIVE CHAINS. One drop weekly.
- h.* VALVE ROLLERS. One drop weekly.
- i.* DRIVE MOTOR. One drop weekly.
- j.* TAKE-UP BEARING. Apply one drop of oil between spacer and bearing daily.
- k.* SHUTTER SHAFT AND MAGAZINE BEARINGS. Check every 100 hours of operation and grease as may be necessary.

### **23. Sound Heads**

- a.* SOUND HEAD OIL LEVEL. Check daily before turning on motor. Keep to recommended oil level.
- b.* After lubrication has been accomplished, wipe off all excess oil to prevent accumulation of dirt.
- c.* For additional information, refer to factory charts.

### **24. Rectifier Arc Supplies**

The fan motors of these units have grease packed seal bearings. No attempt will be made to oil them.

### **25. Rewinds**

Two drops of oil per day is sufficient for oil-lubricated rewinds.

## SECTION III

### CLEANING

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#### 26. General

The cleanliness of the equipment and of the rooms in which it is located is of utmost importance. The tendency of oily surfaces to collect dust necessitates frequent and thorough cleaning. A mixture of oil or grease and dust produces a grinding paste which causes excessive wear of the various units.

*Caution:* Never attempt to clean machinery while it is in operation.

#### 27. Gears, Projection and Sound Head

a. The fact that the gear side of the projector mechanism is inclosed does not prevent the infiltration of dust and its mixture with any lubricant that has accumulated on the gears. The gears and frames will be kept free from such a mixture. Upon the completion of cleaning operations, the equipment will be lubricated immediately.

b. The frame and gears of the projector mechanism and sound head will be cleaned at regular intervals. The first step is to wipe all accessible portions of the frame with a clean cloth. Then all gear teeth will be cleaned with a small brush. Brush thoroughly as many teeth on a given gear as possible without moving the mechanism and then brush the teeth of the gear with which it meshes. Rotate the machine by hand in the direction that will bring the cleaned teeth into mesh first. Care will be exercised to keep the brush clean during this operation, and to avoid depositing bristles within the mechanism.

#### 28. Film Path

In the course of projection, foreign matter (emulsion, oil, grease, dust, etc.) is deposited on the various parts in the film path. This collection of foreign matter, if allowed to remain, causes excessive wear of units, damage to film, and unsteady picture on the screen, sound distortion, and, in some cases, a complete outage of sound.

#### 29. Film Trap Units

a. After each reel has been projected, the film trap shoes and the film trap door pad will be cleaned, using a small piece of lintless cloth for this purpose. By following this practice, it should usually be unnecessary to remove the film trap door during a performance for cleaning purposes.

b. While the projector is at rest, the film trap door will be removed from the mechanism once each day for a thorough cleaning in the types of equipment where provision is made for its convenient removal.

c. Ordinarily, any accumulation of dirt can easily be removed with a soft, lintless cloth; however, if the dirt adheres firmly to the film trap shoes or film trap pad, it will be dissolved by the application of carbon

tetrachloride or water; or in the case of hardened wax or emulsion, hydrogen peroxide. These parts are highly polished and for proper operation must remain so. Under no circumstances, therefore, will a hard or abrasive tool be used to remove an accumulation of dirt. To do so may result in these parts becoming scratched, an imperfection which may result in serious film damage. Where scraping of a surface over which film travels becomes necessary for the removal of dirt, a copper tool or a copper coin can be used safely.

*d.* Film trap shoes that are screwed to the film trap (rigid part of projector mechanism frame in which light aperture is located) will be cleaned daily with a clean cloth.

*e.* Foreign matter has a tendency to accumulate about the guide rollers. Unless they are kept free from dirt the guide rollers will not be able to keep the film in its proper course, with the result that the picture image will weave from side to side on the screen. A small stiff-bristled brush will be used for this cleaning operation.

### 30. Sprockets

*a.* An accumulation of dirt between the teeth of the intermittent sprocket and the intermittent film guide assembly (curved and grooved unit that holds the film in place on the intermittent sprocket) produces an unsteady picture on the screen. Such an accumulation will be prevented by a thorough cleaning of these parts. A stiff-bristled brush may be used for this purpose.

*b.* Sprockets in the projector mechanism and the sound head will be cleaned after each reel.

### 31. Pad Rollers

The pad rollers (rollers holding the film in place against the sprockets) are grooved in such a manner that the sprocket teeth pass between the sides of the grooves. The face of the pad roller is spaced twice the thickness of ordinary film from the face of the sprocket in order to permit the film to pass safely between these two parts. Any collection of dirt within the grooves of the pad roller causes excessive wear of the sprocket teeth and may cause serious film damage. The grooves of all pad rollers will be kept clean at all times, using a brush for removal of dirt.

### 32. Automatic Fire Shutter

*a.* Between the projection light source and the picture aperture is the automatic fire shutter. This automatic fire shutter raises after the projector reaches a safe operating speed and closes when the projector speed drops below a safe operating point. If for any reason the projector is stopped, or falls below safe operating speed during its operation, the automatic fire shutter immediately drops, thereby preventing the projection light beam from reaching the film and causing it to ignite.

*b.* The proper operation of this safety device is of such vital impor-

tance as to necessitate its being checked at least once each day. If any tendency for the shutter to stick is noticed, then all pivoting points, links, or grooves will be thoroughly cleaned.

### 33. Magazine Rollers

*a.* The shafts of the steel magazine rollers ride in bearings, and these bearings will be kept free from dirt; otherwise, the rollers will not rotate. In time, this failure to operate will cause wear to such an extent that the valve will not stop a film fire. Furthermore, if the rollers do not rotate, serious film damage usually results.

*b.* Foreign matter has a tendency to collect in the upper magazine roller holder assembly at a point below and between the rollers and the holder. An excessive accumulation of foreign matter at these points will prevent rotation of the rollers with the dangerous results previously described.

*c.* Dirt will be removed daily from behind the rollers by means of a small brush with long, fairly stiff bristles. If accumulation is excessive, the magazine may be removed to permit thorough cleaning.

