Disclaimer

The information contained in this Adobe PDF file is for general information purposes only. Due to the age of the information and the difficulty in converting it to computer formats it may not be up to date or correct, we make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the Adobe PDF or the information, products, services, or related graphics contained in the Adobe PDF document for any purpose. Any reliance you place on such information is therefore strictly at your own risk.

In no event will we be liable for any loss or damage including without limitation, indirect or consequential loss or damage, or any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of this Adobe PDF.

The

G.B.-Bell & Howell

16mm Sound-Film Projector

MODEL 621

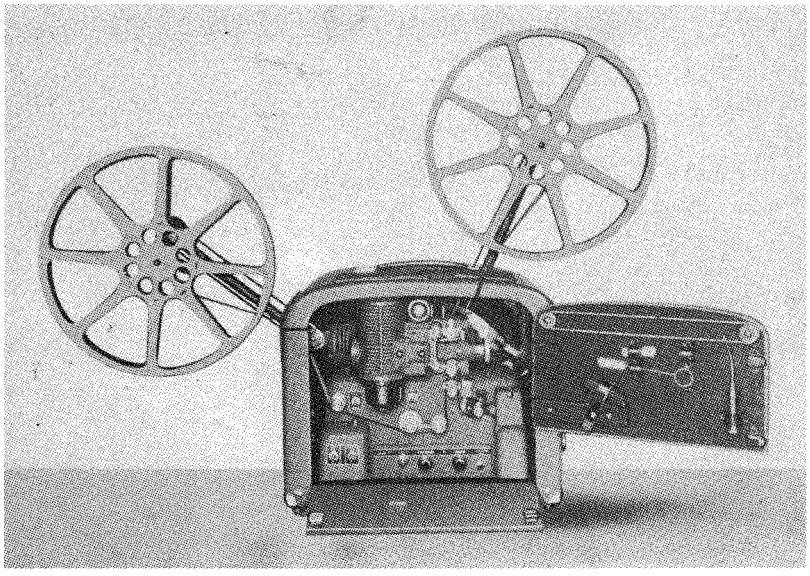
Service and Instruction Manual

The

G.B.-Bell & Howell

16mm Sound-Film Projector

MODEL 621



Instructions for Operation
Care and Maintenance

Service Manual

Spare Parts List

G.B. EQUIPMENTS LTD.,
MORTIMER HOUSE,
MORTIMER STREET,
LONDON, W.I,
ENGLAND.

G. B. BELL & HOWELL MODEL 621 PROJECTOR

C O N T E N T S

SERVICE INSTRUCTIONS

SECTION 1.

DISMANTLING

SECTION 2.

ASSEMBLY

SECTION 3.

FINAL ADJUSTMENTS

SECTION 4.

AMPLIFIER DATA

SECTION 5.

CONDENSED FAULT TRACING GUIDE
COVERING SIMPLE ADJUSTMENTS

SECTION 6.

SPARE PARTS LIST

ILLUSTRATIONS AS UNDER: -

G.B.BELL & HOWELL

MODEL 621 PROJECTOR

OPERATING INSTRUCTIONS.

SECTIONS 1 - 4

Instructions for Operating the

G. B. - BELL & HOWELL MODEL 621

16 m.m. Sound-on-Film Projector.

General Information

The projector is equipped with still picture clutch, a sound-silent speed (24. F.P.S. and 16 F.P.S.) switch, and a reverse switch, permitting the film to be run forward or backwards without re-threading. It is factory equipped with the faster 2-inch F.1.6 lens as well as the light-increasing Magnilite Condenser.

Preparing to Operate the Projector

The removable spool arms are carried inside the projector case, one on the door and the other at bottom of case. Locate arms in sockets, the

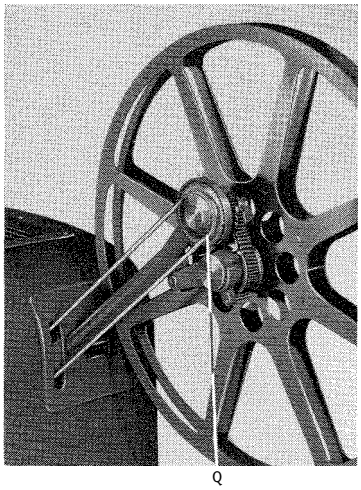


Figure 2.
Q. Take-up pulley

smaller one in front, and the other arm (with take-up pulley) at the upper rear of the projector case, as shewn in Figure 1. Loop the rear spring belt, without a twist, from the drive pulley, 2, Figure 16, at the rear of the projector motor, to the take-up pulley Q, Figure 2, at the end of the spool arm.

Loop the front belt, without a twist, over the small pulley at the top of the feed spool arm.

CAUTIOUS BEFORE PROCEEDING

Be sure that:

1. The mains to which you are connecting your equipment are A.C. (alternating current). See page 7 for the use of converter on direct current.

2. If your mains supply is A.C. of more than 110 volts, a transformer is used to supply 110 volts to the projector.

3. The fuse in the power lines is rated at least at 15 amperes, provided that no other equipment is on the same circuit.

4. All controls on the projector are in "off" position.

5. That the transformer tapping or the resistance or converter is set to, the voltage of the mains supply before making any connection to the projector. If there is any doubt as to the exact voltage, consult the local electricity undertaking.

6. Before making any connections or alterations to connections make sure that your wall-plug switch is off.

7. It is important that the equipment be earthed by connecting the third lead in the mains cable to the earthing pin on the wall-plug or other suitable point.

Electrical Connections

After removing the speaker grille cover and all accessories from the speaker case, carry the speaker and the speaker cable to the front of the room. Place the speaker as nearly as possible at the centre of the screen and above the heads of the audience. Where this is not possible the speaker may be positioned at the side of the screen and tilted downwards slightly towards the back of the audience. Locate the, speaker at least 18 inches in front of any obstructing surface, but NOT behind the screen unless this is of the perforated type. The door of the speaker case should be closed. The speaker cable comes out of the case through the slot in the lower right side of the case door.

Connect the end of the speaker lead into the input on the Amplifier chassis.

Uncoil the speaker cable as you go toward the projector. Avoid placing the cable where your audience might trip over it.

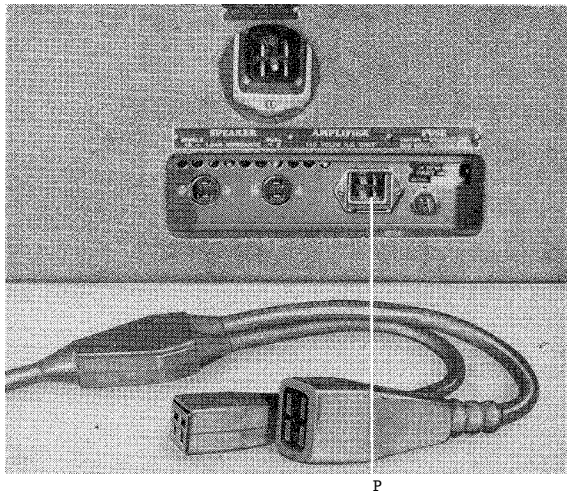


Figure 3.
P. Amplifier Input 110 volts A.C. only.
Projector Lamp and Motor
Input 110 volts A.C. or D.C.
Single speaker connection 16 ohms
Dual speaker connection 8 ohms
Amplifier fuse 1 $^{1}/_{2}$ amps.

Insert the speaker connector into the "single 16" inlet on the Amplifier chassis.

Connect the appropriate leads- to the projector and amplifier or converter inputs according to the type of supply. Full information as to the type of step-down device, if necessary, and method of connection is given in detail on page 7.

Adjusting the Projector to the Screen

The small case door in front of the projection lens must he opened. Turn on the projector switch, C1,. Figure 4, and the lamp switch, C2, Figure 4.

If the electrical connections are correctly made the projector mechanise should now operate and a beam of light should be projected on the screen, provided that the clutch control X, Figure 4 is turned to the extreme clockwise position.

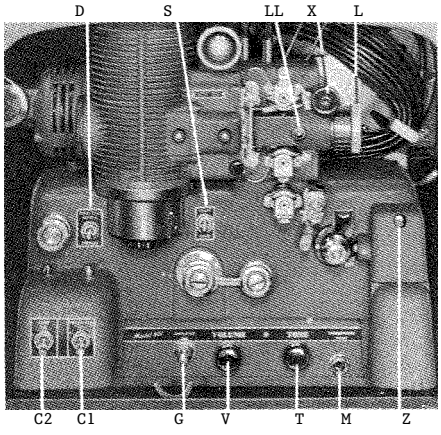


Figure 4.
C1. Projector switch
C2. Lamp Switch
D. Direction Switch
G. Amplifier Switch
V. Volume control
M. Microphone jack.
L. Lens.
LL. Lens Locking Screw
S. Sound-silent Switch
X. Clutch control
Z. Exciter lamp cover screw

Move the projector on its stand or table to such a position that the projected beam coincides with the screen. The projector is raised to the required height by turning the tilt adjustment knob in a clockwise direction. The tilt knob is located on the front of the projector case (23, Fig. 16.)

If the projected image is larger than the screen move the projector closer. If the image is too small, move the projector farther from the screen.

If room size, limits the throw, select the correct lens, indicated in the table on page 8.

With the projector operating and the lamp turned on, loosen lens locking screw LL, Figures 4 and 14, by turning to the left and slide the lens, L, forward or backward until the outlines of the aperture or frame are sharply defined. To sharpen further the focus, revolve the lens first in one direction then in the other, relocking the lens when sharp focus is obtained.

Now turn off the projector and turn on the amplifier switch, G, Figures 4 and 13. Allow about one minute for the valves to heat, then move the volume control V, Figures 4 and 13, in a clockwise direction until a hiss is heard in the speaker. At the same time, light should be seen from behind the exciter lamp cover Z, Figure 4.

If the above conditions exist, the electrical connections are properly made and the projector is ready for threading.

Threading the Film

The Practice Film should be spooled on a large spool before use. Place the practice spool, on the top spool am spindle with perforations toward the operator, and an empty "take-up" spool on the rear spindle. Press each of these spools firmly on the spindle up till the small retaining spring-bells lock the spools on the spindles. Pull off about four feet of leader film for threading.

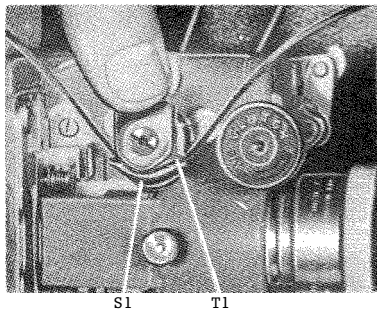


Figure 5.
S1. Safe-lock sprocket
T1. Sprocket guard tab

The film, if correctly wound, should feed from the front of the spool with the perforated edge toward the operator. Slip the film into the slot at the base of the spool arm and over the roller. Lead the film below sprocket S1, Figure 5. Slide the film as far toward the machine as it will go. Holding the film snugly as in Figure 7 press on tab T1 Figure 5, to open the guard. Pull gently on the film until the perforations seat over the sprocket teeth. Then release tab T1 locking the film on the sprocket. Swing lever A, Figure 6, upward. (This lever is beyond the projection lens.) This movement will open the film gate. Now form the first loop,following the loop outline on the side of the gear case as shewn in Figure 7. Pass the film through the channel behind the lens as in Figure 7, being certain that it is fully seated in this channel. Then close the gate by pressing down lever A, Figure 6, as far as it will go. Form the second loop, conforming to the outline on the gear case and slip the film over the second sprocket S2 Figure 8. Again press the film as far toward the projector as it will go, and, while maintaining correct loop size, lock the film as for S1.

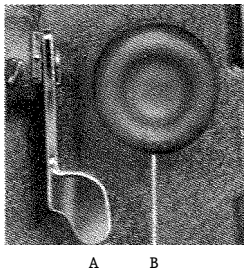


Figure 6.
A. Gate lever.
B. Hand setting knob

Now turn the hand setting knob, B Figure 6, several clockwise revolutions. this will engage the film with the shuttle teeth. Should the lower loop slide upward, continue to turn the hand setting knob until the claw teeth are withdrawn, when the film may be pulled down to re-set the loop to

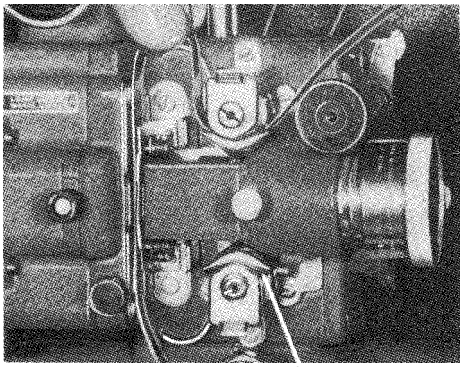


Figure 7.
T2. Sprocket tab

the outline on the gear case. It is not possible to move the film downward through the gate unless the claw teeth are withdrawn. Again test the threading with the hand-setting knob.

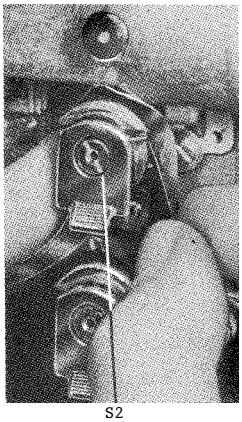


Figure 8.
S2. Second sprocket

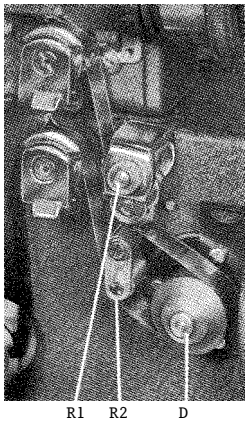


Figure 9.
D. Sound Drum.
R1 and R2. Stabilizer rollers

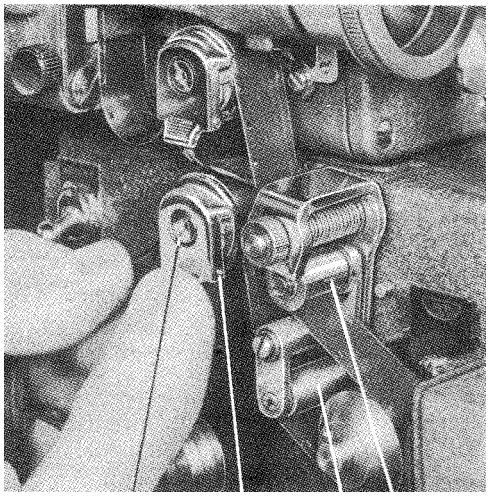


Figure 10.
R1 and R2. Stabilizer rollers
S3. Third sprocket
T3. Sprocket tab.

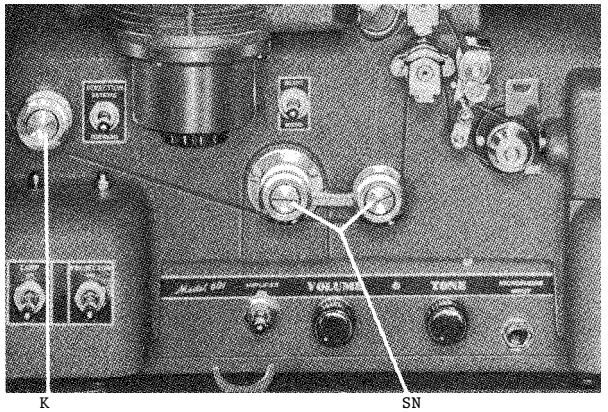


Figure 11.
SN. Snubber.
K. Rear idler roller

Lead the film from the second sprocket S2, Figure 8, under the top roller of the Oscillatory Stabilizer, R1, Figure 9, around the sound drum, D, Figure 9, under the bottom stabilizing roller R2, Figure 9, and over the third sprocket S3, Figure 10. Press the film as far toward the projector

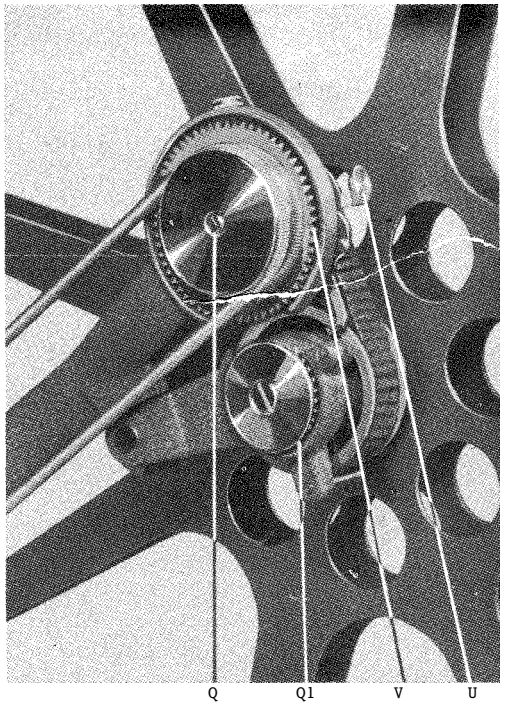


Figure 12.
Q. Take-up pulley
Q1. Rewind-gears
U. Take-up lock lever
V. Rewind gears

as it will go over the sprocket S3, and pull down on the film as it passes over this sprocket. When the Oscillatory Stabilizer is moved to its extreme position by the tension on the film, open the film guard by pressing on tab T3, Figure 10. Then, free the film just sufficiently to permit the Oscillatory Stabilizer to pull it back to the first available set of perforations. Release tab, T3, permitting the guard to lock the film in place on the third sprocket.