### 34. Film Guide, Sound

*a.* Two lateral guide rollers are mounted on the guide roller assembly of the sound head. Any accumulation of dirt between the guide rollers and their supports tends to force the film to ride out of its intended path. This causes a "motor-boating" sound to be introduced along with the recorded sound. Any such accumulation will be removed after each reel. Keep guide rollers free to roll.

*b.* After the projection of each reel, the film guide surface will be wiped with a clean lintless cloth and drums will be cleaned. The presence of dust, dirt, or lint in the path of the exciter light beam causes sound distortion, loss of volume, and, in some cases, complete sound outage.

### 35. Optical System, Sound

*a.* The sound optical system may be described as consisting of an exciter lamp; an optical barrel with a condensing lens facing the exciter lamp, and an objective lens facing the film; a photo-electric cell condensing lens; on some types, a reflector; and a photo-electric cell. The exposed glass surfaces of these units will be cleaned with lens tissue or a clean soft cloth each day. Any oil on these surfaces will be removed by applying a small amount of carbon tetrachloride to the tissue or cloth. The accumulation of dust on these lenses and upon the envelopes of the exciter lamp and photo-electric cell necessitates operation at unduly high volume setting of the amplifier.

*b.* After these units have been cleaned, the proper alignment of exciter lamp and photo-electric cell will be checked. The setting of the exciter lamp will be such that a maximum image of the filament is focused on the photo-electric cell. The horizontal focal alignment of the exciter

lamp, in most equipments, is predetermined. With this type the main point of adjustment is the vertical. To set the exciter lamp, insert a white card in front of the photo cell to observe the position of the filament image.

*c.* The adjustment of the sound optical system can be properly made only with test film and meters. A maladjustment of the system causes sound distortion, loss of volume, and even outage of sound. In following the cleaning operations above described, none of the component parts of the optical system except the exciter lamp and photo cell will be removed, and extreme care will be exercised to guard against the system being thrown out of adjustment.

*d.* Where carbon tetrachloride is used on lens surfaces (lens, reflectors, exciter lamps or photo cells) for the removal of oil, the surfaces will be recleaned with water and polished with a clean, soft, lintless cloth to remove any residue that may be left on the lens surface.

### **36. Projection Lens**

The faces of the projection lenses are highly polished and extreme care will be exercised in cleaning to prevent these surfaces from becoming damaged. With the lens removed from its holder, first blow all dust possible from the faces of the lens, then, using lens tissue, a clean soft brush or cloth, remove remaining dust. Remove any oil on these surfaces by applying a small amount of carbon tetrachloride to the tissue or cloth. The desired standard of projection can be secured only by a daily cleaning of the projection lenses.

### **37. Ports, Projection and Observation**

Frequent attention will be given to the cleaning of the optical glass used in the projection ports. As in the case of the projection lenses, the quality of the projected image depends in part upon the condition of all glass surfaces through which the light passes on its way to the screen.

### **38. Reflectors**

*a.* In arc lamphouses, proper and frequent cleaning of the reflector is necessary both for proper screen results and in order to prevent breakage of the reflector. An excessive deposit of oxide, which has a tendency to collect in greater quantities on the reflector at the retaining clips, causes a difference in surface tensions. This is the natural result of differences of heat absorption, or radiation, between the clean surface of the reflector and the oxide covered surface. When the difference becomes great enough, the reflector will crack.

*b.* The face side of the reflector must be cleaned daily in the same manner that the projection lenses are cleaned. The reflector will be cleaned only when at normal room temperature. Never clean when temperature extremes of either room or reflector exist. Normally it is not necessary to remove it from the supporting mount for cleaning.

*c.* When a reason exists for the removal of the reflector, care must be

exercised to prevent the silver coating from becoming damaged. No liquid will be allowed to come in contact with the coated side of the reflector.

### 39. Condensing Lenses, Lamphouse

Some types of lamphouses have condensing lenses. They require the same care and attention as other lenses.

### 40. Lamphouse, Arc

*a.* Where the carbon arc is used as a projection light source, it is essential that the oxide formed by the burning of the arc be removed daily. If this oxide, which is a soft, white powder, is allowed to remain between the moving elements that compose the arc control units, stiff operation and excessive wear will develop.

*b.* The hard, black residue of the burned carbon accumulates in drip cups or in the bottom of the lamphouse. This residue will be removed daily. Where carbon drip cups are used, empty them frequently. Where sand traps are used, they will be kept three quarters full of sand and the drippings will be removed after each reel to prevent splashing of metal on the reflector.

*c.* The carbon jaws, feed rollers, and all other parts where the necessity for cleanliness is apparent, will be cleaned frequently. In arc lamps using rotating carbons, the feed rollers will be kept clean at all times.

### 41. Relay, Automatic Arc Feed

In some lamps, the proper operation of the automatic carbon feeding mechanism depends largely upon the cleanliness of the contact points of the relay switch. These contact points must be kept smooth. Under no circumstances should a hard or abrasive tool be used to clean these points. The proper cleaning operation, which will be performed once a week, consists in placing a piece of hard, clean paper between the contact points and then moving the armature until the paper is clamped LIGHTLY between the points, upon which the paper will be withdrawn. After repeating this process several times, the points should be thoroughly clean. If the above procedure does not produce satisfactory results, the servicing engineer will be consulted.

### 42. Motor, Automatic Arc Feed

*a.* When accessible, the commutator of the automatic arc fed motor will be cleaned periodically, using clean cloth for this purpose.

*b.* Irregular feeding of the arc is sometimes caused by collection of dirt in the brush holders, preventing free movement of the brush and resulting in poor contact to the commutator. When these brushes are removed for cleaning, care should be exercised to insure their replacement with the same side up in the brush holder from which they were removed; otherwise they will not fit the commutator properly.

### 43. Commutator, Generator Sets

*a.* Commutator of the arc generator set requires weekly cleaning. As in the case of all commutators, a clean piece of canvas will be used. When cleaning, turn armature in operating direction by hand. An oxide-stained appearance to the commutator bars under the brush paths is normal and it is unnecessary and undesirable to attempt polishing this off.

*b.* In some types of arc generators, there is a tendency toward a collection of carbon dust between the face of the commutator and the brush holder. Care will be exercised by frequent cleaning to prevent this collection.

### 44. Rectifier Type Arc Supplies

There are two types of contact rectifiers in service: the magnesium copper sulphide and copper oxide. The rectifiers will be kept clean at all times. Keep ventilating system free from clogged and dirty air passages. Do not allow excess dirt to accumulate on rectifier stacks, as dirt holds moisture which tends to cause arcing in stacks when voltage is applied. Rectifier stacks can be successfully cleaned by using a long-hair soft paint brush, or by blowing out with air or bellows.

### 45. Screen

*a.* The quality of the projected picture depends very largely upon the condition of the face of the screen. It is highly important, therefore, that the screen be cleaned at regular and frequent intervals. Under normal conditions, cleaning once a week is sufficient. Where the screen is unprotected and subjected to excessive air circulation, dust, coal gas, etc., it will be cleaned as frequently as experience indicates to be necessary.

*b.* The highly treated surface of the screen requires care in cleaning to avoid damage to the coating and consequent material shortening of the life of the screen.

*c.* A special screen brush has been supplied as a part of the theater equipment. This brush will be kept in a dustproof container when not in use. It will be thoroughly cleaned both before and after use. Under no circumstances will the screen brush be used for any purpose other than cleaning the FACE of the screen.

*d.* The first step in cleaning the screen is to pass a vacuum cleaner brush over its rear surface to draw any dust accumulation from the perforations; then the face of the screen will be brushed with the special screen brush. The cleaning will be done by starting in an upper corner and brushing LIGHTLY over the screen face from top to bottom. Never brush the screen crosswise in a horizontal plane nor use a circular motion.

## SECTION IV

### HANDLING OF FILM

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#### 46. General

*a.* Film is a highly inflammable material; therefore, it must be handled with extreme care.

*b.* Film will be exposed only when necessary; for example, when being transferred from shipping case to film cabinet; during process of inspecting and rewinding; when being transferred from film container to projector; when being transferred from projector to film cabinet; or when being transferred from film cabinet to shipping cases.

*c.* No more than one reel of film will be exposed at any given instant.

*d.* Exposed film will not be left unattended.

*e.* After each reel of film is placed in shipping case, the lid of case will be securely closed.

*f.* Scrap film will not be left exposed nor allowed to accumulate. In the projection room, scrap film must be kept in a closed metal container. It will be disposed of each day in accordance with the post fire regulations or instructions of the fire marshal.

*g.* Only the house reels provided by the Army Motion Picture Service are to be used in the projection equipment. Shipping reels are NEVER to be used in either the upper or lower magazines of the projection equipment. The transfer from exchange to house reels will be made as the first act of film inspection, and the film retransferred to the exchange reels for shipping only after the last showing of each reel has been completed. Projectionists will exercise every precaution necessary to prevent bending or warping of the house reels, since bent reels cause uneven winding of the film and edge damage.

#### 47. Film Handling

*a.* Prior to shipment from the laboratory film is treated with a protective coating, sometimes resembling wax or oil. No effort should be made to remove this protective coating during the course of inspection.

*b.* During the course of projection, some of the material used as a protective coating and some of the emulsion are sometimes deposited and may adhere to the various parts of the projector mechanism and sound head. The surfaces normally collecting the greatest amount are the shoes of the film trap and the pads and shoes of the film trap door. The deposit quickly hardens as a result of the heat at the aperture, and bears against the film with considerable pressure, frequently causing scratches. As the amount becomes excessive, a peculiar high pitched sound is usually produced. In other cases, the increased drag on the film causes an abnormally loud clicking noise at the intermittent sprocket. Either of these noises indicates that damage is occurring either in the form of scratches or at the sprocket holes.

*c.* On the first several runs of a new print, the deposit quite often accumulates so rapidly that before a single reel has been projected the amount becomes excessive. Where projectors are provided with gate pressure adjustments, the pressure will be reduced. If this does not permit the film to run freely or if the projector has no adjustment, temporary correction to prevent film mutilation may be accomplished by applying a small drop of oil to the finger and transferring it to both surfaces of the film by light contact in the area of the sprocket holes only, while the equipment is in operation. In no case will the oil be applied excessively or applied in the area of the picture image or sound track.

*d.* In all instances it will be absolutely necessary to clean all parts of the film path, with particular attention to the film trap and film trap door, after each reel has been projected.

*e.* Several types of sound heads have a lateral guide roller assembly incorporating a roller having a felt surface. The felt surface of the roller rests upon the emulsion surface of the film. Where this type of lateral guide roller assembly is used it will be necessary to clean the felt after each reel has been projected.

#### **48. Inspection of Film**

*a.* Before film is threaded in a projector, it must be thoroughly inspected by the projectionist and repaired where necessary. In addition to the inspection made before the film is first projected at the initial (lead theater if in a shuttle group) run theater, complete inspections should be made in subsequent run theaters (lead theaters if in a shuttle group) and an inspection form filled out to show the condition in which it is received there. Thus the source of damage can be definitely located. Film must also be examined after the projection of each reel to enable the projectionist to determine whether it has been damaged in projection and to determine and eliminate the cause of such damage. The projectionist is responsible for any damage to film arising through negligence on his part in its inspection, repair, handling, or projection.