Pass the film under the snubber SN, and the roller K, Figure 11, and thence to the take-up spool. The film must be inserted in the slot in the case and over the roller on its path to the take-up spool. The film should pass around the bottom of the take-up spool, Figure 16.

Remove the film slack before starting the projector by revolving the take-up spool clockwise. No special precautions need be observed to synchronize the sound to the picture, since adherence to the foregoing instructions will assure correct synchronization.

The mechanism on the rear spool arm is a combination take-up and rewind device. Set this for take-up by pressing lever U, Figure 12, while the spool is on the spindle.

No adjustment or compensation is necessary for various spool sizes, since the flat fabric belt between pulleys Q and Q1, Figure 12, provides complete and automatic compensation without any manual adjustments. The projector is now ready for operation.

BFORE PROJECTING, YOU MUST BE ABLE TO ANSWER "YES" TO THE FOLLOWING QUESTIONS

1. Have you read, and carefully followed, the preceding instructions?

2. Have you cleaned the aperture, gate plates, and optical components?

3. Are all loops of the correct size?

4. Is the film properly engaged on all sprockets?

5. Is the film gate closed?

6. Is the film properly started on the take-up spool, with all slack removed?

7. Is the take-up rewind assembly set to TAKE-UP film?

8. Is the direction switch, D, Figure 4, set for forward operation?

9. Have you selected the correct speed for the film you are projecting (sound or silent)?

10. Is the transformer or resistance voltage tapping screw in the correct position for the voltage of your electric supply?

11. Have you tested the threading by turning the hand setting knob or by momentarily turning on the motor?

12. If projecting sound film, is the amplifier turned on?

13. If using a microphone with silent film, is the amplifier turned on?

14. Have you learned from the ensuing pages of this manual how to use a microphone and a turntable; how to use the still picture clutch; the tone control; how to re-wind the film; and how to operate the projector in reverse?

.(After you have become adept at threading the film through the mechanism, turn on the amplifier before threading. The amplifier valves will warm up to the proper operating temperature, so that sound projection can be started as soon as threading is completed).

SECTION 2.

OPERATION

Projecting

With the amplifier valves warmed and the film volume control at zero, start the projector using switch C1, Figure 4. Immediately after the motor has started, turn on the lamp switch C2, Figure 4.

As the title appears on the screen, carefully revolve the lens in one direction or the other until the title or the first picture appears in sharp focus. Lock in focus with screw LL, Figure 4.

Framing

If the picture frame line shows on the screen, turn the framer knob E, Figure 14, to make the frame line disappear. If framing moves the picture off the screen, readjust the tilt control.

Sound Volume and Tone Control

The volume control knob V, Figure 13, may now be advanced or retarded. The volume control operates similarly to volume controls on radio sets and either full volume, to the limit of the amplifier or minimum volume for the smallest room may be achieved.

The tone control T, Figures 4 and 13, is also operated similarly to a tone control on a radio receiver. By means of this control, frequency range can be compensated for in accordance with the acoustical conditions under which the equipment is being used.

It should be set up by the operator for the most desirable reproduction at each showing. The practice film should now be projected in its entirety. Run this practice film until you are thoroughly familiar with every phase of operation and threading. As "The End" title appears on the screen, turn off the projector lamp and, as the end of the narration or music is reached reduce the volume control until no sound is heard. Run the remaining "trailer" of film completely through the machine.

Projecting Silent Film

To project silent film, thread the machine in the usual way. Set the speed control switch S, Figure 4, at "silent". Do not turn on the amplifier unless oral comments are to be made through the speaker by means of a microphone, or musical accompaniment is to be reproduced by means of a turntable.

Still Picture Projection

To project a still picture, the clutch control knob X, Figures 4 and 14, is revolved to a full

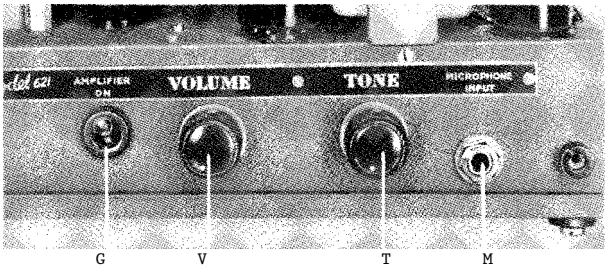


Figure 13.
G. Amplifier Switch
V. Volume control
T. Tone control
H. Microphone jack

counter-clockwise position, thus disengaging the projector mechanism. If no picture appears on the screen, the closed section of the shutter is obscuring the light. A small movement of the hand setting knob, B, Figure 6, will bring the open section of the shutter into correct position, thus permitting the projection of single frames of film. It will be necessary to adjust the lens to focus a still picture. Re-focus when motion is resumed.

Reversing

Turn the volume control until the sound is inaudible. Switch off the projector motor before moving the direction switch, D, Figure 4, to reverse". The motor must be stationary before oper-

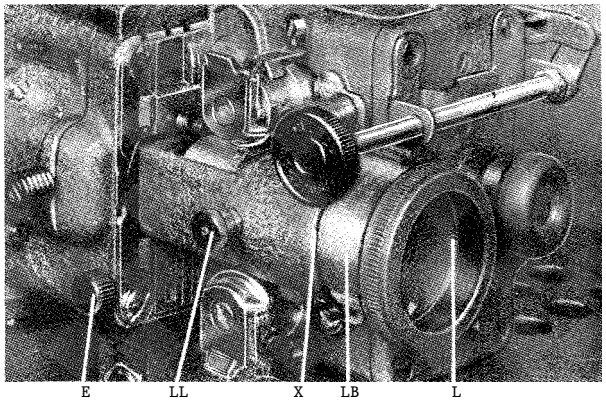


Figure 14.
E. Framer control
L. Lens
LB. Lens barrel
LL. Lens locking screw
X. Clutch control.

ating this switch. Always advance the volume control to the working position after switching from "reverse" to "forward".

Re-winding

The take-up spool, which has now received the entire film, should be removed from its spindle on the rear or take-up spool arm. The empty reel should be removed from the top reel arm, and the two spools interchanged so that the film leaves the full spool from the top. Use a hand rewinder where possible, to save wear on the mechanism.

The end of the film is led over the top of the empty spool. The lever U, Figure 12, is pressed forward, and the take-up spool lifted up as far as it will go to engage the two re-wind gears, V, Figure 12. Then, while still holding the spool in the lifted position, the pressure should be released from lever U, thus locking the assembly in the re-wind position, as shewn in Figure 15.

With direction switch in "forward" position, turn the projector switch on, allowing the motor to run until all of the film has been rewound on the original spool. To save wear on mechanism, the clutch should be disengaged.

Immediately after re-winding, and before removing the loaded reel, again press lever U, Figure 12, thus restoring the assembly to the take-up position, as shewn in Figure 12.

CAUTION: No twisting, changing, or removing of any belt is necessary when rewinding or taking up film.

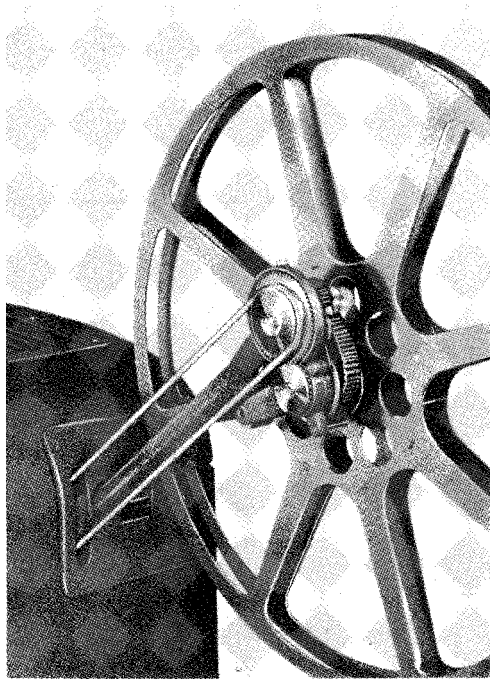


Figure 15.
Gears on take-up arm locked in re-winding position

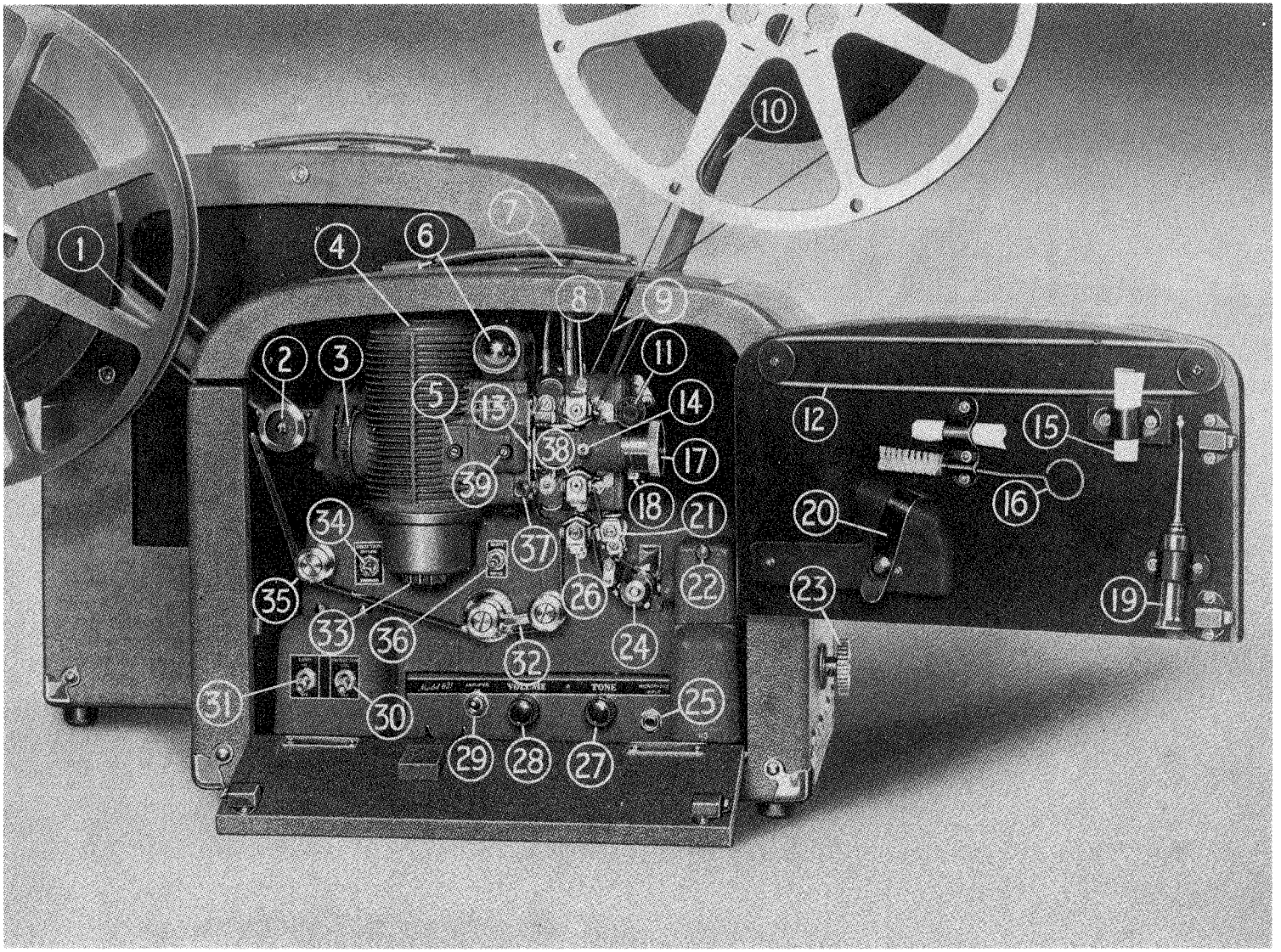
Microphones

A high-grade crystal microphone or high impedance dynamic microphone may be used with any model. The microphone is plugged into the jack, M, Figure 13. Volume control, V, Figure 13, controls volume for microphone.

If the volume control is advanced too far, howl may be set up in the speaker, this is caused by acoustic feed-back and can be eliminated by reducing the volume or altering the position of the microphone in relation to the speaker.

Record Players

Any record player with crystal pick-up or high impedance magnetic pick-up arm may be used. The jack is plugged into the receptacle M, Figure 10, and the volume is controlled by the volume control, V, Figure 13. It is important to note that the equipment be earthed as described on page 1. para. 7, when using a microphone or record player, otherwise a hum may be reproduced.



1. Take-up spool arm
2. Take-up drive pulley
3. Reflector
4. Projector lamphouse
5. Main condenser
6. Pilot lamp
7. Oil cups
8. 1st sprocket
9. Reverse belt
10. Feed spool arm
11. Clutch operating control
12. Spare belt
13. Removable gate shoe
14. Lens locking screw
15. Spare exciter lamp
16. Aperture cleaning brush
17. Lens
18. Gate operating lever
19. Oil can
20. Spool arm holding strap
21. Oscillatory stabilizer
22. Exciter lamp cover screw
23. Tilt control
24. Sound drum
25. Microphone |ack
26. Third sprocket
27. Tone control
28. Volume control
29. Amplifier switch
30. Projector operating switch
31. Lamp switch
32. Take-up snubber rollers
33. Lamp lock screw
34. Forward-reverse switch
35. Guide roller
36. "Sound-silent" control switch
37. Framer
38. Second sprocket
39. Magnilite Condenser.

Figure 6

Pilot Light

The pilot light is identified by the disc cap mounted on top of the projector casting, 6, Fig. 16. To operate the pilot light, pull the cap forward; to turn it off, push the cap back. The pilot light should ALWAYS be off when the projector is in operation. To replace the lamp first disconnect the mains, then turn the cap counter-clockwise until it can be removed then insert the new lamp (120v. 6w) and replace cap.

When the projector is supplied by 200/250 D.C. through the normal resistance the 110-volt pilot lamp must be replaced by a 230/250-volt lamp of suitable wattage. The brilliance of a pilot lamp of 200/250 volts, used as stated above will be greatly reduced when the projection lamp is, switched on.

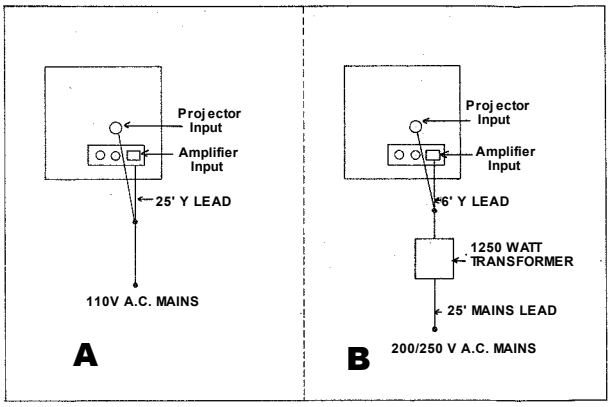


Figure 17.
Arrangement and connection of units for 110-volt and 200/250 volt A.C.

Operating on 200/250 volt 50 to 60 cycle Alternating Current

To operate on 200/250 volt alternating current a 1,250 watt, 200/250-volt to 110-volt transformer is required. Plug the 200/250 volt side, using the mains lead provided, into the wall socket, first making sure that the earthing lead is properly connected as already instructed. Plug the 6-ft. "Y" lead into the 110-volt socket on the transformer. Connect the two-sockets to amplifier and projector lamp and motor input as shewn in Figure 3.

Make sure that the transformer voltage tapping screw is set to correspond with the voltage of the mains supply in use. The method of connection is as shewn in Figure 17B. The transformer is fitted with a voltage selector panel carrying two tapping screws. The Panel is marked 10/0/200/220/240-volts. One tapping screw must always be in the C-or 10-volt tapping. When in the 0 tapping the voltage selected is as indicated by the second tapping screw. When in the 10-volt tapping the voltages as selected by the second tapping screw are increased by 10-volt, i.e. 210/230/250-volts. The life of the lamp can be conserved by utilizing a voltage tapping on the transformer or resistance above that of the voltage of the mains supply, e.g. mains supply voltage 220, tapping 230. This results in under-running the projector lamp. In order to make certain of the exact voltage of the mains supply it is advisable to consult the local electrical authority or, if this is not practicable, to measure the mains voltage with a voltmeter. It is not sufficient to examine the house meter or a lamp in use and take the presumed voltage from these.

Operating on 110-volt 50/60 cycle Alternating Current

To operate from this supply no transformer is necessary and the projector is connected to the mains supply by a 25-ft "Y" lead, as shewn in Figure 17A.

Operating on 200/250-volt Direct Current

A special lamp and motor and converter resistance are available. These units are tapped to enable the equipment to be adjusted to accommodate the various mains voltages which may be encountered. The method of connection is shewn in Figure 18B.

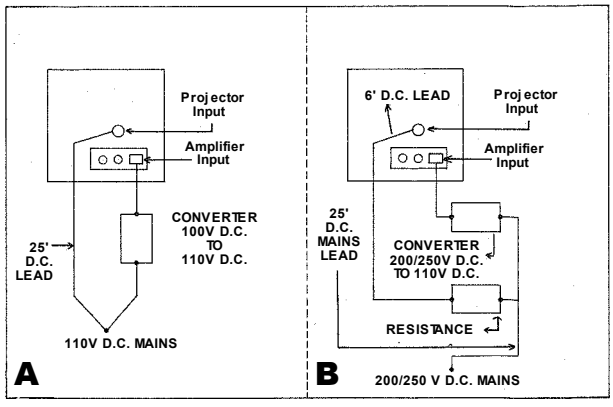


Figure 18.
Arrangement and connection of units without polarity changer for 110-volt or 200/250 volt D.C.

In all cases the resistance converter unit tapping must be adjusted to correspond with the voltage of the mains in use.

The standard resistance unit supplied is suitable only for 750-watt projector lamp. If 1,000 watt lamp is to be used, a special resistance unit will be required for use only with this lamp.

Operating from 110-volt Direct Current

It is important that under no circumstances should the D.C. mains be connected directly to the input of the amplifier without the use of a converter. When ordering rotary converters the input voltage must be stated as 110 volts D.C. Or 200/250 volts D.C.

Operating from Main Supplies other than those already described

In cases where it is required to use the projector on frequencies outside 50/60 cycles, a special amplifier and specially wound 1,250 watt transformer will be required.

A.C. voltages of 50/60 cycles outside the normal ranges can be accommodated by using a transformer of suitable rating wound for the particular voltage of the supply. For the non standard D.C. voltages either a specially wound resistance unit or rotary converter is necessary. Advice of any of the above problems can be obtained from G.B.Equipments Limited.

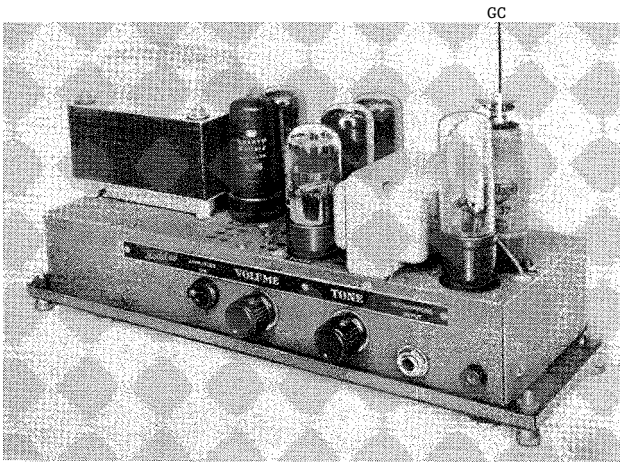


Figure 19.
Amplifier removed from projector.
GC. Grid clip.

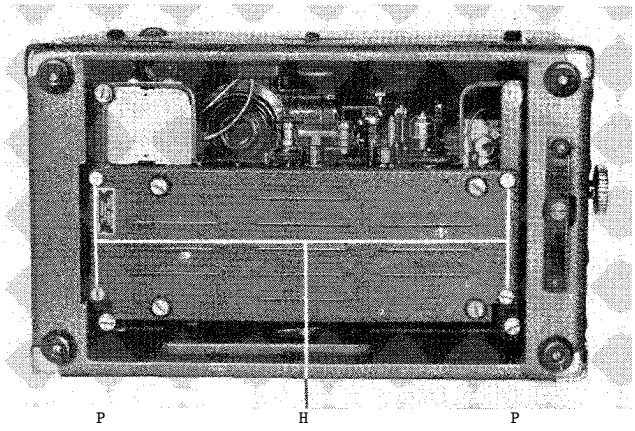


Figure 20.
H. Amplifier retaining screws
P. Projector retaining screws

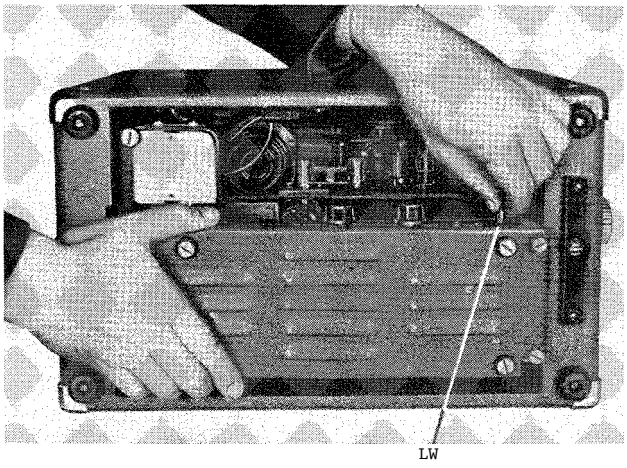


Figure 21.
Removing amplifier.
LW. Lead wire

PROJECTED PICTURE SIZES OBTAINED WITH VARIOUS PROJECTION LENSES

LENS FOCAL LENGTH	DISTANCE IN FEET FROM SCREEN TO FILM															
	8'	10'	12'	15'	20'	25'	30'	35'	40'	45'	50'	60'	75'	100'	125'	150'
16 mm. Projector	WIDTH AND HEIGHT OF PICTURE															
5/8"	4'9" 3'6"	5'11" 4'5"	7'2" 5'4"	9'0" 6'8"	12'0" 8'11"	Upper Dimension is Width of Picture Lower Dimension is Height of Picture										
3/4"	3'11" 2'11"	4'11" 3'8"	5'11" 4'5"	7'6" 5'7"	10'0" 7'5"	12'6" 9'3"										
1"	2'11" 2'2"	3'8" 2'9"	4'5" 3'4"	5'7" 4'2"	7'5" 5'7"	9'4" 6'11"	11'3" 8'4"	13'1" 9'8"								
1 1/2"	1'11" 1'5"	2'5" 1'10"	2'11" 2'2"	3'8" 2'9"	4'11" 3'8"	6'2" 4'7"	7'5" 5'7"	8'9" 6'6"	10'0" 7'5"	11'3" 8'4"	12'6" 9'3"					
2"	....	1' 10" 1 '4"	2'2" 1'8"	2'9" 2'1"	3'8" 2'9"	4'8" 3'5"	5'7" 4'2"	6'6" 4'10"	7'5" 5'7"	8'5" 6'3"	9'4" 6'11"	11'3" 8'4"	14'0" 10'5"	18'9" 13'11"	23'5" 17'5"	28'2" 20'11"
2 1/2"	....	1'5" 1'1"	1'9" 1'4"	2'2" 1'8"	2'11" 2'2"	3'8" 2'9"	4'5" 3'4"	5'2" 3'10"	5'11" 4'5"	6'S" 5'0"	7'5" 57"	9'0" 6'8"	1 1'3" 8'4"	15'0" 11'2"	18'9" 13' 11"	22'6" 16'9"
3"	....	....	....	....	....	3'1" 2'3"	3'8" 2'9"	4'4" 3'3"	4'11" 3'8"	5'7" 4'2"	6'2" 47"	7'5" 57"	9'4" 6'11"	12'6" 9'3"	15'7" 11'7"	18'9" 13'11"
3 1/2"	....	....	....	....	....	2'7" 1'11"	3'2" 2'4"	3'8" 2'9"	4'3" 3'2"	4'9" 37"	5'4" 3'11"	6'5" 4'9"	8'0" 5'11"	10'8" 7'11"	13'4" 9'11"	16'1" 11'11"
4"	....	....	....	....	....	2'3" 1'8"	2'9" 2'1"	3'3" 2'5"	3'8" 2'9"	4'2" 3'1"	4'8" 3'5"	S'7" 4'2"	7'0" 5'2"	9'4" 6'11"	11 '8" 8'8"	14'0" 10'5"

SECTION 3

Care and Maintenance of Model 621

Cleaning Optical Parts

Before every show, and at any other time that appears necessary, the projection lens and aperture should be cleaned. The projection lens as well as the condenser lens and the Magnilite Condenser, on equipment with this device, must be kept scrupulously clean and free from dirt and oil. For cleaning, use lens cleaning kit or lens cleaning tissue, either of which may be secured from your dealer at small expense.

The greatest care must be taken when cleaning bloomed lenses, to avoid scratching or rubbing the surfaces. Dust may be removed with a soft camel hair brush applied very lightly and carefully, or alternatively lens cleaning tissue may be used with equal care. The aperture should be cleaned with the Magnilite condenser in position. This will avoid damage to the Safety Shutter. It may be necessary to clear the Flicker shutter from the path of the brush.

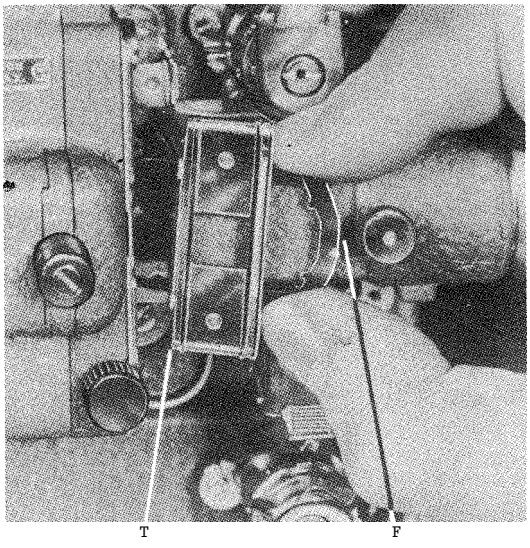
The projector lens, L, Figure 14, is removed by loosening lens locking screw LL, Figure 14, and pulling forward on the lens barrel, LB Figure 14.

The same treatment should be given the Magnilite Condenser, 39, Figure 16, and the main condenser lens, 5, Figure 16.

The condenser lens and the Magnilite Condenser are removed from the projector by pulling on the holder handles. They should be cleaned frequently with the same- materials as used for the lens. NEVER attempt to remove or adjust the lens of the sound optical system. This requires special training and equipment.

This lens, with one face exposed within the exciter lamp compartment and the other exposed toward the sound drum should be cleaned occasionally. The mirror, which can be seen by looking down behind the sound drum from the front of and above the machine, should also be cleaned occasionally.

Figure 22.
T. Guides
F. Metal Frame



Remove the exciter lamp compartment cover by the same methods employed to replace the exciter lamp. This is described in a following paragraph.

Both ends of the lens of the sound optical system should then be cleaned with lens cleaning tissue wrapped around the end of a toothpick, as should the mirror, already described.

Cleaning Film Handling Parts

Preparatory to cleaning the aperture, open the film gate, remove the lens, and the removable gate shoe. To remove the gate shoe grasp the metal frame, F, Figure 22, and withdraw. Use no Tools. Clean and. polish with a soft cloth. If dirt or emulsion has gathered and hardened on the shoe, remove by rubbing with a soft dampened cloth. To avoid scratching polished surfaces, use no sharp tools. To clean the aperture insert the brush supplied with the projector through the opening, being careful to stop forward motion of the brush, at the first sign of contact with the safety shutter.

Slowly withdraw, the brush, turning it in a clockwise and counter-clockwise direction to remove all dust and dirt. Clean the film channel by opening the gate and inserting the brush into the channel in a vertical position. With the gate partially closed, move the brush up and down to remove all dirt and emulsion. THE MACHINE MUST MOT BE RUNNING.

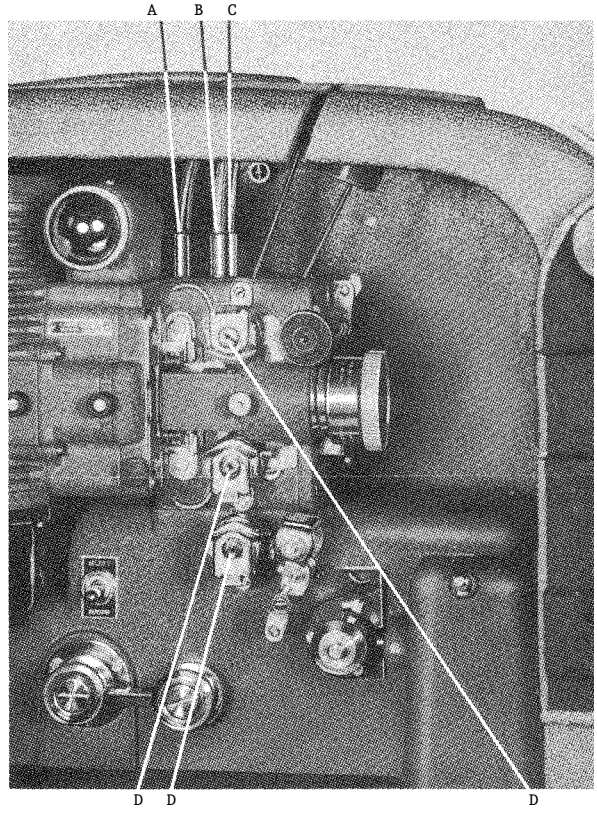


Figure 23.
Points requiring lubrication

When replacing the gate shoe, be sure that guides, T, Figure 22 are placed in the grooves formed by the metal plate attached to the back of the lens casting. An audible click will be heard when the metal frame F is correctly positioned.

Projector Lubrication

The application of Projector Oil at the proper

Lubrication Chart *(See Figure 23.)*

	Silent Speed	Sound Speed
Oil Cup A	One drop of Projector oil after each 8 hours of operation.	One drop of Projector oil after each 4 hours of operation.
Oil Cups B & C	One drop of Projector oil after each 32 hours of operation.	One drop of Projector oil after each 16 hours of operation.
Oil Holes D	Saturate felt reservoirs every 6 months.	Saturate felt reservoirs every 3 months.

points is a simple but very important part of operation.

Correct lubrication will assure long, trouble-free life of the projector. Lack of oil will result in serious damage. Oil cups and holes are readily accessible without removing any part of the machine whatsoever, and the lubrication points indicated in Figure 23, should be given careful attention according to the chart below.

To saturate the felt reservoirs within the sprocket shafts, disconnect the projector from the line and speaker, and lay it on its side. Insert the tip of the oil can in the holes D, Figure *23,* and squeeze the bottom of the oil can three times. After every 100 hours of use, remove thumb screw cap and add grease as necessary to spool arm grease cup E, Figure 24. After every 100 hours of operation, place one drop of Projector Oil on snubber SN and roller K, Figure 11, and on idler rollers where film enters and leaves case.

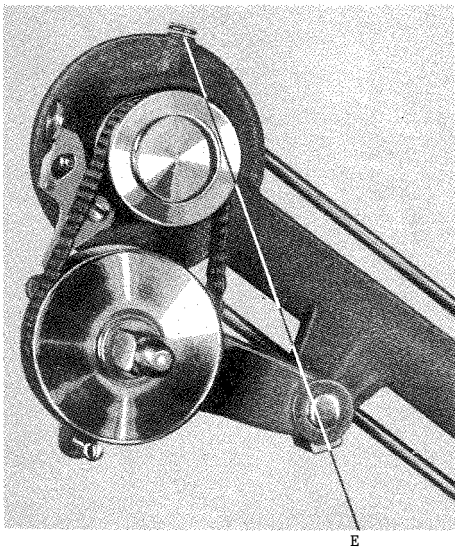


Figure 24.
E. Grease cup.

Exciter Lamp Replacement

The exciter lamp is beneath a three-sided metal cover at the front right-hand corner of projector base, Z, Figure 4, and 22, Figure **16. U**nscrew the thumb nut (on the front) and remove the cover of the exciter lamp compartment. Remove the exciter lamp shield. Press the lamp down, turn it counter-clockwise slightly, and lift it out. It is not necessary to loosen the set screw which holds the exciter lamp socket in place. After a new exciter is installed, and before it is lighted,

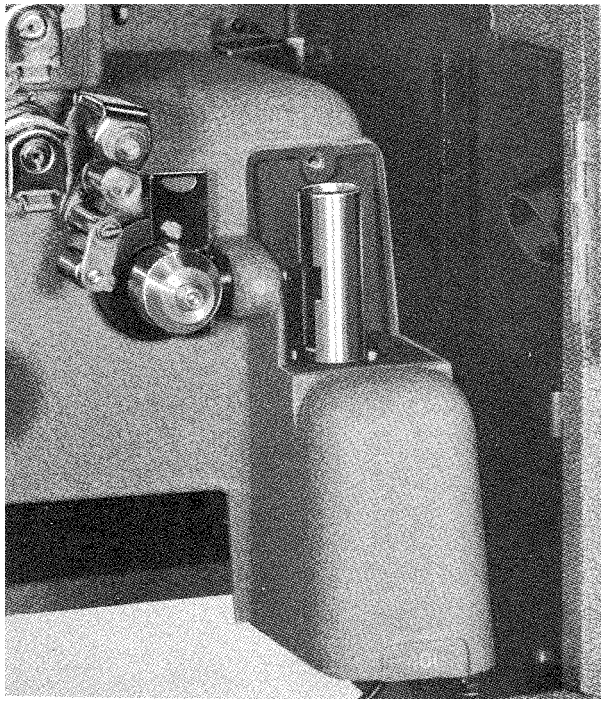


Figure 25.

wipe it (as a lens) to remove all finger marks. An extra exciter lamp is provided with each projector.