*b.* In rewinding film, the reel to be rewound is placed on the idler end (left-hand unit) of the rewind in such manner that the film will run off the bottom of the reel and over the top of the hub of the empty reel on the crank end (right-hand unit) when the rewind reel is revolved in a clockwise direction. Always rewind slowly to prevent damage to film. The edges of the layers of film must form a smooth surface. This can be accomplished by guiding the edge of the film lightly against the edge of the reel. Film carelessly wound may have its edges turned or cracked. Sufficient uniform tension will be maintained so that the film will not wind loosely since slippage of adjacent film surfaces can cause scratches. For this reason, the reel must not be permitted to coast at any time. Excessive tension, nonuniform rewinding or fast rewinding will damage film.

c. Generally, a reel of film is received from the exchange "head out," that is, with the title on the outside. It must then be rewound twice before projection. In the first rewinding, it will be transferred from the shipping reel to a house reel. During the second rewinding it will be inspected. The full reel will be placed on the left or idler rewind unit, with the film feeding off the bottom of the reel and over the top of the receiving reel on the right-hand unit. The receiving reel will revolve in a clockwise direction. This will place the emulsion side of the film upward, which is a necessary condition for proper inspection.

d. The edges of the film during inspection will be held between the thumb and index finger and the film bowed slightly by pressure. With the film held in this manner, it will be possible to detect all splices and edge imperfections. No part of the fingers or hand should bear on either surface of the film nor should the surface touch the edge of the reel or any object during rewinding. All splices must be examined as to strength and frame relation. If not in perfect condition, a new splice will be made. All splices will be made with a film splicing machine in the manner prescribed below. Other points to check include scratches, crimps, and split or pulled sprocket holes. Where one or two sprocket holes are torn to the edge of the film, the broken edge will be clipped out at an angle to prevent it from catching in the mechanism. If three or more consecutive holes or two holes directly opposite each other are torn out, the damaged section will be removed and a splice made.

e. Below are listed the principle types of film damage and conditions relating thereto.

(1) *Splices*. Defective splices are known to generate dirt particles that scratch the film and through the misalignment of film, due to distorted splices, cause a "run-off." Examine alignment of sprocket holes in the splice.

(2) *Run-off*. The term "run-off" applies to the defects caused by the film running off the sprocket teeth and the teeth in turn making indentations or perforations in the picture or sound track area of the film. Always feel sprocket teeth after the film is threaded and make certain loops are proper size.

(3) *Sprocket damage*. This defect has been termed pulled perforations, strained sprocket holes and sprocket damage, and its causes may be either faulty splice, loss of loop, tight friction shoes, under-cut or badly worn sprocket teeth, misaligned or tight take-up of upper magazine shaft, or increased tension due to accumulated dirt or emulsion on skids or friction shoes. Always make sure rollers are closed properly over sprockets. Examine take-up belts before each performance. Remember a spare is in the spare parts cabinet.

(4) *Short heavy scratches*. This type of scratch is usually caused by the cinching of a reel, that is, the tightening of a loose reel by pulling the outside end of the film. Small dirt particles are ground into the film.

This can occur in rewinding if even pull is not applied, or by sudden stopping of the reel especially if film is wound loosely.

(5) *Short fine scratches.* These small scratches running across the width of the film are caused primarily by dirt particles between the film layers being ground into the film when an unevenly wound roll is pressed on the side to straighten it.

(6) The safeguards against both the above types of scratches are first, to maintain a clean operating condition; second, to wind all reels firmly and to see that edges are squared, that is, without one or several layers extending out from the edge of the roll. Examine film path for cleanliness after each reel.

(7) *Long deep scratches.* Scratches of this type are largely caused by running the film through a dirty cloth to clean it, or by holding the film during inspection so that one side or the other comes in contact with fingers or a rough surface. Continuous scratches are usually caused by defective or dirty projection equipment.

(8) *Short deep scratches.* These are largely due to excessive pressure used in applying a dirty cleaning cloth. *Do not attempt to clean film.*

(9) *Sound track scratches.* Experience has shown that the sound track edge of the film seems to pick up more scratches than the opposite side. This is generally a projection defect and is commonly caused by sticking rollers or accumulation of dirt in film traps or sound gates. Keep rollers free to roll.

(10) *Short angular scratches.* This defect is caused by holding the film so that one or the other of its surfaces comes in contact with the rotating edge of the film reel. Hold the film (or correct alignment of rewind elements) so that it touches the reel flanges only at the edges.

(11) *Edge break-down—important.* This defect may be pictured as a small piece of the film having been broken out of the edge. It may be caused by holding the film so that it rubs too forcibly against the reel flange or by winding with an uneven edge, against which the reel flange is forced during shipment. Wind the film to insure flat surfaced sides.

(12) *Brittleness.* Brittleness through low temperatures may be overcome to a large extent by permitting the film, after it has been subjected to very low temperatures, to warm up after delivery to the theater. At least 2 hours' storage in a warm room previous to inspection or use is desirable.

(13) *Holding film.* (a) The proper method of holding the film during inspection is between the left forefinger and thumb, bearing lightly on the edges of the film, slightly cupping it. Do not let any part of the hand touch other surfaces. Film that will not stand a slight cupping is not safe to use.

(b) In no event will film be cupped excessively during inspection.

(c) In running the film through the hands to find splices an excessive pressure on the edges of the film may cause it to crimp or split through the center.

*f.* One of the most important parts of the reel of film to be inspected is the footage leader preceding the picture. It is at this point that the film is subjected to the most strain, due to the starting of the projector and the pull of the take-up. This part of the reel, usually neglected, should be in perfect condition. The changeover cue marks (dots in the upper right corner of four consecutive frames) will be checked. The first cue mark, used for starting the incoming projector, is located approximately 12 feet from the last frame of the image. The second cue mark, which indicates the moment of light and sound changeover, is located approximately 20 frames from the last frame of the image.

*g.* No leaders will be removed nor will separate reels be spliced together, except that trailers may be spliced to the subject immediately preceding the feature, the run-out leader being removed for this purpose.

*h.* The film *will not* be permanently defaced with cue marks of any nature. When cues are missing, new cues will be made by identifying the scene and sound. Where difficulty in so cueing is experienced, a paraffin crayon may be used to mark the film in accordance with standard practice (small dots in the upper right corner of the image).

*i.* A detailed written report regarding the physical condition of the film will be rendered on the form provided for that purpose.

*j.* Under present conditions it is desirable to inspect and repair film prints following use, and prior to shipment to another theater or to the film exchange. When such a preshipping inspection is accomplished, suitable notations as to any changed physical condition will be made on the film inspection report form.

*k.* It is highly important that film be properly rewound for shipment. The outer edge must present a flat surface to the reel, otherwise the edges may be damaged in shipment. The film will be snugly rewound to prevent slippage. The retaining band will be safely secured in place.