No adjustment is required when an exciter lamp is replaced, as the lamp is pre-focussed.

Fuse Replacement

A 1 $^{1}/_{2}$-ampere fuse (See Figure 3) is provided in the amplifier. It should be checked immediately if the exciter lamp fails to light. The fuse will burn out if direct current is fed Into the amplifier supply receptacle.

Always disconnect the mains leads before removing the fuse. Unscrew the insert marked "FUSE" for inspection. Never replace with a fuse larger than the 1 $^{1}/_{2}$-ampere size.

Projector Lamp Replacement

To replace a projector lamp, unscrew the cap at the bottom of the lamphouse and allow the lamp to slide out into the hands as in Figure 26.

If a projector lamp is being replaced during a show, be careful as the lamp slides down to grasp it by the relatively cool pre-alignment gauge ring. This operation should be performed quickly, since a moment or two after the lamp is disengaged from the socket, the pre-alignment gauge ring, acting as a cooling flange, becomes quite warm.

Insert the new lamp with the vertical tongue on the pre-alignment gauge ring toward the front of the projector and revolve it slightly one way or the other until the tongue settles into the pre-alignment gauge slot in the bottom of the lamp-house.

Replace the screw cap, making sure that it screws in squarely and tightly to lock the lamp in the proper position.

Before attempting to change a lamp disconnect the mains lead from the wall-socket.

Since the lamps are designed to burn base down,

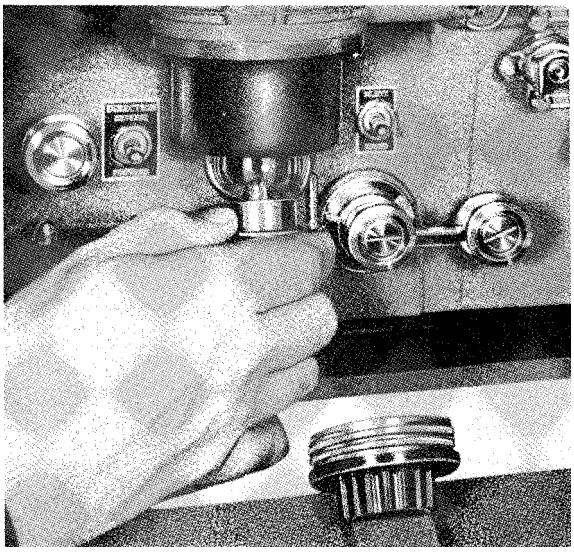


Figure 26.
Lamp replacement

the machine must not be turned upside down or laid on its side while the lamp is burning.

Reflector

The reflector is permanently adjusted at the factory, and no further adjustments should be attempted.

Occasionally it is desirable to polish this reflector in the same manner as the projection lens or the Magnilite condenser. The reflector is removed by turning the holder, Figure 27, counter-clockwise. Polish carefully and replace.

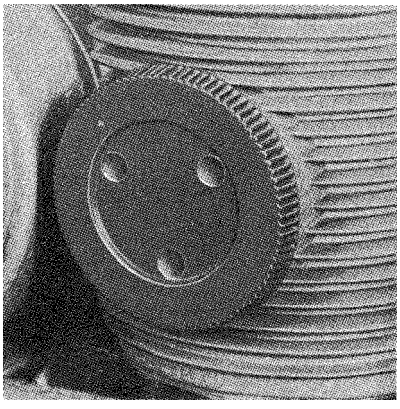


Figure 27.

SECTION 4.

VALVE TESTING

All valves should be tested periodically, if the projector is used frequently, and replaced if they are not up to standard. Gradual deterioration of the valves before the valves actually stop functioning detracts from the amplifier's effectiveness.

A complete set of spare valves should be carried with the equipment to avoid missing a scheduled show.

Correct valve types are shewn on labels near each socket. It is essential that each valve be inserted in the correct socket.

Assuming that a valve has become defective, and that installation of the new set of valves has corrected the difficulty, it then becomes necessary to isolate and eliminate the defective valve.

After the showing has been completed, remove the amplifier from the projector. One at a time the old valves should be replaced in the amplifier, the correct connection made with the speaker and power source, and the amplifier turned on. A loud humming noise will be heard, due to exposure of the photo-cell when the amplifier is functioning. As soon as the defective valve is placed in it, the noise probably will not be heard. This, together with possible new or different noises, will help to identify the defective valve.

If the difficulty with the amplifier was an extraneous noise due to a defective valve, gently tapping each of the valves with the end of a pencil will cause a "rasping" noise when the defective valve is tapped. Discard the defective valve and install a new valve of the same type.

Correct Valves for the Amplifier

Since new types of valves are frequently used in amplifiers as they are made available by the valve manufacturers, and the Model 621 is not necessarily changed because of this, we do not append a list of valves used in this equipment. Remove the amplifier from the chassis, and check the labels Identifying the sockets.

Replacement Valves

Although the valves used in the amplifier can be obtained from most radio stores, it is advisable to use valves which have been thoroughly tested at our factory, as well as on standard-valve testers, to insure finest quality of reproduction.

IF YOU NEED ADVICE, ASSISTANCE, OR SPARE PARTS FOR YOUR EQUIPMENT, A COMPLETE SERVICE IS AVAILABLE UPON APPLICATION TO THE AGENT WHO SUPPLIED YOUR EQUIPMENT, OR DIRECT TO THE 16 MM. SERVICE DEPT., WOODGER ROAD, SHEPHERD'S BOSH, LONDON, W.12. (TELEPHONE - SHEPHERD'S BUSH 2050).

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 1.

DISMANTLING

DISMANTLING

a. REMOVE AMPLIFIER (Figures 20 and 21 - Operating Instructions)

(1) Pull the exciter lamp lead wire out of the small receptacle in the front side of the amplifier.

(2) Remove amplifier holding screws from each corner of the amplifier

(3) With this done, the amplifier can be lifted out of place.

b. REMOVE PROJECTOR FROM BLIMP CASE

(1) Pull reverse belt No. 12830 (figure 5) to the inside of carrying case. The take-up belt No. 21898 can be removed without separating the joined ends, or cutting, by moving the joined ends around to the retaining pin on the motor cap. The belt can then be manipulated from the motor cap pulley and will remain attached to the case.

(2) Lay the projector case on its side with the doors facing up and the bottom facing you, and remove screws No. 50480 (figures 7 &14).

(3) Set the projector case back on its feet, and remove the entire projector assembly from the case by lifting the front end and bringing it out of the case first. The complete projector unit as removed from the case is shewn in figure

c. REMOVE GEAR CASE AND MOTOR FROM SOUNDHEAD ASSEMBLY

(1) Lay the projector on its back and remove three screws No. 21796 (figure 5) and lock washers No. 12661, which are located inside the soundhead and which are directly beneath the gear case.

(2) Disconnect the motor leads where they are connected on the terminal strip in the soundhead.

(3) Remove screw No. M50289 and Washer M 50290 (figure 5) also located inside the soundhead. The entire motor and gear case assembly can then be moved up from the soundhead sufficiently far to allow the dowel holes in the bottom side of the gear case to disengage from the two dowel pins, and to permit separation of the motor and mechanism from the base, if any shims are found, lay these aside and subsequently replace before assembly.

d. REMOVE GEAR CASE FROM MOTOR

(1) The film guide rail No. 5641 (figure 5) will be freed by removal of the two screws No. 5267. There is a small spacing washer No. 4258 under the head of each screw. Remove and handle carefully to prevent loss of washers when the screws are removed.

(2) Continue holding the gear case and motor assembly together and remove fillister head screw No. 5266 (figure 5) and screw No. 873. The clutch lever spring clip No.570 is then free.

(3) Move the gear case slightly until the fibre gear breaks mesh with the motor pinion gear and until the dowel pin on the clutch side of gear case is free of the dowel hole. Pull outward to separate the gear case from the motor assembly. This must be done carefully to avoid the possibility of any damage being done to the fibre gear.

e. DISASSEMBLE GEAR CASE

(1) REMOVE FILM GUIDES AND LENS CARRIER

(a) Remove the pressure plate assembly No. 03788 (figure 5), by pulling on the visible metal frame. Use no tools. The pressure plate assembly is made up of the pressure plate No. 11796 (figure 1), pressure plate yoke No. 13720, bushings Nos. 16198 and 16207, compression springs No. 12071, spring cups No. 12776, and fillister head screw No. 12778. To dismantle, remove the two screws. Care must be taken that the parts do not spring from position as the two screws are removed.

(b) To remove the lens carrier assembly it is necessary, first, that the (2) film guides No. 11761 be removed, unscrew the (4) screws No. 7493 and slip the upper and lower film guides No. 11761 from position. These guides are the same, and can be interchanged.

(c) Unscrew the (4) pilot screws No. 15203 and remove the (2) lens carrier retainers No. 11799.

(d) Lift straight up on the lens carrier assembly to remove it. As the lens carrier is lifted from the gear case, note the position of the gate operating block No.

5160 (figure 1) which is located in the channel on the back of the carrier. The hole in this block engages the stud on the gate lever assembly and actuates the in and out movement of the carrier.

(e) The entire lens carrier assembly, when thus removed, can be taken apart for any necessary repairs. Lens lock No. 03037 (figure 1), can be removed by turning the hexagon base counter-clockwise. To remove lens retaining ball No. 145 and spring No. 5618, unscrew fillister head screw No. 5148.

2. REMOVE SPROCKET GUARDS, FILM HOLLER, TENSION CLIPS AND APERTURE PLATE

(a) To remove the upper and lower sprocket guards. No. 04946 (figure 2), unscrew the (2) screws No. 11757 which are located in the centre of the guard and in the end of the sprocket shaft. As the guards are removed, note spring clips Nos. 16243 and 16244 located beneath the hinged part of the guard.
(b) Unscrew fillister head screw No. 7493 (figure 2) and remove lower film stripper No. 11762. The upper film stripper is the same as the lower and can be removed in the same manner.
(c) Unscrew the (2) fillister head screws No. 5021 (figure 1), and remove the upper and lower film tension clip assemblies No. 03462 and No. 03463, respectively. These two clips are seated on the film gate thrust spring No. 4255 which also is held in place by two screws.
(d) The back edge of the film, gate thrust spring rests against the inner edge of aperture plate No. 11852 (figure 1), and thus holds it in position on the gate case assembly. When the film gate thrust spring has been removed, the aperture plate can be separated from the gear case.

3. REMOVE FRAMER SHAFT AND KNOB

(a) On the back of the aperture plate No. 11852 (figure 1) are two prongs which fit over the eccentric of the framer shaft and knob assembly No. 03464. After the aperture plate has been removed, the framer shaft and knob assembly can be withdrawn from the outside of the gear case casting.

4. REMOVE AND DISASSEMBLE FRONT COYER

(a) To remove front cover assembly No. 04206 (figure 1), remove clamp nut (12087) and unscrew knob assembly No. 03573. This will free the clutch lever No.025033. Remove 4 oval headed screws No. 1587. This will enable the cover to be completely removed from the gear case.
(b) The idler gear No. 890 (figure 1), located on the inside of the front cover can be removed by unscrewing fillister head screw No. 112. Carefully hold the gear in place so the (18) ball bearings No. 6715 do not fall out.
(c) Remove idler gear shaft No. 891, idler gear No. 890, washer No. 11713, and the (18) steel balls No. 6715.
(d) Unscrew fillister head screw No. 3914, fillister head screw No. 971, and lift off the gate operating lever No. 965. The eccentric bushing No. 966 and gate operating lever cam No. 0772 can then be separated from the casting. The eccentric bushing provides the means of adjusting, and the cam provides the action for opening and closing of the lens carrier.

5. REMOVE SPROCKETS, SPROCKET GEARS AND SPROCKET SHAFTS

(a) Each of the sprocket assemblies No. 03461 (figure 1) is locked in place by (2) Allen set screws No. 11859 which are located in the hub of the upper sprocket gear No. 11868, and the lower sprocket gear No. 03460R. Use a 2BA Allen Key to loosen these screws. The sprockets can be slipped from the end of the shaft. Note that the end of sprocket stem locates in the hub of gear. Remove thrust washer No. 6419 located between the end of sprocket and gear.
(b) To remove the sprocket gears, the (2) sprocket shafts No. 11758 must also be removed. Use a 3BA Allen Key, loosen the (2) Allen set screws No. 11269 and slip the (2) sprocket shafts from casting. Note that there is a washer No. 11147 between both the upper and lower gears and casting. The upper sprocket gear is No. 11868 and the lower sprocket gear is No. 03460R.
(c) The ends of felt oiler No. 01477 rest against the sprocket gears, and thus maintain constant lubrication of gears and shafts at all times. Oiler No. 01477 is fastened to gear case with fillister head screw No. 4460.

6. REMOVE CLUTCH LEVER

(a) Unscrew pilot screw No. 5639, (figure 1), and pull out clutch lever stud, No. 5636. This stud is eccentric and is used to make correct adjustment of clutch lever.

(b) Clutch lever No. 025033 can be slipped out of position and removed from gear case.

7. REMOTE SHUTTER AND SHUTTLE

(a) To remove the hexagon shutter nut No. 5112 (figure 1), from the shuttle shaft No. 5322, it is necessary that a special off-set wrench (S-10310-F2) (figure 10) be used.

(b) Insert the end of wrench between bottom of shutter support No. 5111 (figure 1) and oil baffle No. 9558 so that wrench engages the straddle milled end of shuttle shaft No. 5322. Hold firmly in place and turn hexagon shutter nut No. 5112 counter-clockwise. A 7/16" wrench can be used for removing the nut.

(c) Lift off the (2) shutter supports No. 5111 and shutter No. 5110. Note that the stud on the bottom of lower shutter support engages the index of the flat surface on shuttle shaft and that the stud on the bottom surface of the upper shutter support extends through the hole in shutter and into the recess in top of lower shutter support. The above assembly should be observed closely so the various parts can be reassembled in the same manner.

(d) Lift up on lubricator assembly No. 01078, and oil baffle No. 9558 which is connected to lubricator will come free with it. Note the manner in which the oil baffle engages the slot in gear case casting near aperture opening.

(e) Unscrew the (2) fillister head screws No. 5123 (figure 1) and lift up on shuttle No. 8933 until it clears the end of shutter shaft No. 5322. The dowel pins No. 5113 can then be slipped free of shuttle.

8. REMOTE SHUTTLE SHAFT

(a) Invert the gear case and place it over a holding fixture (S-4007-F15) (figure 11) so the shuttle shaft No. 5322 (figure 1) is held securely. Turn shoulder screw No. 8918 (figure 1) counter-clockwise and remove compression spring No. 11110.

(b) Lift tension spring to release Collar and Balls.

(c) Carefully remove the shuttle shaft No. 5322 (figure 1) from the bottom of the gear case so that none of the (15) ball bearings No. 9260 on the under side of the main bearing become lost. As the shutter shaft is removed, note the felt oiler No. 9426 that is wrapped around the small diameter of the shuttle shaft and on the inside of the main bearing No. 529 6 (figure 1).

9. REMOTE WORM DRIVE GEAR AND EXTENSION

(a) Use 2BA Allen Key and loosen the (2) Allen set screws No. 11282 (figure 1) located in worm drive gear extension No. 11279. Slip the extension from the end of counter gear shaft No. 03135.

(b) Place the gear ease over a holding fixture (S-4007-F15) (figure 11) so the fibre counter gear and shaft assembly No. 03135 rests on the round seat as indicated in (figure 11). Unscrew with a 3BA Allen Key the (2) Set screws No. 11281 and No. 11282 (figure 1) which are located in the collar of the worm drive gear No. 11276. Slide the worm drive gear from the end of shaft. Note that the end of set screw No. 11282. is fist on the end while set screw No. 11281 comes to a point. This pointed screw is used so it engages the T-shaped slot in the counter gear shaft.

(c) Slip the worm drive gear from the end of counter gear shaft and remove the (15) steel ball bearings No. 9260 from the seat of the main bearing.

(d) Carefully withdraw the fibre counter gear and shaft assembly No. 03135 (figure 1), from the gear case, and remove the (15) ball bearings No. 9260 from the main bearing. There is also a flat felt oiler No. 9426 around the small diameter of the fibre counter gear shaft. The fibre gear and shaft is one assembly and cannot be separated.

10. REMOTE MAIN BEARINGS

(a) To remove the (2) main bearings No. 5296 (figure 1), unscrew flat head screw No. 11055 and lift out spring clamp No. 11054.