*l.* An engineer of the service command will give the projectionist additional detailed information and instructions relative to these problems at the time of regular servicing visits.

## 49. Film Splicing

*a.* **SPLICING.** Splicing plays an important part in the wearing quality of the print. Film will be wiped with a clean cloth to remove dirt before making a splice and wiped after opening splicer to remove excess cement. All splices that are mismatched, buckled, or that can be pulled apart will be remade properly.

*b.* **TOO LITTLE SCRAPING.** When small particles of emulsion are permitted to remain on the scraped area the cement does not hold. Clean and dry film after removal of emulsion. Also clean the end of the other piece of the film being spliced.

*c.* **TOO MUCH SCRAPING.** When an excessive amount of the celluloid is removed in addition to the emulsion, the remaining celluloid tends to distort through the application of the cement and thus the splice is weak-

ened. In preparing a splice no more than the emulsion will be removed by scraping.

*d. DIRTY SPLICE.* Small particles of emulsion or film in the splice will cause air pockets to form, which in turn expand during projection to the point where they are likely to part the film.

*e. TOO MUCH CEMENT.* Too much cement will contribute to defective splices because of the distortion that will occur. An excess will not dry in the normal length of time and will distort the film so that both its width and thickness will be changed.

*f. TOO LITTLE CEMENT.* The result of having too little cement is obvious, for a suitable union will not have been made between the two layers of film. Likewise, air spaces will form, which will eventually cause a break.

*g. OFF-CENTER SPLICE.* May result from one film not lying squarely over the other; that is, one edge of the film extending over the edge of the other film.

*h. OFF-PITCH SPLICE.* This type of splice may be caused in the same way as the off-center splice. It takes the form of one set of perforations not fitting squarely over the other set in a longitudinal direction.

*i. CEMENT.* Cement that has been exposed to air too long makes a poor splice. Keep only a small amount of fresh cement in the bottle used in splicing, and keep it tightly closed when not in use.

*j. GRISWOLD FILM SPLICER.* In using the Griswold splicer these directions will be followed:

(1) Swing both left-hand jaws up against the stop, and the upper jaw on the right side against the stop.

(2) Place the film with the emulsion (dull) side up on the lower right jaw with the dividing (frame) line at the left edge of the center bar on the splicer.

(3) Bring the upper right jaw down on the film.

(4) Bring the left cutter down to cut the film and then swing it up to the stop again.

(5) Swing the upper right jaw back to the stop, remove the film from the splicer, and polish the celluloid (shiny) side of film with a clean cloth to remove any oil that may be present. Replace the film on the lower right jaw in its former position, and replace the upper jaw on the film.

(6) Swing the right jaw (with the film in place) back against the stop.

(7) Bring the lower left-hand jaw down into position and place the other end of the film in same with the dividing line (frame line) at the left edge of the center bar on the splicer.

(8) Bring the upper left jaw down on the film, then both right-hand jaws (with film in place) down to cut film.

(9) Swing right jaws back to stop after cutting.

(10) With dampened felt disk, moisten emulsion of film held by left

jaws over the center bar. The emulsion is then removed by means of the scraper. Take care that the remaining celluloid is left clean and dry.

(11) Raise the left-hand jaw sufficiently to lift the film about  $\frac{1}{4}$  inch above the center bar, apply cement to the film in this jaw, and return it to its original position. The right-hand jaw, with the other end of the film in place, is clamped down immediately. (Raising the film from the center bar while applying cement prevents it from getting on the bar and flowing under the film.)

(12) Allow the cement to set for approximately 10 seconds, then:—

(a) Raise both upper jaws of the splicer and wipe away any excess cement.

(b) Let the splice dry and then *inspect thoroughly*, paying particular attention to the presence of any air bubbles as observed from the celluloid (shiny) side of the film.

(13) If the splice is not perfect, it will be remade.

(14) Technicolor is a nitrate-base single-coated film substantially similar to regular black-and-white product. Continuous rewinding of technicolor often leaves a thin coating of the colored emulsion on the back of the film which interferes with the solvent action of the film cement and prevents the complete cohesion of the splice. This can be completely overcome by *lightly* scraping the back of the film and being sure that the scraping of the face or emulsion side is right down to the celluloid. Many times the clear emulsion of the sound track layer is mistaken for the celluloid. Use the same film cement as used for black-and-white film.

(15) Cinecolor is a nitrate-base double-coated film with the red image on one side and the blue-green image on the reverse side, each side having a single layer gelatine emulsion. Emulsion will therefore be cleaned from both pieces when splicing.

(16) Safety or acetate film is not used for film intended only for projection in theaters, but is used for educational pictures that may be projected with portable equipment. This film cannot be spliced with most film cements intended for nitrate film and does not splice as easily as the latter with any cement. To insure a good splice, the emulsion will be removed in the usual manner and the back of the other piece of film lightly scraped.

(17) The splicing machine will be kept clean and free of dirt, oil, hardened emulsion and film cement.

## 50. Film Inspection Report Form (Amps Form #186)

a. The projectionist will check the titles of subjects listed, and if a substitution is received make proper correction on the form. In the case of numbered subjects, such as news and miscellaneous novelty reels, the number will also be checked.

b. Information concerning any deficiencies found in a print will be entered on the form as the inspection progresses.

c. A detailed written report regarding the physical condition of the

film will be rendered. Physical damage, that is, damage that will affect the strength of the film or that may have a bearing on the safety of projection, will be reported. This will include poor splices, damaged sprocket holes, edge break-down, broken or torn film, etc. Film damage or defects in printing that are visible in the projected image or that cause audible disturbances in the sound and reproduction will be reported. This will include scratches that are visible on the screen, visible run-offs, improperly framed splices, defaced film, or any film condition that produces noise in the sound. Damage such as minor scratches that does not weaken film and that is neither visible nor audible will not be reported; such conditions result from normal wear and tear and do not affect projection in any way. Film will be described as "good" if none of the above reportable defects are observed; "fair" if a few such defects are observed but where the general condition does not detract from the presentation or enjoyment of the show; and "poor" if the condition is such that projection would be seriously hazardous or if the visible or audible defects are so frequent or noticeable as to be objectionable during the performance.