(b) Between the (2) bearings is a connecting hole in which is located a round felt oiler No. 9427 (figure 1). Use a small curved instrument, and press this oiler away from the one of the bearings.

(c) Invert the gear case, and, using a drift punch (S-14878-F1), - figures 10 & 12 carefully tap the bearings until they are free. This punch is of such a size that it does not come in contact with the polished surfaces of the No. 5296 hearings. These bearings are pressed into place and can be removed only in the manner described and as shewn in (figure 12).

(d) When removing the bearings No. 5296 (figure 1), any shims that may be between the shoulder of the bearing and the casting should be saved, as it is essential that the same number of shims be replaced under the same bearing.

(e) The felt oiler No. 9427 (figure 1) can be removed after the bearings have been taken out.

(f) The number of the gear case with all parts removed as described in previous paragraphs is 15199R.

DISASSEMBLE MOTOR, GOVERNOR, BLOWER HOUSE AND LAMP HOUSE.

(1) REMOTE AND DISASSEMBLE GOVERNOR CAP

(a) Unscrew the (2) fillister head screws No. 10349 (figures 3 & 5) which are located at the rear of governor cap assembly No. 02789, (figure 5) and the cap can be pulled out of position on the motor end of housing.

(b) The take-up drive and pulley is a part of the governor cap assembly, and is driven from the governor. At the inside centre of the cap are two studs. The larger one is a guide which engages a hole in centre of governor, and the smaller one is the drive pin which engages either of the two holes in the metal, adjacent to the centre bushing.

(c) To remove take-up pulley No. 10540 (figure 3), unscrew fillister head screw No. 5239 and lift clutch drive cover No. 12864 from the centre of pulley. Disassemble carefully and note the correct assembly of each part.

(d) Remove small compression spring No. 10750 from the slot in clutch cam No. 5514 and lift the cam from the end of the shaft. Note that the bottom of this cam has a slightly raised centre portion. This side of cam must always be assembled downward.

(e) Remove the (3) steel balls No. 5238 from between the upright fingers on the edge of clutch ball retainer No. 10749.

(f) The take-up pulley No. 10540 and the (18) roller bearings No. 5495 can now be removed.

(g) At the back of the cap is a round black penetrated nut No. 10554, which has two holes in it. If a spanner wrench to fit these holes is not available, the nut can be removed with any pointed tool. Turn counter-clockwise to remove.

(h) Hold the take-up drive pin from the inside of the cap and unscrew the fillister head screw No. 6129 at the back end of the cap. The worm shaft and drive blade assembly No. 02794 can now be removed from the inside of cap. If the worm shaft does not readily come out, carefully tap the end of the shaft that fits in the ball bearing cone at the back of the cap. Note felt washer No. 10547 on the worm shaft.

(i) The standard ball race No. 2464 can be lifted from the seat in the cap casting.

(j) Remove dust cover No. 14863 (this cover is push in fit). The removal of the dust cover will expose a coned collar item 14862, clamped to the shaft and pin assembly, item 04454. Slacken 2 Allen screws, No. 12332 with a 2BA Allen Key. Remove collar. Directly beneath this collar are located 35 steel balls, item No. 6715. Remove the complete shaft assembly by gently pulling the drive pulley No. 10540, located at opposite end of shaft, taking care not to lose the second row of steel balls, No. 6715 located on the opposite end of the shaft. When the shaft and pin assembly, (04454) is removed from the governor cap the tufnol worm wheel, No. 14864, will be exposed; note that the slot on one end of this worm wheel engages in the drive pin on the shaft, No. 04454. Between the tufnol worm wheel No. 14664 and the cone collar item 14862 will be found a spring washer, No. 15003.

(k) The take-up drive mechanism is packed in bearing grease during the assembly and additional grease is forced through the assembly by means of a grease gun. The screw hole at the top rear of the cap is the hole through which grease is forced. This hole is plugged with screw No. 10551. The governor cap with all parts removed is No. 02799.

(2) REMOVE GOVERNOR

(a) Loosen the (2) Allen set screws, which are in the hub of governor No. 9428 (figure 3) with the 4BA Allen key, and slip the governor from the end of the shaft.

(b) Remove the (3) governor brushes No. 4664 from the brush holders in motor cap. Note that these brushes must fit freely in holders.

(3) REMOVE AND DISASSEMBLE PILOT LIGHT

(a) Loosen the (2) headless set screws No. 11117 (figure 4) and lift up on pilot light unit assembly No. 03084 to remove. The (2) studs to which the unit is fastened are No. 11116 (figure 4).

(b) The chrome plated pilot light cover No. 11119 can be removed by unscrewing counter-clockwise.

(c) Unscrew fillister head pilot screw No. 11114 (figure 4) from the top of pilot light assembly. The pilot light socket No. 987 and socket tube No. 11120 can be pulled free of pilot light housing No. 11123R. Note that the pilot end of screw No. 11114 engages a slot in socket tube thus acting as a guide for the in and out movement of the pilot light.

(d) To separate socket tube No. 11120 and light socket No. 987, remove round nut No. 986 on the rear end of assembly.

(e) Spread the (2) ends of friction spring No. 985 to remove it from around the socket tube.

(f) The pilot bulb is No. 988.

(g) Beneath the pilot light unit is contact block No. 03085R, (figure 4) with two wires which lead to the terminal strip in soundhead assembly casting. These two wires pass from the contact block, through the blower housing and motor housing, into the soundhead where they connect to the terminal strip.

(h) The terminal strip in the soundhead casting is completely covered with an insulated cover No. M025111 (figure 2) held in place with (2) hexagon nuts No. 3089 and washer 9567. The removal of this cover exposed the terminal strip and all connections.

(i) Disconnect the (2) pilot light lead wires from terminals on terminal strip and the wires can now be withdrawn through the lamphousing. Note that these two wires are so placed that they are clear of the blower fan.

(j) Beneath contact block No. 03085R (figure 4) is a compression spring No. 11118.

(4) DISASSEMBLE CLUTCH MECHANISM

(a) Slip motor clutch spring and roller assembly No. 02252 (figure 5) from its position at the end of armature shaft. Notice that the four rollers on clutch spring engage the (4) motor clutch jaws No. 5188.

(b) Remove the (4) clutch jaws No. 5188 by pivoting each outward until they can be unhooked from the ring around motor clutch jaw adjusting nut, No. 01033. Use care so that they are not broken where they engage the rim of the adjusting nut.

(c) Pull out motor clutch operating pin No. 5189 and remove motor clutch Jaw adjusting nut No. 01033 by unscrewing counter-clockwise.

(d) Slide motor pinion washer No. 5193 from the end of the shaft.

(e) The motor pinion gear No. 9207 turns on (31) roller bearings No. 9208 that lie between the inside surface of the gear and the shaft. Carefully lift off the pinion gear, and remove the roller bearings.

(f) The inner motor pinion washer No. 5193 can then be removed from shaft.

(5) REMOTE BLOWER HOUSING ASSEMBLY

(a) Unscrew the (2) fillister head screws No. 5211 (figure 3) that are located just above and below the main condenser opening.

(b) Hold the motor assembly and remove the (4) fillister head screws No. 5212 (figure 4) located around the motor housing, and the motor assembly can be separated from the blower housing assembly.

(6) REMOVE SAFETY SHUTTER ASSEMBLY

(a) Carefully disengage safety shutter No. 03927 (figure 4) from fire shutter guide No. 5247 in the blower housing. Two fillister head screws No.5248 fasten the guide in place.

(7) REMOTE BRUSH HOLDER HOUSING

(a) On the back end of the armature shaft is a hexagon nut No. 9117 (figure 3), that is locked in place by (2) prongs of locking washer No. 10390. Straighten these prongs, hold the hub of the blower fan with a pair of pliers, and remove the hexagon nut. When removing the hexagon nut be certain that the fan hub is gripped with pliers. Under no circumstances should the armature shaft be held with pliers as even the slightest burr will affect the operation of the clutch.

(b) Remove the (2) motor brush caps No. 11888 (figure 3) and lift out brush spring No. 12909 and motor brushes No. 12918.

(c) Unsolder the yellow lead on the governor brush holder furthest from the centre; unsolder the yellow lead from the brush holder nearest the centre. Unscrew the 4 screws (9718), ease the complete Assembly(M025154) away from the motor housing. It will now be possible to pull the yellow, white, black and green leads away from the motor housing, one at a time. This will free the complete brush housing (025154) which can be laid on the table for further disassembly if required.

(d) Remove spacer No. 10350 (figure 3) from the end of the armature shaft. This spacer locates on the shaft between the end of the commutator and the inside of the motor brush housing.

(e) The (2) Motor brush holders No. 14842 (figure 3) are pressed into the bosses of motor cap, so they may be rather difficult to remove. Unscrew the (2) set screws No. 61 from the bosses and carefully tap the ends of holders from the inside. Note that (2) sides of the square hole in the motor brush holder are parallel to the segments of the armature commutator.

(f) The governor brush holders No. 50,000 and 025000 (figure 3) may also be rather difficult to remove as shellac is used to insulate as well as to secure the holders in position. Use a piece of brass or fibre, and tap the ends of the holders from the inside.

(g) The radial bearing No. 10356 is held in position by the dust plate 10388 which in turn is secured with 3 screws No. 7495. Unscrew these and remove bearing.

(8) REMOVE BLOWER FAN ASSEMBLY.

(a) Unscrew dowel screw No. 374 (figure 4) from the hub of blower fan assembly No. 04883 (figure 4); as the screw is first screwed into place and then staked to prevent it from coming loose, it is necessary to clear away the staking before the screw can be removed.

(b) Carefully pull on blower fan No. 04883 to remove it from the armature shaft but be sure that the fan is not damaged in doing so.

(c) Beneath the fan is a six pronged armature spring washer No. 5162 (figure 4). Note that the prongs point outward and rest against the inside surface of the fan.

(d) Remove spacer No. 5692 from beneath motor spring washer No. 5162.

(9) REMOTE ARMATURE AND FRONT ARMATURE SHAFT BEARING

(a) The Armature No. 16199 (figure 3) can be removed from the rear of the motor housing.

(b) With the armature removed, and the blower housing separated from the motor housing, the front armature shaft bearing No. 2347, (figure 3), and bearing retainer No. 127 62 are accessible. Turn the bearing retainer counter-clockwise to remove it, and use a hooked tool to lift the bearing from position.

(10) REMOVE MOTOR FIELD AND GOVERNOR RESISTOR

(a) To remove motor field No. 15244 (figure 3), unscrew the (4) field retaining nuts No. 5201 and withdraw the field from the motor housing. Note the manner in which the wires leave the field and the way they are placed to avoid contact with any moving part.

(b) To remove motor brush holders unsolder brush connecting leads being sure that all surplus solder is removed from the brush holders. Remove insulating washers (12223) slacken grub screws (61). The brush holders can now be driven out of the castings. To remove governor brush holder; unsolder appropriate wires noting colour coding. The governor brush holders (M.501000 and M.025000) can now be driven through from the back of the casting for replacement if necessary. NOTE: These brush holders are cemented in at the factory and unless replacement is necessary they should not be disturbed. So re-build the brush holder assembly reverse the above procedure paying particular attention to colour coding and that

the brush holder just clears the diameter of the commutator. The best way to ensure proper clearance without too great a gap is either to use the actual commutator as a gauge locating the shaft of the commutator temporarily in the ball race (10356) pushed into the casting or to make up a wooden former which can be centralized from the ball race bore.

(11) REMOVE TERMINAL BOX

(a) The terminal box No. M025201 (figure 4) wiring must be disconnected.

(b) To remove the terminal box, unscrew the (3) fillister head screws No. 5211.

(c) The lamp lock screw is No. 01846R (figure 4).

(12) DISASSEMBLE REFLECTOR ASSEMBLY

(a) To remove reflector assembly No. 03864, (figure 4), from the lamphouse turn it counter-clockwise. The reflector No. 12458 is removed by removing the spring clip 50275. Do not touch the surface of the mirror with the fingers, as its efficiency might be permanently impaired. The mirror should not be removed except for replacement.

(13) DISASSEMBLE 45-50 CONDENSER

(a) The 45-50 condenser No. 01847 (figure 5) is held in position in projector by means of a condenser friction spring No. 5206 (figure 4), which is fastened to motor housing with fillister head screw No. 6716.

(b) Note that condenser lenses No. 6926 and No. 5306 (figure 4) are left slightly loose in the holder to allow for expansion when heated.

(c) Remove the staking from notches in lens retainer No. 5866 and turn the retainer counter-clockwise to remove it from the holder.

(d) As the curvatures of the two condenser lenses are different, one lens being of 45 mm. focus and the other one being of 50 mm. focus, they are located in holder and identified as follows:-

Directly beneath the lens retainer is the 50 mm. condenser lens No.5306. To identify this lens use a micrometer and carefully gauge the thickness of the lens at the peak of its curvature. The dimension at this point is .175 (plus or minus .008) of an inch. Remove spacer No. 1369 and condenser lens No. 6926. The thickness of the No. 6926 lens when gauged in the same manner as the No. 5306 lens is .195 (plus or minus .010) of an inch.

(e) The condenser holder is No. 1561, the handle is No. 15589, and the fillister head screw which fastens the handle to casting is No. 5212.

(14) DISASSEMBLE RELAY CONDENSER

(a) The relay condenser assembly No. 0500 (figure 5) consists of only one lens No.8066 (figure 4) and retaining spring No. 5014 (figure 4).

(b) Use a pointed tool to pry retaining spring No. 5014 (figure 4) from holder No. 5012, being careful that lens is not scratched or chipped. The handle is No.15589 and the fillister head screw is No. 5212.

(c) The relay condenser is held in position in projector with spring retainer No.5626, (figure 4), which in turn is fastened to blower housing with (2) fillister-head screws No. 6716.

g. DISASSEMBLE SOUND HEAD

(1) REMOVE AND DISASSEMBLE FILM SNUBBER

(a) The film snubber assembly No. 05551 (figure 5), can be removed as a separate unit. To do so, unscrew the fillister head screws No. 5266. The entire snubber assembly can now be removed from soundhead.

(b) The snubber actuating torsion spring No. 9412 (figure 2), is located in the snubber bearing No. 9415. Unscrew fillister head screw No. 9178 and slip bearing No. 9415 from the end of shaft. Note that the one end of the torsion spring engages a hole in the collar on the shaft, the other end engages a hole in the end of the bearing. The snubber bearing plate is No. 9414.

(c) The upper idler roller No. 02247 is fastened to the snubber lever and shaft assembly No. 17310 with screw No. 14849 and Nut No. 12087.

(d) To remove snubber assembly, remove 3 screws No. 5266.

(e) The adjustment and correct setting of the snubber is explained in the assembly instructions and also in the section on final adjustments.

(2) REMOTE IDLER ROLLER AND STUD ASSEMBLY

(a) To remove idler roller No. 0224V (figure 2) unscrew idler roller stud No. 17311.

(3) REMOVE OPTICAL SLIT

(a) The optical slit assembly No. 02678 (figure 2) is assembled at the factory positioned in the sound head by means of several delicate precision instruments, and is set to ensure its maximum efficiency. Note that the tube is then locked in place with screw No. 8195 and that a coating of cement has been placed over the screw head. Experience has shewn us that it is not satisfactory to attempt the setting of this tube except at the factory or with the special sound optics setting gauge.

(4) REMOVE ROLLER YOKE AND ARM ASSEMBLY

(a) It is possible to adjust or repair the roller yoke and arm assembly No.03690 (figure 5), but this unit requires an extraordinary amount of care. It is precisely set for run-out and smoothness of operation. Before disturbing these parts, make every attempt to trace the trouble to its real source, which in turn, may save time and difficulty.

(b) The roller yoke and arm assembly No. 03690 (oscillatory stabilizer) is removed by loosening two set screws No. 12248 on the knurled collar No. 12512 and withdrawing the entire assembly from the pivot stud No. 12511. Do not remove this assembly or tamper with its critical adjustment unless it fails to function satisfactorily. Unless the roller will not revolve, it is unlikely that any adjustment whatsoever is needed.

(5) REMOVE EXCITER LAMP SOCKET

(a) Remove the exciter lamp cover No. M50409 (figure 2) by unscrewing knurled head thumbscrew No. 50418.

(b) To remove the exciter lamp No. 17327 (figure 2) press down on the bulb, turn counter-clockwise, and lift out.

(c) The exciter lamp holder No. M025120 is held in position with 4 screws, No. 5266. Unscrew these screws and remove.

(6) REMOVE LOWER SPROCKET GUARD, SPROCKET AND SPROCKET GEAR

(a) Remove film guide No. 11761, (figure 2), by unscrewing the (2) screws No.7493, which hold it in place. This guide is the same as the guides on the (2) sprockets of gear case assembly.

(b) Remove film stripper No. 11762 (figure 2), by removing screw No. 7493.

(c) Remove screw No. 11757, (figure 2), in the centre of the sprocket and pull the sprocket guard assembly No. 04946 from the end of the sprocket assembly. As the guard is removed notice the spring clip No. 16243, and the spacer 16244 which will be free to fall adrift.

(d) The sprocket assembly No. 03461 (figure 2), is fastened to the hub of the sprocket drive gear No. 11867 with (2) Allen headless set screws No. 11859. Use a 3BA Allen Key to loosen these screws. Slip the sprocket from the shaft and remove washers No. 13499 and 6419 located at the end of the sprocket assembly.

(e) To remove sprocket drive gear No. 11867 from sprocket shaft No. 11758, loosen Allen set screw, No. 11268, located on the top of the sound head casting adjacent to the sprocket drive gear use a 2Ba Allen Key. With the set screw loosened, the sprocket shaft can be slipped from position and the drive gear removed. A washer No. 11147 is located between the end of the gear and the casting.

(8) REMOVE SOUND DRUM BEARING, SHAFT ASSEMBLY, AND FLYWHEEL

(a) On the back side of the soundhead casting is a ball bearing retaining cap 13656, held in place by 3 screws No. 5266. Remove cap and the phosphor bronze plunger 13661, together with its loading spring 13659 will be exposed.

(b) Remove (3) screws No. 5266 (figure 2), which hold the front bearing support in place. The light shield No. 12145 will come off at the same time.

(c) Partly withdraw sound drum No. 04169 (figure 2), until the hexagon nut which holds the flywheel No. 17348 on the shaft is accessible. The front hearing (mirror support) is part of the sound shaft assembly (04169) and will lift out of position. Before the sound shaft assembly can be completely removed from the soundhead a tommy bar will have to be inserted in the hole in the sound shaft and the flywheel released by undoing the hexagonal nut 10314.

(d) Turn the hexagon nut No. 10314 counter-clockwise and remove it so that the flywheel can be slipped from the shaft.

(e) The sound drum and shaft No. 01469 should be considered a unit, and should not be taken apart. If it becomes damaged to such an extent that the sound quality is affected, the entire assembly should be replaced. Any attempt to separate the sound drum from the shaft will result in a loss of time, and will be followed by difficulties which cannot be overcome. These sound drum and shaft assemblies are carefully assembled, balanced, and aligned at the factory, and can be replaced only as a unit.

(9) REMOVE RECEPTACLE

(a) The main line receptacle No. 50090 (figure 2), is held in place by (2) fillister head screws No. 7764. Remove the screws and the receptacle can be withdrawn from the soundhead.

(10) REMOVE SWITCHES

(a) The single-pole, single-throw (silent or sound speed) switch No. M025015 (figure 2), the double-pole, double-throw (reverse) switch No. 11025149; and the (2) double-pole, single-throw (lamp and projector switches Nos. M025144 and 12025145 (figure 2) can be removed by unclamping the moulded bakelite screwed ring which holds them in place.

(b) Disconnect the switch leads from their respective terminals on terminal strip (figure 2).

(11) REMOVE MOTOR FILTER CONDENSER

(a) Unscrew 2 chromium plated nuts Ho. 14176 (figure 2) and remove 2 washers (14175). Remove 2 self-tapping screws (13741) and remove terminal cover (M025123). Unsolder 5 wires noting colour coding. Remove condenser (14014J and shield (M50030) together. Two spacers (M50449) will be found assembled to the condenser fixing studs.

(12) REMOVE TERMINAL STRIP

(a) With all wires disconnected from the terminal strip, the strip can be removed from the soundhead. Beneath the terminal strip No. 13812 (figure 2), on each of the overhead screws No. M50395 (figure 2), is a hexagon nut No. 3089 and fibre insulating spacer No. 11908.

h. DISASSEMBLE FRONT SPOOL ARM ASSEMBLY

(1) The front-(feed) reel arm No. 05321, (figure 5), has a clutch which adapts it to act as a take-up when the projector is operated in reverse.

(2) A holding block, made from a piece of hard wood and having a 5/16 inch square hole, 1 inch deep, to hold the square spindle shaft, is a valuable aid during the disassembly and reassembly of the arms.

(3) Hold the square shaft of the reel spindle No. 01138 and unscrew fillister head screw No. 5239 from the centre of the pulley, No. M50358. Lift off reel drive clutch cover No. 12864. Before removing any other parts, note the manner in which the clutch is assembled, particularly clutch cam No. 5514.

(4) Lift out the clutch cam, and remove (3) steel balls, No. 5238 and clutch ball retainer, No. 10749. Note that these balls are located between the three sets of upright-fingers of the retainer.

(5) Remove pulley No. 50358 and the (18) roller bearings No. 5495, which are located between the pulley and the spindle shaft.

(6) Beneath pulley No. M50358 and around the spindle shaft No. 01138, may be found one or more shim-washers No. 1367. These washers are used to eliminate excessive end play.

(i) DISASSEMBLE REAR SPOOL ARM AND TAKE-UP ARM

(1) REMOVE TAKE-UP ARM

(a) To remove take-up arm No. 11481 (figure 6), from the rear reel arm No.05319, press take-up arm shaft No. 11468R from the casting.

(b) Carefully, but securely, hold the square take-up spindle, and remove hexagonal nut, No. 11475.

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 2

ASSEMBLY

A S S E M B L Y

REASSEMBLE GEAR CASE

(1) REASSEMBLE MAIN BEARINGS INTO GEAR CASE

(a) Replace felt oiler No. 9427 (figure 1), into the connecting hole between the two main bearing seats. Oil outside of shuttle shaft bearing.

(b) Carefully start shuttle shaft bearing No, 5296 (figure 1), into place so that the round hole in the side of bearing will line up with felt oiler No. 9427

(c) Use a drift punch (S-14878-F1) - Figs. 10 & 12 insert into the end of bearing and carefully tap punch until bearing is correctly seated. The same punch as shewn in (figure 12) is used, but the bearing is assembled from the opposite side of the gear case from that shewn in the illustration. Note that this punch is of such a diameter that it does not seat on the polished bearing surface. If the punch should in any way damage the polished surface, it will be necessary to replace the bearing.

(d) In removing counter gear and shaft bearing No. 0296, (figure 1), one or more shims may have been found between the shoulder of the bearing and casting. As the height of this bearing directly controls the throw of the shuttle (in and out movement of shuttle teeth), it is essential that the same number of shims be used when replacing the bearing. If no shims were under the original bearing none should be used under the replacement.

(e) The same procedure is used to assemble the counter gear shaft bearing No. 5296 into the gear case.

(f) With the bearings in position, check to see that felt oiler No. 9427, (figure 1) extends through the hole in the side of each bearing. This is very important.

(g) Lay spring clamp No. 11054 (figure 1), in place and fasten down tightly with flat head screw No. 11055.

(h) Saturate felt oiler No. 9427 (figure 1) , thoroughly with projector oil. Fasten Oiler with screw.

(2) ASSEMBLE APERTURE PLATE AND FILM TENSION CLIPS

(a) Insert framer shaft No. 03464, (figure 1) , into the hole in the side of gear case. Lay aperture plate No. 11852 in position on gear case and see that the (2) prongs that extend to the back side of aperture plate engage the eccentric earn on framer shaft No. 03464 (figure 1).

(b) Film gate thrust spring No. 4255, (figure 1) , is next placed in position; then the upper and lower film tension clips. No. 03462 and No. 03463 are placed in their respective positions, fasten the clips and thrust spring to the gear case with (2) fillister head screws No. 5021.

(c) The back edge of the film gate thrust spring rests against the inner edge of the aperture plate and will thus hold it in position on the gear case during the remainder of the assembly. The aperture plate will be solidly secured by (2) large headed screws when the completed gear case assembly is fastened to the motor and blower housing assembly.

(3) ASSEMBLE SPROCKET SHAFTS. SPROCKET GEARS. SPROCKETS AND FILM GUARDS

(a) Place the end of sprocket shaft No. 11758, (figure 2), through the hole in the side of gear case and assemble upper sprocket gear No. 11868 and spacing washer No. 11147, over the end of the shaft. Insert the end of shaft into the hole in the casted boss of gear ease. The flat surface on the end of the shaft must face so that the Allen set screw No, 11269 engages the flat surface. Set screw No.11269 can be started into the casting and screwed down far enough to prevent the shaft from turning, but it must be left loose enough so that shaft can be adjusted in or out. Use a 2BA Allen Key on the set screw.

(b) The lower sprocket shaft is assembled into place in the same manner as the upper one and all parts are the same with the exception of the lower sprocket gear, which is No. 03460E.

(c) Oil the shafts thoroughly and see that the gears revolve freely.

(d) The next step is to assemble film guides No. 11761, using fillister head screws No. 7493 to fasten them loosely in place.

(e) In order to correctly adjust the sprocket shafts, it is necessary that a special service tool (S-15177-N1-N2) Fig.10 & 12 be used. Place gauge (S-15177-N1) on end of shaft against the step in film guide No. 11761. Hold the film guide against the circumference of the gauge and tighten the (2) fillister head screws No. 7493.

(f) With gauge (S-15177-N1) Figs. 10 & 12. in position on the shaft, against the step in film guide No. 11761, screw shaft setting gauge (S-15177-K2) into the end of sprocket shaft as far as possible. This will withdraw the shaft until the large diameter of shaft is flush with the outer end of gauge (S-15177-N1) and properly locates the sprocket shafts so that when sprocket is assembled, the position of the sprocket will he in correct relation to the film guide. Once this setting is attained the Allen set screws No. 11269 Fig. 1. which lock the sprocket shafts in place should he securely tightened. Remove gauge (S-15177-N1-N2) from the shaft.

(g) When the shaft is properly located, the distance from the face of the step in the film guide to the shoulder at the end of the sprocket shaft is .635 (-.003) of an inch.

(h) Place the sprocket assembly tool (S-15177-F3) (figure 10), over the end of the sprocket shaft. Thoroughly oil the sprocket shaft and the felt oiler on the inside of sprocket No. 03461. Slip thrust washer No. 6419 Fig. 1. and sprocket No. 03461 over the end of the shaft. The thrust washer locates between the end of toe sprocket and sprocket gear. The assembly tool is used to prevent damage to the oiler felt on the inside of the sprocket.

(i) To adjust the sprocket gear place a .002 shim (S-15177-N4) Figs. 10 & 12 between the back of the sprocket gear hub and the spacing washer. The (2) Allen set screws No. 11859 Fig. 1. , located in the hub of the sprocket gear, can not be tightened, thus locking the sprocket to the gear. These (2) screws should be tightened a little at a time to avoid binding. Remove the .002 shim. The sprocket and gear must revolve freely.

(j) Place sprocket guard No. 04946, (figure 2), spring clip No. 16243. and spacer No. 16244 in position on the end of the sprocket shaft, and fasten in place with fillister head screw. No.11757. The spring clip No. 16243 supplies the necessary tension to automatically close the guard and hold it so during the operation of the machine.

(k) Both sprockets are assembled in the same manner and the parts involved are the same.

(l) Assemble upper and lower strippers into place. Fasten with Fillister Head screws.

(4) ASSEMBLE COUNTER GEAR AND SHAFT ASSEMBLY INTO GEAR CASE

NOTE: The 60 Steel balls removed from the gear case must be destroyed and replaced by 60 new steel balls during reassembly. Only G.B. Bell & Howell specially graded steel balls should be used.

(a) For this assembly special service tools are required (S-4007-F5-F6-F11-F14-F15 and stock 1459) (figures 10 & 11).

(b) Place brass sleeve (S-4007-F5) and bearing retaining sleeve (S-4007-F6) on the post of holding fixture (S-4C07-F15). Around the top of bearing retaining sleeve (S-4007-F6), place (15) ball bearings No. 9260. (Fig. 1.).

(c) Place a small amount of bearing grease on the bearing seat of the counter gear and shaft No. 03135 (figure 1) , adjacent to the fibre gear.

(d) The end of the shaft should be placed over the small diameter of the steel stud on the holding block (S-4007-F15), (figures 10 & 11), and into the end of the projecting brass sleeve (S-4007-F5). Hold the part upright on the stud, and slip the bearing retaining sleeve (S-4007-F6) upward so that it presses the ring of balls against the bearing surface (greased) of the shaft. Hold the brass and bearing retaining sleeves (S-4007-F5 and S-4007-F6) firmly against the bearing surface of the shaft; remove the stud, and invert the shaft and sleeves so that the gear end of the shaft is downward. Next, slip the brass sleeve off the shaft; then remove the bearing retaining sleeve. Correctly done, a snug ring of (15) balls should be embedded in the grease around the base of the shaft.

(e) One of the steel quills (S-4007-F15) should be placed in the holding block (S-4007-F11) with the brass end of the quill resting on the supporting post. Lay the felt oiler No, 9426 Fig. 1. in the channel on the top of the block approximately centred over the quill. Place the counter gear shaft with the (15) balls embedded in grease as described in the preceding paragraph, into the quill so that the felt oiler No. 9426 fits around the shaft. luck the two ends of the oiler under the other quill, and hold the quills and the shaft securely while removing from the fixture. The clip (stock STK 1459) should be clamped around the quills at approximately the centre of the shaft, as shewn in (figure 11).

(f) The shaft of the counter gear No. 03135, (figure 1), with the quills and clip still attached to it is assembled into the main bearing No. 5296 until the quills are in about halfway. Remove the clip and push the quills and shafts the remainder of the way into the bearing so that the bearings that are on the shaft rest on the main bearing. The two quills can then be withdrawn.

(g) Hold the counter gear and shaft firmly in place so that the ball bearings cannot fall out, and invert the gear case.

(h) Place the gear ease with counter gear and shaft assembly No. 03135 onto the holding

fixture (S-4007-F15), as indicated in (figure 11), so that (15) more ball bearings No. 9260 can be laid into the bearing surface inside the gear case then slip the worm gear No. 11276. (figure 1). over the end of the shaft until it rests on the bearings. Lock the worm gear in place on the shaft with socket set screws No. 11281, and No. 11282, using a 2BA Allen Key. Note that the end of one set screw is flat, while the end of the other set screw is pointed. The pointed set screw must engage the U-shaped slot in the shaft; the flat set screw must rest against the smooth side of the shaft. These set screws must be tightened so that there is no possibility of the worm gear slipping.

(i) There must be absolutely no end play of the fibre counter gear and shaft in the main bearing.

(j) Slip the worm gear extension No. 11279 onto the end of the shaft, and lock in place with two socket set screws No. 11282.

(5) ASSEMBLE SHUTTLE SHAFT, SHUTTLE AND SHUTTER INTO GEAR CASE

(a) The assembly of the (15) ball bearings to the bearing seat of the shuttle shaft No. 5322, (figure 1), is done in the same manner as the reassembly of the counter gear and shaft assembly. See (figure 11). When the oiler has been secured by the two quills (S-40Q7-F14), Fig. 11., the shuttle shaft is placed in its respective bearing No. 5296. Be sure that the oiler felt No. 9427 between the main bearings contacts both shafts.

(b) Before proceeding further with the assembly, it is necessary that the fibre counter gear No. 03135 Fig. 1. and the cam of the shuttle shaft No. 5322 be correctly timed. To do so, the index slot on the cam of the shuttle shaft must be in correct alignment with the index hole in the top of the fibre counter gear. This setting is very important and must- be made correctly.

(c) Once the setting is made, hold the shuttle shaft carefully in position and invert the gear case. Place the milled end of the shuttle shaft into the holding fixture -(S-4007-F15), as indicated in (figure 11).

(d) Fifteen more ball bearings No. 9260 Fig. 1. are placed into the seat formed by the bearing and the shaft. Oil the balls, and slip the shuttle shaft collar No. 11280 (figure 1), over the end of the shaft, making certain that the smooth end of the collar rests on the ball bearings as solidly as possible so there will be absolutely no end play of the shuttle shaft in the main bearing when the collar is fastened on the shaft.

(e) Lift Tension Spring. Replace steel balls and collar.

(f) Place compression spring No. 11110 Fig. 1. over the end of the shaft and screw shoulder screw No. 8918 into the threaded end of the shaft. Tighten the screw firmly in place.

(g) Remove the gear case from the holding fixture and invert it for the assembly of the shuttle and shutter.

(h) Insert the two shuttle dowel pins No. 5113, (figure 1), into the (2) shuttle slides. These dowel pins should have a minimum amount of play in the shuttle slides, but must slide freely.

(i) Place shuttle No. 8933 over the cam on the shuttle shaft No. 5322 so that the V-shaped heel of the shuttle engages the grooved cam section of the counter gear and shaft assembly No. 03135, fitting the two dowel pins No. 5113 into the half-round milled grooves in the casting.

(j) Press the (2) dowel pins out toward the sides of the casting as far as possible and lock in place with the (2) fillister head screws No. 5123.

(k) Turn the mechanism by revolving the counter gear shaft extension. All parts should revolve freely and evenly. Care must be taken that the T-shaped heel on the shuttle is not too tight in the cam groove of the counter gear and shaft assembly, and that the shuttle operates freely around the cam of the shuttle shaft and on the dowel pins. The play in all three parts should be held to an absolute minimum, but all parts must work freely and evenly.