*d.* Always list print number or letter on report. The print number is always shown on the retaining band, and some exchanges perforate the information in the leader of the film.

*e.* If film is received in such condition that there is a possibility the film exchange may file a claim for damages, it is desirable that the damage be shown to a superior, preferably the theater officer, *prior to the time of use*. In such instances, it is desirable to have the superior indicate on the film inspection report the fact that the damage was noted prior to the time of use.

*f.* If film is received in poor condition, the report will be mailed to the Army Motion Picture Service regional office immediately following the inspection and verification by a superior (preferably the theater officer). If the condition is such that the projectionist believes the exchange may file a claim for damages against the theater, then wire or telephone the regional office, preferably prior to the time the film is used, and at the time give specific details as to the nature and extent of the damage.

## 51. Equipment Design Relative to Fire Hazard

*a.* Because of the highly inflammable nature of film, projection equipment has been designed as nearly fireproof as is possible. The projection equipment consists of three separate fireproof film compartments—the upper magazine being one, the projector mechanism combined with the sound head a second, and the lower magazine the third. These units are so designed and constructed that when properly maintained and operated fire is not likely to spread from one compartment to another.

*b.* A valve having a series of steel rollers is located in the upper magazine, and a similar device is located at the entrance to the lower mag-

azine. When these rollers are kept clean and free to rotate, a film fire will seldom pass between them.

*c.* The igniting of a film in the projection equipment ordinarily occurs at the light aperture. Here again the equipment has been so designed that it will prevent or at least retard the passage of fire.

*d.* The film trap door clamps the film in such a fashion that the amount of air surrounding the film is extremely limited. In many instances fire starting at the aperture will not spread beyond the limits of the film trap door because of this clamping action and the small amount of air coming in contact with the film.

*e.* When the film does burn beyond the limits of the film trap door, it then must pass between the sprockets and pad rollers. The design of these units also tends to prevent the passage of fire.

*f.* In addition to these fire prevention devices, there is an automatic fire shutter located at the film or light aperture. This shutter will not open before the projector comes up to a safe operating speed. It automatically closes before the projector speed drops below a safe operating condition.

## 52. Threading Projector and Sound Head

In order to further reduce the possibility of film fire in the projectors, to minimize the likelihood of film damage and to insure uninterrupted projection, the following system for threading the projector and sound heads will be followed:

*a.* Before threading a machine, the entire film path will be carefully inspected. It is essential that all traces of dirt be removed with clean cloth, brush, or orange stick from any point where it could contact film and that all rollers turn freely. This inspection will be repeated between all reels, as dirt lodged in a machine during the running of a show could easily damage film. All traces of wax or emulsion depositing on film paths will be removed at once before they can harden. If deposits are permitted to harden, they will be dissolved with water after which the part is wiped dry with a clean cloth.

*b.* The light source of the projector that is being threaded will be out and all dousters closed.

*c.* Prior to the insertion of the film in the magazine, it will be checked to ascertain that it is the proper reel and that it has been properly re-wound. Where projection and rewind rooms are separate, the checking will be accomplished in the rewind room.

*d.* Immediately after the film has been placed in the upper magazine and the valve threaded, with sufficient film reeled off to extend just to the floor, the magazine door will be securely closed. The film will not be permitted to touch the floor, but will be threaded on the reel in the lower magazine at once.

*e.* Turn the projector by hand until intermittent sprocket stops. If the film is threaded with the intermittent in this stationary portion of its

cycle the picture will remain in frame when the machine is started.

f. Place the film between the upper feed sprocket and its pad roller.

g. The film is then placed on the intermittent sprocket in such a manner that the image area of the film entirely covers the aperture, and, at the same time, forms a loop above the film trap door.

h. While holding the film securely in place on the intermittent sprocket and between the guide rollers, gently close the film trap door.

i. Loops of the size specified in the instructions for particular types of equipment will be formed between all other sprockets. Care will be used in placing the film properly in the sound gate and in closing the gate.

j. After threading the projector mechanism and sound head and properly securing the film to lower take-up reel, the doors of the projector mechanism, sound head, and lower magazine will be immediately closed.

k. The projector will then be turned by hand until the starting point of film is reached. The starting point will depend on the starting speed of the machine, and should be such that if the motor is started when the first cue mark appears on the screen, the leader will have entirely run through and the picture will just have reached the aperture of the incoming projector at the appearance of the second cue mark. This starting point will usually be near the 8- or 9-foot mark on the standard leader.

l. While a projector is in operation, the doors of the upper and lower magazines will be kept securely closed. There is absolutely no reason for opening them. To open them while projector is in operation only increases the fire hazard.

m. No attempt will ever be made to operate a standard projector with a reel having less than a 5-inch hub. Never use shipping reels in the magazines of a projector, since such use can damage film and equipment, and may be the direct cause of a film fire.

### 53. Procedure in Case of Projection Room Fire

a. In the case of an accidental film fire in the projector, shut off the light source, stop the motor, close projection room fire shutters, and retire to a safe point of observation by the projection room door until the extent of the fire is judged. *Do not open doors of projector mechanism, sound head, or magazine until it is absolutely certain film has ceased burning.* If circumstances require the assistant projectionist will notify the assistant manager of the fire and then return immediately to rejoin the chief projectionist at his place of observation. House lights will be turned on to prevent possible panic.

b. After being positive the fire has ceased, the projector mechanism and sound head doors may be opened. After ascertaining that there are no hot sparks remaining, the film may be removed from the upper and lower magazines.

c. *Remember, after a fire, do not open magazine doors until inspection of the projector mechanism and sound head discloses there are no signs of fire or hot sparks remaining therein.*

*d.* After a fire in a projector, it will not be used until all parts, including the projection lens, have been thoroughly cleaned. Relubricate and turn by hand to insure that no serious damage has been done.

*e.* The projector will be cleaned as soon as possible, using water as a solvent. Oil will then be applied to metal parts to prevent rust.