(l) The shuttles are made in four types in order to assure greater ease in good fitting. Each shuttle is marked either 1, 2, 3, or 4. For replacement, a shuttle bearing the same number as that of the shuttle removed should be used whenever possible.

(m) The distance that the shuttle teeth should project above the surface of the aperture plate is .028 (plus/minus .005) of an inch.

(n) A gauge (S-4529-N3), (figure 10), should be used to check the height of the shuttle teeth. The shuttle cam should be revolved to the point where the shuttle teeth protrude farthest through the aperture plate. The gauge is then placed on the rails of the film guide plate as shewn.

(o) The .023" step in one end of the gauge should strike the teeth; the .033" step in the other end of the gauge should pass over the teeth. If the teeth come at any point between these two settings of the gauge, they may he considered set for normal operation. The two heights mentioned are clearly marked on the side of the gauge.

(p) When the shuttle teeth do not project far enough through the aperture plate, as determined by gauging, correction is made by disassembling the counter gear Ho. 03135 and placing the required number of shims beneath the bearing No. 5296 (figure 3).

(q) When a shuttle tooth projects too far through the aperture plate, correction is made by using another shuttle or stoning down the teeth.

(r) Avoid bending the shuttle to make a proper fit. Do not alter the grooves in which the shuttle dowel pins lie. Make certain the aperture plate is flat.

(s) Check to see that all moving parts and all bearings surfaces have been sufficiently oiled.

(t) A gauge (S-16931-N1), (figure 10), should be used to check the shuttle stroke. Lay the mechanism so the aperture plate faces up.

(u) Open the film gate and turn the mechanism by revolving the counter gear extension until the shuttle teeth start to protrude through the aperture plate, at the beginning of the shuttle stroke. Lay the gauge into the film channel so that the slots in the edge of the gauge rest over the shuttle teeth. Close the film gate and hold the gate lever down lightly, and again, turn slowly to operate the mechanism. The movement of the shuttle will slide the gauge along the aperture plate until at the bottom of the stroke the shuttle teeth withdraw behind the plate. Continue turning the hand setting knob until the shuttle teeth again come up through aperture. Visually, or by feel, determine whether the teeth are striking the gauge as they come through. If so, it indicates that either the distance between the shuttle teeth is too great, or that the shuttle bearing pins are not in line, or that they are not parallel with one another. Be sure that the shuttle dowel pins No. 5113 Fig. 1. are seated solidly and that the retaining screws are tight.

If these conditions are not observed carefully, the stroke of the shuttle is likely to be insufficient, and faulty projection will result.

(v) Place lubricator Ho. 01078 (figure 1), into place and see that the (2) felt fingers touch the shuttle pins.

(w) Remove the lubricator and assemble oil baffle No. 9558 to fit it. Saturate all felts of lubricator thoroughly with oil. Lay the entire assembly into place in the gear case and make certain that the tip on the end of the oil baffle fits into the slot in the casting, which is near the condenser opening.

(x) Place one of the shutter supports No. 5111 over the end of the shuttle shaft No. 5322, so that the round extruded stud of the support engages the index slot in the surface of the shuttle shaft.

(y) Lay shutter No. 5110 in place and assemble the second shutter support No. 5111 on the top of the shutter so that the extruded stud of this support passes through the hole in the shutter and engages the slot on the top of the lower shutter support.

(z) Hold the cam part of the shuttle shaft with special offset wrench (S-10310-F2) as shewn in (figure 10), and assemble hexagon Nut No, 5112 Fig. 1. on the end of the shaft. Tighten nut securely. Revolve the shutter, and see that it does not strike the oil baffle or the easting at any point.

(6) ASSEMBLE AND INSTALL FRONT COVER (See Figure 1.)

(a) Assemble control shaft (03573) through first hole in bracket (12077), assemble nut (12081) to shaft, push control shaft through second hole in bracket, screw shaft through link assembly, (03574), assemble and tighten nut (12087) to end of control shaft cheeking for free movement of control. Offer front cover assembly to the front of the gear case ensuring that the idler gear (890) meshes correctly and that the 2 dowel pins register in the gear case. Fit 2 screws (1587) to the bottom 2 fixing holes. Enter 2 screws (1587) through the clutch manipulator assembly (12077) and offer the assembly up to the front of the gear case dropping the link (03574) over the top of the clutch operating lever (025033). Enter the 2 screws into the top of the front cover and tighten. Check free action of control.

A later type of front cover (04721R) has the bracket 12077 incorporated as lugs on the front and the front cover assembly is fixed to the gear ease with 4 screws(1587), Check mesh of gear (890) and location of dowels. Push clutch control shaft through the 2 holes in the front cover assembly, screw end of shaft into the* link on the clutch lever assembly (025176), screw on locking nut (12087) push cir-clip (16184) into the groove provided on the clutch control shaft. Check free action.

As a further modification the circlip will be found assembled to the control shaft about an inch and a quarter from the control knob.

(b) Place gate operating Lever No. 965 Pig. 1. over the end of the shaft on the gate operating lever cam, and fasten in place with fillister head screw Ho. 971. Screw fillister head screw No. 3914 into the front of the lug to look the eccentric bushing.

(c) The eccentric bushing of this assembly provides the necessary means of adjusting the gate for proper setting of the film channel. Detailed explanation of this setting is covered in paragraph b of Final Adjustment section.

(d) The assembly of idler gear Ho. 890 to the lug on the inside of the front cover is performed by installing the idler gear over idler gear shaft No. 891 and placing (18) ball bearings No. 6715 into the race thus formed. Pack with grease. Lay the washer No. 11713 over the shaft and on top of the gear. Carefully assemble these parts, and fasten into place with fillister head screws No. 112. The idler gear must revolve freely.

(e) Fasten the complete front cover assembly No. 04206R (figure 1), to the gear case with (4) oval head screws No. 1587. The clutch remote control assembly No. 03575 is held in place by the (2) upper screws.

(7) ASSEMBLE CLUTCH LEVER TO GEAR CASE

(a) Insert the roller end of clutch lever assembly no. M025033, (figure 1), into its place on the side of the gear case easting.

(b) Place eccentric clutch lever stud No. 5636 into the hole in the side of casting, and through the clutch lever. Lock in place with fillister head screw No. 5639. Adjustment of the eccentric is made later. See paragraph d of Final Adjustment.

(8) ASSEMBLE AND INSTALL LENS CARRIER

(a) Place lens retaining ball No. 145, (figure 1), into the tapered hole on top of the lens carrier, and clamp into place with spring No. 5618 and fillister head screw No. 5148.

(b) The lens lock No. 03037 should be screwed firmly in place so that the knurled adjusting nut can be turned without the lens lock coming loose.

(c) Assemble the pressure plate carrier No. 12719 to the lens carrier with (2) pressure plate adjustment nuts No. 11795 and (2) fillister head screws No. 12075. The adjustment nuts are eccentric and are used to properly centre the pressure plate in relation to the aperture plate.

(d) Remove film guides No. 11761, (figure 2), from the first and second sprockets. They were installed for adjustment of sprocket shaft.

(e) Place the gate operating block No. 5160, (figure 1), into the milled slide on the back of the lens carrier. Note that one side of this block has rounded corners. The block should be placed into the slide so that the rounded corners rest against the lens carrier casting.

(f) Lay lens carrier assembly and the gate operating Block No. 5160 into the milled channel of the gear case so that the hole in the gate operating block engages the stud on the plate and shaft assembly. Place the two lens carrier retainers No. 11799 in position so that the three prongs on the edge of each retainer hold the lens carrier in place. Fasten in place with (4) pilot screws Ho. 15203.

(9) NSTALL AND ADJUST FILM GUIDES

(a) The film guides No. 11761, (figure 2), are held in place below the upper sprocket and above the lower sprocket by fillister head screws No. 7493.

(b) The clearance between the film guide and the sprocket should be from .012 to .014 inches, and under no circumstances should it be set at less than the .012 inch minimum. To adjust, loosen the two screws that hold the film guide in place, and slip the, gauge (S-15638-N4), (figure 10), around the sprocket so that the thin edge of the gauge (curved to fit the contour of the sprocket) rests between the shoulder of the film guide and the edge of the sprocket. Press the film guide against the gauge and tighten the screws.

(b) REASSEMBLE MOTOR, GOVERNOR, BLOWER HOUSIHG, AND LAMP HOUSE

(1) INSTALL GOVERNOR RESISTOR

(a) Slip the governor resistor No. 13982 and Insulating Sleeve No. M50093, (figure 3) into the resistor clamp No. 13983 and then lay it in place in the round cut-out portion of the lower fin, inside the motor housing. Fasten in place with fillister head screw No. 1738.

(a) Bring the lead wires forward, and lay the wires against the inner surface of the motor housing; one wire on one side, the other wire on the opposite side of the housing.

(b) The lead wires will be connected after the motor has been assembled.

(2) INSTALL MOTOR FIELD AND MOTOR AND CAP ASSEMBLY (See Figure 3).

(a) Screw the 4 field retaining studs (5200) into the 4 holes inside the motor housing.

(b) Insert the 3 field coil leads into the special outlet channel in the front of the lamphouse casting; at the same time lead the 4 leads from the end cap assembly through the same channel, thus, there will be 7 leads in all to be carefully pulled through together.

(c) The motor fields (15244) should be carefully guided into place over the retaining studs and clamped in position by 4 nuts (5201).

(d) The complete motor end cap assembly should be left hanging sufficiently loose for the armature to be passed through the field tunnel and the front bearing, after the fields have been fixed and the motor end cap is ready to be clamped into position.

(3) INSTALL ARMATURE SHAFT FRONT BEARING

(a) If during disassembly, it was found necessary to remove the front armature shaft bearing No. 2347 (figure 3), from the front armature bearing seat, the new race should be carefully pressed or tapped into place so that it seats evenly and is not tilted.

(b) Thoroughly grease the bearing.

(c) Use a spanner wrench which fits the (2) slots in top of the bearing retainer. No. 12762 and tighten it securely.

(4) INSTALL ARMATURE

1. Before assembling armature No. 16199 (figure 3), into the motor housing, check to see that all the field and resistor wires are clear and properly placed, so there is no possibility of their rubbing on the armature.

2. Insert the long (threaded) end of the armature shaft through the motor field, and the front armature shaft bearing. Place spacer No. 10350 over the back end of the

3. armature shaft (next to the commutator).

4. Again cheek to see that all the wires are clear of the armature.

5. Place the brush holder assembly on to the motor housing, ensuring that the two resistor leads are left sticking through ready to be soldered. Fasten the assembly to the motor housing with 4 screws (9718). Solder 1 resistor lead to the governor brush holder farthest from the centre and one resistor lead to the brush holder nearest the centre.

6. The (2) resistor lead wires, and the (2) motor field wires are all pulled through the openings in the brush holder housing.

(5) INSTALL BLOWER FAN ASSEMBLY

1. Place spacer No. 5692, (figure 4), on the armature shaft until it rests against the front armature shaft bearing, then place star-shaped spring washer No. 5162 on the shaft so the (6) prongs will press against the inside surface of the fan when it is assembled into place.

2. Note that the dowel screw hole in the armature shaft is counter bored. Place blower fan No. 04883 on the shaft so the large diameter of the hole in the shaft is visible through the hole in the hub of the fan. Fasten the fan into place with dowel screw No. 374.

3. After the dowel screw has been screwed firmly into place, lay the hub of the fan on a solid block, to avoid the possibility of bending the armature shaft, and carefully stake the edge of the screw hole over the head of the dowel screw. This will eliminate any possibility of the screw working loose.

4. Place lock washer No. 10390, (figure 3), over the rear end of the armature shaft next to the bearing in brush holder housing, and screw the hexagon Nut No. 9177 on to the shaft. Now, hold the hub of the fan with a pair of pliers, and tighten the nut securely. Under no circumstances, should the armature shaft be gripped with the pliers, as even the slightest burr will affect the operation of the clutch.

5. With the hexagon nut securely tightened, at least two of the prongs on the lock washer should be bent up against the sides of the nut to prevent it from coming loose.

(6) INSTALL MOTOR BRUSHES

(a) Insert motor brash Ho. 12918, (figure 3), and brush spring No. 12909 into the square hole of the brush holder. If the brush is not new, be sure the concave contact surface of the brush will fit the curve of the commutator. The brash and the spring are held in place with motor brush cap No. 11888 (figure 3).

(7) ASSEMBLE AND INSTALL BLOWER HOUSING

(a) Place safety shutter guide No. 5247 (figure 4), in its position on the blower housing, and fasten with (2) screws No. 5248.

(b) Place safety shutter No. 03927 into its channel in the blower housing, and engage the small right-angle hook on the shutter with the safety shutter guide. The safety shutter must slide up and down freely in the channel, and not stick or bind at any point. The shutter also must fit fairly close in order to prevent an excessive amount of air from escaping along the sides. This would cause the shutter to operate sluggishly.

(c) Directly above the fire shutter channel and beneath the pilot light unit, an adjusting screw No. 5893, (figure 4), is located to facilitate the operating adjustment of the shutter. An added air vent is drilled from the front of blower housing and intersects the screw hole which is drilled from the top of housing. In turning the screw either up or down, the flow of air to the fire shutter can be controlled by either permitting part of the air from channel to escape when the screw is partly removed or by sealing the hole with the screw and allowing it the air to act against the shutter. The correct operation of safety shutter is explained under paragraph & of the section on Final Adjustments.

(d) Screw the (2) pilot light fastening studs No. 11116 (figure 4), into the holes on top of the blower housing, directly above the fire shutter channel.

(e) Insert the (2) lead wires of the contact block No. 03085R between the two pilot light fastening studs. Coil spring No. 11118 should be placed in the hole on the underside of the contact block.

(f) The two pilot light lead wires must be pressed together the top (inside) of the blower housing and inserted into the slot through the bottom of motor housing. Where the two pilot light lead wires pass through the blower housing, they must be formed and placed so that they will not come in contact with the blower fan.

(g) Be careful to avoid damaging the fire shutter when placing the blower and motor housing together. Line the units up so that the dowel hole in the motor housing lines up with the dowel pin No. 5173 in the blower housing. Use the (2) fillister head screws No. 5211, (figure 3), one on each side of condenser opening, and (4) fillister head screws No. 5212, (figure 4), around the motor housing, to fasten the two units together.

(8) ASSEMBLE AND INSTALL PILOT LIGHT

(a) Place light socket No. 987, (figure 4), into socket tube No. 11120 so that the threaded end of the socket extends through the hole in the rear of the tube, and the extrusions on the inside of the tube engage the slots in the rear end of the light socket. This holds the (2) terminal screws, located on the side of the socket, in a vertical position, as required. Screw round nut No. 986 onto the rear end of the socket until it holds the units securely together.

(b) Assemble friction spring No. 985 into the groove on the outer surface at the front of the socket tube. This spring supplies the friction which prevents the pilot light from moving in and out too freely. Sometimes it may be necessary to spread the spring in order to obtain the tension required.

(c) Screw the chrome-plated light cover No. 11119 onto the front end of the socket tube.

(d) Compress friction spring, and slide the assembly into pilot light housing No. 11123R so that the long slot in the socket tube faces up.

(e) Prom the top of the pilot light housing, screw No. 11114 into the casting making certain that the end of the screw engages the slot along the top of the socket tube. This acts as a guide for the in-and-out movement of the pilot light.

(f) Lay the pilot light assembly over the contact block, and lock it in place with (2) headless set screws No. 11117 (figure 4).

(9) INSTALL GOVERNOR (See Pigs. 3 & 5) .

(a) Assemble 3 Governor Brushes (4664), ensuring free movement in holders.

(b) Slip governor No. 9428 onto the end of armature shaft. As the take-up drive mechanism in the governor cap is driven from the governor, it is necessary that the governor be located on the end of armature shaft so there is a space 39/64 of an inch between the back of the governor and the rim on motor cap against which the governor cap seats.

(f) The governor must also ran true to within .003 of an inch, This means that when the governor is running, it must not weave more than the .003-inch. By loosening the set screws in the hub of the governor, and slightly revolving the governor on the shaft, any weave or run-out can he eliminated.

(10) ASSEMBLE AND INSTALL GOVERNOR CAP

(a) Place tufnol worm wheel No. 14864 (figure 3), on shaft and pin assembly No. 04454R so the slot in one end of the gear engages the pin in the large diameter of the shaft.

(b) Insert these two parts into the governor cap until a bearing seat is formed between the large diameter of the shaft and the cap casting. Place (35) steel ball bearings No. 6715 in this seat and pack with bearing grease. Then slip the shaft the remainder of the way into the cap. Carefully hold the shaft in place and invert the cap so that the other end of the shaft is accessible.

(c) Replace the same number of shims No. 10555 that were removed during disassembly. More can be added later if needed to eliminate end play.

(d) Assemble thrust spring washer No. 15003 lay 35 steel balls around track and assemble coned collar No. 14862 by compressing the thrust spring as tight as possible (by hand) and tighten 2 Allen set screws with a 2BA Allen Key. Finally push home the dust cover No. 14863.