#### **54. Fire Extinguishers**

*a.* No attempt will be made to fight a film fire in a projector. It is usually impossible to extinguish burning film. Further, burning film generates a highly toxic gas that is dangerous to breathe. Extinguishers will therefore not be used on film fires, but may be used on other types of fires. Projectionists or others present during fires will remain at a safe distance from burning film and must avoid being trapped by a fire.

*b.* Because of the presence of electrical equipment only carbon tetrachloride extinguishers, or other types approved for use on electrical equipment by the National Board of Fire Underwriters, will be used. In the use of carbon tetrachloride be mindful that when it is used on a fire it forms a heavy toxic gas that smothers fire because it excludes oxygen. Soda-acid and water types of extinguishers must never be used on electrical or projection equipment. They not only damage such equipment seriously, but also present a shock hazard to the user because the stream is an electrical conductor.

## SECTION V

### ROUTINE INSPECTION

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#### 55. General

Even after a projectionist has become thoroughly familiar with the proper maintenance procedure, there is always a likelihood of his overlooking a few details, and the neglect of any phase of equipment maintenance can lead to serious trouble. The projectionist should not rely on his memory but should follow a routine inspection guide, a copy of which should be posted in the projection room. A sample routine inspection guide follows:

#### ROUTINE INSPECTION GUIDE (Daily except as noted)

##### PROJECTORS AND SOUND HEADS

###### Lubricate:

- Projector mechanisms
- Intermittent movement (maintain proper oil level)
- Sound heads
- Motor bearings (once per week, if oil lubricated)

###### Clean:

- All sprockets (between reels)
- All pad rollers (between reels)
- Projector mechanism film trap (between reels)
- Sound gate (between reels)
- Magazine roller assemblies (between reels)
- Magazines
- Lenses of sound optical system, including condenser lens
- Projection lens
- Photo-electric cell and exciter lamp
- Projection and observation port glass
- All gears (at regular intervals)

##### LAMPHOUSE

###### Lubricate:

- Motor bearings (once per week)
- Automatic arc feed units (once per week)

###### Clean:

- Lamphouse interior
- Carbon jaws
- Feed mechanism
- Reflector
- Condensers
- Commutator of arc feed motor (weekly)
- All other parts where necessity for cleaning is apparent.

## GENERATOR SETS

Lubricate:

Bearings (according to recommendation of manufacturer)

Clean:

Commutator

## MOTION PICTURE SCREEN

Clean (once per month minimum)

## GENERAL

Check alignment of exciter lamp and photo-electric cell

Check operation of magazine rollers and automatic fire shutter

Turn projector by hand before applying power and give all equipment thorough operating test

Check operation of lower take-up

Oil motor bearings of projection room exhaust fan and curtain control once per week (if oil lubricated)

## SECTION VI

### TROUBLES AND THEIR CAUSES

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#### 56. Common Types of Trouble

It is considered that a complete and detailed discussion of sound reproduction troubles and their causes in this manual would be more confusing than beneficial; however, as minor troubles do occur and the projectionist is called upon to carry on with the show, some of the common troubles and their causes are listed below.

**a. NO SOUND FROM EITHER PROJECTOR.** (1) Fader (sound change-over) switch not in proper position or defective.

(2) Filament of tube, or tubes, burned out.

(3) Fuse blown in amplifier or power unit.

(4) Fuses blown or circuit breakers open in power supply circuits.

**b. SOUND ON ONE PROJECTOR ONLY.** (1) Exciter lamp burned out or entirely out of alignment.

(2) Fader switch not in proper position or defective.

(3) Sound aperture clogged.

(4) Defective photo-electric cell (rare cause).

**c. LOW VOLUME.** (1) Power supply voltage low.

(2) Exciter lamp voltage too low.

(3) Exciter lamp blackened, dirty, filament warped, or out of adjustment.

(4) Photo-electric cell weak (rare cause).

(5) Defective tubes.

(6) Power amplifier tube burned out.

**d. NOISE.** (1) Contacts of volume control dirty or corroded.

(2) Fader switch contact points dirty.

(3) Dirty prongs on tubes or dirty socket contacts cause a staticlike noise.

(4) Loose elements of tubes. Tubes in first and second stages should ring when tapped very slightly. If ringing noise is greatly exaggerated and prolonged, tube is microphonic and should be replaced. If a cracking noise is heard when tube is lightly tapped, it indicates very loose elements or poor socket contact.

(5) Loose terminals in sound head or amplifier.

(6) Heavy "motor-boating" sound is caused by sprocket holes or frame lines of film intercepting exciter lamp beam.

(7) Soft, steady hum indicates that an a-c line is inducing an a-c voltage into an unshielded section of the sound system or an a-c source of light reaching the photo-electric cell.

(8) Microphonic photo cell (rare cause).

**e. POOR QUALITY.** Poor film, dirty or scratched film, dirty sound gate, defective tube or photo cell, sound gate open.

*f. UNEQUAL VOLUME.* (1) Eliminating cleanliness of units composing sound optical system, the usual cause for unequal sound volume is difference of age or condition of exciter lamps.

(2) Where means have been provided for individually controlling voltage applied to photo-electric cell the voltage applied to the photo-electric cell having the strongest signal output may be decreased until a balanced condition is reached.

*g. NO SOUND FROM ONE SPEAKER.* (1) Plug pulled.

(2) Loose, disconnected, or broken terminals.

(3) Defective voice coil.

*h. NO SOUND FROM STAGE SPEAKERS.* (1) Field supply unit inoperative.

(2) Speaker switch in off or test position. (Monitor loud speaker may be used in emergency.)

## 57. Procedure in Case of Emergency

*a. GENERAL PROCEDURE.* In case of serious trouble with the sound or projection equipment, proceed as follows:

(1) Determine the exact nature of the trouble and, if possible, the particular part of the equipment at fault.

(2) Determine whether any corrective measures can be taken to overcome the trouble or to permit operation pending arrival of parts or an engineer.

(3) If the trouble cannot be corrected, notify the service command, giving all details.

(4) Until trouble is cleared, remain available for telephone contact with the servicing engineer of the service command.

*b. Adherence to the above and to the following more detailed instructions will frequently prevent loss of shows, will enable the prompt dispatch of the nearest engineer, and will often enable the shipment of the required parts to meet him on his arrival at the theater.*

*c. TROUBLE WITH SOUND.* The following procedure will help in localizing the defect, and the information gathered will often permit the shipment of replacement parts before the arrival of an engineer:

(1) Check all switches, seeing that all are on and that emergency switches are in the "normal" position.

(2) Check all fuses.

(3) In case a fuse blows, substitute a new one of the same rating. If it blows out, look for trouble in the equipment. Be careful not to confuse fuses and fusetrans—they are not interchangeable. Do not keep burned-out fuses in the projection room.

(4) Observe the exact nature of the sound, whether it is weak, distorted (noting the sound of the distortion), or entirely lacking. Note the presence of any unusual hum, whistle, or frying or popping sound. Note whether the trouble comes and goes; if so, under what conditions or what affects it.

(5) Note whether trouble occurs with or without film running. Note whether it is observed on one or both projectors. If on one only, the trouble is in that sound head or in the changeover switch. Try replacing the photo cell and replacing and focusing the exciter lamp.

(6) A faulty exciter lamp supply unit usually results in a dark or dim exciter lamp. If there is an emergency switch on the unit, throw it to "emergency." Try replacing the tubes. If all else fails, the exciter lamps may be lit by means of storage batteries, using 4 cells (8 volts). To do this, disconnect the wires from the socket to remove the faulty power unit from the circuit.

(7) If the trouble is present on both machines, check the amplifiers. If emergency channels are provided in the equipment (see description below), throw the switches, one at a time, to emergency, observing the one that may correct the trouble. If the amplifier is equipped with a tube testing meter, check the tubes. Replace all tubes (even if a tube tests "good" it may occasionally be noisy).

(8) If sound is heard in the monitor but not from the stage speaker, the fault may be either in the field power unit or in the speakers or parts associated with them.

(9) Unless the speakers are of the permanent magnet variety, the trouble may be in the speaker field supply unit. If there is an emergency switch, throw it to "emergency." Replace the tubes. If the fuse blows, the fault may be in the power unit or it may be a shorted speaker field coil. Disconnect all speaker fields and plug them in one at a time. If one blows the fuse, leave it disconnected. If the power unit is at fault, the monitor speaker, which is usually of the permanent magnet type, may be moved to the stage. (See below.)

(10) If this fails to overcome the trouble, it may lie in the speaker signal circuits. If there is an emergency switch to cut out defective units, throw it to emergency. Disconnect one voice coil at a time by pulling plug connection or disconnecting at the binding post on speaker unit to locate a bad unit. If necessary, use the monitor speaker, connecting it across the two wires of the signal circuit except in the case of the RCA PG-140 and Simplex B-30, where it must be connected in place of the low frequency speakers at the terminal box and the speaker switches at the amplifier thrown to the emergency position.

(1) In general, if no other defect is found, check all connections, making sure that they are tight.

*d.* RCA PG-140 (EMERGENCY CIRCUITS). (1) Amplifier switch on monitor amplifier substitutes the monitor amplifier and its volume control for the voltage and power amplifiers and the front wall volume control.

(2) Speaker switch, on unit below power amplifier. Both switches normally *up*. Throwing left switch down disconnects high frequency

speakers and feeds all power to low frequency speakers. (Both switches down kills sound on stage.)

(3) Speaker field switch, present on most equipment using motor generators for arc supply, located on the field power unit, beside the tube with the blue glow. Throwing it to emergency connects the speaker fields to the arc motor generator.

(4) Exciter lamp switch, on the bottom unit of the rack, connects the exciter lamps direct to the transformer for a-c operation.

(5) To use the monitor speaker in place of the stage speakers (in case of power unit failure) connect it in place of the low frequency speaker voice coils in the terminal box of the stage speakers, and throw the speaker switch in the amplifier rack (referred to above) down, to feed all the power to this one speaker. Operate sound at minimum satisfactory volume.

*e. SIMPLEX B-30 (EMERGENCY CIRCUITS).* (1) Switches in the volume control amplifiers on the front wall cut out one or the other of the amplifiers in each unit (see instructions posted in amplifier).

(2) Switch on main amplifier cabinet, with positions marked 1, 1-2 and 2, connects amplifier #1 only, amplifier #1 and #2 (normal) or amplifier #2 only.

(3) Switch on center unit, marked H.F., in the "off" positions, disconnects high frequency speakers and feeds all power to the low frequency speakers.

(4) Monitor switch, on the chassis of the middle unit in front of the monitor amplifier, cuts out the monitor amplifier and connects the monitor speaker direct across the line to the stage speakers.

*f. ARC CIRCUITS.* (1) *Rectifiers.* (a) In case of failure of one unit of a contact rectifier, throw the switches in the arc switch panel to put both lamps on the good unit and operate by stealing the arc, according to the instructions posted in the switch panel.

(b) In case of failure of operation of both units of a contact rectifier, check the fuses. Be sure that all three of the three phase lines are delivering power. In case of sparking in the rectifier units, line voltage may be excessive, or the units may be defective. A burned-out transformer will usually smoke. Check the relay operation. The post electrician can check line voltages and three phase power circuits.

(c) In the case of tube type rectifiers, flickering of the light on the screen may be caused by weak rectifier tubes.

(2) *Motor generators.* Check fuses, both in the arc switch panel (d-c circuits) and in the three phase power switch. Be sure all three lines are delivering power. If the machine is noisy or fails to start, one of the three phase lines may be dead. If it runs backwards, interchange any two of the three phase lines. If fuses blow frequently, be sure all connections to fuse clips are tight (loose contacts overheat fuses). If the

magnetic starter opens frequently, tighten all connections, and, if the weather is hot, open its cover to cool it.

*g.* MECHANICAL TROUBLES. In case gears are damaged, specify the damaged parts by catalog number, if possible, or at least by careful description. Check the shafts of broken gears—they may be bent. If the machine will not turn (that is, if it is frozen) rock all gears by hand until the sticking part is located. Sometimes a sticking shaft can be removed if it is not too tight, and the bearing wiped clean and relubricated so that the machine will run again.

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