(e) Again, invert governor cap so that take-up pulley No. 10540 can be assembled. Place the pulley over the end of the shaft and lay (18) roller bearings No.5495 between the inner diameter of the pulley and the shaft. Oil thoroughly.

(f) Lay clutch ball retainer No. 10749 into the clutch seat of the take-up pulley, and place clutch cam No. 5514 into the centre of the ball retainer. Note that one side of the clutch cam has a slightly raised centre surface. It is most important that this surface be laid downward against the clutch ball retainer. Under no circumstances must the raised surface face outward, because the action of the take-up would be reversed.

(g) Lay one steel ball bearing No. 5238 into each of the three sets of upright fingers of the clutch ball retainer, and place compression spring No. 10750 into the slot in the clutch cam. All clutch parts should be sparingly oiled.

(h) Place reel drive clutch cover No. 12864 over the clutch assembly, and screw fillister head screw No. 5239 into the end of the shaft.

(i) Lay the 6 mm, bearing No. 2464 into the bearing seat at the extreme rear end of the cap. Place felt washer No. 10547 on worm shaft and drive blade assembly No. 02794; grease the shaft freely with bearing grease, and assemble into place from the inside of the cap. Securely hold the worm shaft, and screw fillister head screw No. 6129 into the rear end of the worm shaft. The rear bearing should be packed with ball bearing grease, and a spanner wrench, fitting the two holes in round black, special nut, No. 10554, can be used to screw the special nut into place.

(j) The entire take-up mechanism, exclusive of the clutch, should be packed in bearing grease. A grease gun can be used to force the grease in around the gears and the bearings. Force the grease through the hole on top of the cap until it comes out at the end of the shaft. Carefully wipe off all excess grease, and seal the grease hole with screw No. 10551.

(k) Place the governor cap into position over the governor so that the drive pin on the shaft inside the cap engages one of the (2) holes in the steel surface of the governor. These two holes are adjacent to the centre bushing of the governor.

(l) Fasten the governor cap assembly No. 02789, (figure 5), securely in place with (2) fillister head screws No. 10349.

(11) ASSEMBLE TERMINAL BOX. LAMP HOUSE COYER AND AIR CIRCULATING TUBE

(a) Place terminal box No. M025201, (figure 4), in position right against the bottom of the lamp housing. Fasten in place with three fillister head screws No. 5211.

(b) The wiring diagram, (figure 19), should be used to supplement the following instructions. It is absolutely necessary that the wires be attached to the proper terminals as shewn, because an incorrect connection may result in serious damage to the equipment.

(c) Screw lamp lock screw No. 01846 (figure 5), into the bottom of the terminal box.

(d) Insert the air circulating tube No. 03941, (figure 4), into the lamp-housing from the top so that the two projections on top of the tube fit into the slots on top of the lamp-housing and the round hole on the side is toward the reflector. Cheek to see that the tube is seated all the way.

(e) Place lamp house cover. No. 13428, on top of the Lamp housing, and fasten in place with (2) fillister head screws No. 5212.

(12) ASSEMBLE CLUTCH MECHANISM

(a) Place motor pinion washer No. 5193 (figure 4), over the end of the armature shaft and against the hub of the fan.

(b) Place motor pinion gear No. 9207 on the shaft so that the flat end of the gear is toward the fan.

(c) Place a very small amount of bearing grease in the space between the inside surface of the pinion gear and shaft. Assemble (31) roller bearings No. 9208 into this space so that they completely encircle the shaft.

(d) No other oil or grease should be applied to the pinion gear assembly.

(e) Lay another motor pinion washer No. 5193 over the end of the shaft so that it rests against the pinion gear No. 9207.

(f) To insure the correct operation of the clutch, it is necessary that the following adjustment be made. Screw the clutch jaw adjusting nut No. 01033 over the end of the shaft as far as possible so that the pinion gear and friction discs are locked in place. The adjusting nut should then be unscrewed from one to one and one-fourth turns, until the slots in the adjusting nut line up with the slots in the end of the shaft. (Under no circumstances should the adjusting nut be unscrewed more than one and one-fourth full turns or less than one turn.

(g) Assemble the (4) clutch jaws No. 5188 into place. The small hooked end of the jaw fits under the ring of the adjusting nut, and the under side of the jaw extends through the slot in the adjusting nut and into the slot in the armature shaft.

(h) Place motor clutch spring and roller assembly No. 02252 in position over the clutch jaws so that the rollers on the spring engage the clutch jaws.

(i) By pressing the clutch pin in as far as it will go, the clutch jaws are forced outward, thus releasing the pressure against the pinion gear, and allowing it to turn freely on the shaft. When the clutch pin is pulled part way out, pressure is again exerted against the pinion gear, locking it to the shaft.

(13) ASSEMBLE MOTOR ASSEMBLY AND LAMP HOUSING

(a) Carefully place the gear case assembly No. M025177, (figure 5), into position on the face of the lamphouse and motor assembly No. M025202 (hospitalized) so that the dowel pin on the clutch side of the gear case engages the corresponding hole in the blower housing.

(b) Inasmuch as the fibre counter gear and the motor pinion gear must be meshed when the gear case is assembled to the blower housing, care must be taken that the teeth of the fibre gear are not damaged during the assembly. At no time is it necessary to force the gear case into place, and under no circumstances should it be done. In the event that some difficulty is encountered making the assembly, the gear case should be carefully moved to mesh the fibre gear and pionion gear. At the sane time, move the clutch lever back and forth so it engages the clutch operating pin.

(c) When the dowel pin in the gear case casting has been fitted into the hole in the blower housing, it is certain that the fibre and pinion gears are probably meshed and that the gear case is in its correct position. Fasten the units together with fillister head screw No. 5266, (figure 5).

(d) Fasten the clutch lever spring No. 570 into place with fillister head screw No. 873. This screw also holds the gear case to the blower housing. The clutch lever spring bears against the clutch lever, and holds it flat against the air vent on the side of the gear case.

(e) The (2) large head fillister head screws No. 5267, (figure 5), are used to hold the guide rail No. 5641 and the aperture plate No. 11852 in place, and to secure the gear case to the blower housing. Place the (2) spacing washers No. 5248 into the large holes at the outside corners of the aperture plate, and lay the film guide along the edge of the aperture plate. Press the guide rail inwards so that the fingers of the rail rest against the inside edge of the slots in aperture plate. Screw the (2) large head screws firmly into place.

(f) The aperture plate should move up and down when the framing knob No. 03464 is turned. The spacing washers No. 5248 are used to prevent the aperture plate from binding when the screws which hold the film guide rail in place are tight.

SOUND HEAD

(1) ASSEMBLE SOUND SHAFT AND FLYWHEEL

(a) Extreme care must be used to prevent any dirt lodging in the 6 mm radial bearing No. 12246, (figure 2). If the bearing does not revolve freely, wash the bearing in spirit. Lubricate with very light oil.

(b) Insert the end of the sound drum shaft No. 04169, (figure 2), through the opening in the front of the base casting, and slip flywheel No. 17348 over the end of the shaft. Look the flywheel securely to the shaft with hexagon nut No. 10314. Insert the end of the shaft into the radial bearing previously installed.

(c) The collar (bearing support) on the sound drum end of the shaft is fastened to the easting with (3) fillister head screws No. 5266, (figure 2). One of these screws also holds the light control shield No. 12145 in position. This shield prevents extraneous light from striking the photo cell, and should be adjusted so that it does not intercept the scanning beam.

(d) Properly assembled, the sound drum and shaft must revolve with absolute freedom and with no high spots or indications of sluggishness. It must be perfectly balanced,

(2) ASSEMBLE THIRD SPROCKET GEAR. SPROCKET, AND SPROCKET GUARD

(a) Place the end of sprocket shaft No. 11758, (figure 2), through the hole in the front side of the casting. Assemble sprocket drive gear No. 11867, (figure 2), on the shaft, from the inside of the sound head. Next, place Washer No.11147 over the end of the shaft into the hole in the cast boss. The flat surface on the side of the shaft, must face up so that Allen set screw No. 11268 engages the flat surface. The set screw can be screwed down, using a 2BA Allen Key to prevent the shaft from turning, but the screw must be left temporarily loose enough so that the shaft can be adjusted in or out. Oil the sprocket shaft.

(b) The next step is to install film guide No. 11761 (figure 2), using (2) screws No. 7493 to fasten it in place.

(c) In order to adjust the sprocket shaft correctly, it is necessary that a special service tool be used (S-15177-N1-N2) (Figs. 10 & 12). Place the plug gauge (S-15L77-N1) on the shaft and press it against the shoulder of the guide. (Figure 12) indicates the correct method of using the tools for adjusting the sprocket shaft on the gear case; they are used in exactly the same manner en the sound head. Screw adjusting screw (S-15177-N2). into the end of the sprocket shaft until the large diameter of the shaft is flush with the outer surface of the plug gauge (S-15177-N1). This locates the shaft so that when the sprocket is assembled, the position of the sprocket will be in correct relation to the film guide.

(d) Once the setting is attained, the sprocket shaft should be securely locked in place with Allen set screw No. 11268, Remove the gauges from the shaft.

(e) Place sprocket assembly cone (S-15177-F3) (figure 12), over the end of the sprocket shaft. Oil the. sprocket shaft, and slip thrust washer No. 6419, (figure 2), and spacer washer No. 13499 on the shaft. Saturate the felt, oiler on the inside of sprocket No. 03461 with oil, and slip the sprocket over the cone and on to the shaft. The cone prevents damage to the felt oiler. Remove the sprocket assembly cone.

(f) Place sprocket guard No. 04946, (figure 2), and spring No. 16243 and spacer No. 16244 in position on the end of they shaft and fasten in place with fillister head screw Ho. 11757. Place the guard in a vertical position. The spring supplies the necessary tension to close the guard automatically. Note that the screw has an oil hole through which the felt inside the sprocket may be oiled.

(g) The clearance between the film guide and the sprocket should be from .012 to .014 of an inch and under no circumstances should it be set at less than the .012-inch minimum. To adjust, loosen the (2) screws No. 7493 (Fig. 2), which hold film guide No. 11761 in place, and slip special gauge (S-15638-H4) Fig. 13. around the third sprocket so that the thin edge of the gauge (curved to fit the contour of the film guide), and the sound track edge of the sprocket press the film guide against the gauge, and securely tighten the two screws. (Figure 13) shews the correct method of using the special gauge (S-15638-N4).

(h) Place a .002-inch shim (S-15177-N4) (Figs. 10 & 12) between the back of the hub of sprocket drive gear No. 11867 (figure 2), and washer No. 11147. Then tighten the (2) headless set screws No. 11859, located in the hub of the gear, with a 2BA Allen Key, thus locking the gear to the sprocket. These two screws should be tightened a little at a time to avoid binding. Remove the .002 shim. The sprocket and gear must revolve freely and evenly. This is imperative to obtain satisfactory sound. The use of the .002-inch shim is clearly shewn in (figure 12). It is used in the same manner during this operation.

(3) INSTALL MOTOR AND GEAR CASE ASSEMBLY ON SOUND HEAD (Figure 5) .

(a) Place the motor and gear case assembly on the sound head so that the (2) dowel pins engage the (2) dowel holes in the bottom of the gear case. Carefully hold; the assembly together, and screw the (3) screws No. 21796 with lock washers No. 12661 into the gear case from the inside of the sound head.

(b) The screws No. M50289 and Washer M 50290 are screwed in to endcap easting through the soundhead easting. This helps to support and hold assemblies together. When this is done, all the wires from the motor assembly will extend into the sound head where they can be connected to their proper terminals.

(4) ASSEMBLE EXCITER LAMP SOCKET

(a) The whole of the exciter lamp lead (025121) contains the washer (10598)and compression spring (M 50408) (Fig. 2) and should be referred to as a completely assembled unit which is just dropped into the exciter lamp holder. Check for free movement.

(5) ASSEMBLY OF SNUBBER (See Fig. 2).

(a) Assemble screw (14849) through roller (02247) and bracket (17310) into shaft (17309) ensuring that the raised portion of the bracket rests in the cut away on the shaft (17309). Drop the clamp ring (9414) (polished side towards roller) over the shaft (17309), drop the spring (9412) over the shaft (17309) drop the cover (9415) over the spring (9412) secure the cover through the centre to the shaft with the screw (9178). Assemble second screw (14849) through the roller (02247) serew into the bracket (17310) and lock with nut (12087).

(b) Assemble snubber. Unit (05551) (Fig. 5) onto soundhead
Drop the spring cover (9415) (Fig. 2) of the stabilizer assembly through the hole **in** the soundhead immediately under the sound/silent switch with the extended roller towards the flywheel. Secure the snubber to the soundhead with 3 screws (5266). Whilst the snubber is being clamped to the soundhead the spring cover protruding through the inside of the soundhead casting should be rotated as hard as it will go **in** a clockwise direction. This will ensure that the snubber is roughly under tension correctly. Check that rollers are free,

(6) IHSTAL ROLLER YOKE AND ARM ASSEMBLY (OSCILLATORY STABILIZER)

(a) Place torsion spring pilot No, 12514, (figure 2), in the hole (on inside) in the arm of the roller yoke and arm assembly Mo. 03690.

(b) Place torsion spring No. 12504 in the arm so that the front end fits in the hole in the knurled collar, and the other end extends around the pilot.

(c) Place this assembly on the mounting stud, No. 12511, (as shewn in (figure 2), and tighten the (2) set screws in the knurled collar so that the stabilizer is secured to the stud.

(d) See paragraph h of the Final Adjustment section for correct setting of the roller yoke and arm assembly.

d. ASSEMBLE 45-MM to 50 MM. CONDENSER

1. The 45-mm to 50-mm. condenser No. 01847, (figure 5), consists of two separate lenses one of 45-mm focus, and the other of 50-mm focus. The only way they can be identified is by the curvature of the lens. All the lenses should be clearly labelled to avoid confusion when in stock or when removed from the holder. In the event that they do become mixed, each lens can be identified by gauging the distance from the flat side of the lens directly through the centre of the lens to the peak of its curvature. A micrometer can be used to do the gauging, but extreme care must be exercised so that the lenses are not scratched. The 50-mm lens No. 5306 (figure 4), will gauge .175(plus/minus .008) inch. The 45-mm lens No. 6926 will gauge 1.95 (plus/minus .010) inch.

2. To assemble, lay 45-mm condenser lens No. 6926 on the shoulder inside condenser holder No. 1561 so that the flat side of the lens faces outward.

3. Lay spacer No. 1369 on top of the lens, and lay the 50-mm condenser lens No. 5306 on top of the spacer so that the flat surface of the lens faces outward.

4. Screw lens retainer No. 5866 into the holder until it rests against the condenser lens, and then, back off this retainer from 1/8 to 1/4 turn (measured around circumference of ring) to allow for expansion. Stake the edge of the holder into the (2) slots of the retainer.

e. ASSEMBLE RELAY CONDENSER

1. The relay condenser No. 0500, (figure 5), consists of one lens No. 8066, and is held in holder by retaining spring No. 5014. The curvature of both surfaces is the same.

f. FRONT AND REAR SPOOL ARM HOLDERS

(1) These components, are jig assembled to ensure perfect alignment of belts and film between the Case and the Projector and their position is quite critical. IT IS RECOMMENDED THAT THESE SHOULD HOT BE REMOVED.

g. ASSEMBLE COMPLETE TILT KNOB (Figure 7).

(1) Place end of tilt rack (11168) with tapped hole into milled cut out in bar foot (26911), so that the teeth in the rack are at 90 to bar foot. Assemble with bolt (11649) and washer 26923. Assemble 2 rubber feet (26903) to bottom of bar foot with 2 bolts (26902).

(2) Assemble front projector mounting support (26907) to bracket (26912), using 4 rubber washers (26906) 2 spacers (26905) 2 mashers (WAS 514,) and 2 bolts (26909).

(3) Place the entire assemble in position inside front of case and secure with 4 bolts (SCRI/4166) and 4 cup washers (WAC. 3/2).

(4) Place washer (11170) over pinion bearing (03114) and insert pinion bearing into 9/16" hole in front of case, and screw into bracket (26912). (Note: this is a left-hand thread).

(5) The friction cup is lined with cork. lay the brass band (10736) into the friction cup so that the gap is at the top. The blade spring (11283) is closed to the shape of a 'U' and inserted into the friction cup with the open end of the 'U' facing upwards, placing additional tension on the friction band.

(6) Assemble the tilt rack and foot assembly through the bottom of the case, passing through the two square holes in the bracket (26912). The teeth in the tilt rack should be facing the door apertures.

(7) Place pinion assembly (03115) into pinion bearing (03114) so that the teeth engage with the tilt rack, and pin rests between the ends of the friction band.

(8) Insert pilot screw (10739) into pinion bearing. This engages into the groove in pinion assembly.

(9) Place domed washer (6182) over end of pinion assembly, with the outside of the dome against the shoulder of the pinion.

(10) Place knob assembly (02832) over pinion bearing assembly, so that the 2 pins on the outside of the knob straddle the 2 ends of the brass friction band. Screw hexagon nut (10738) on to end of pinion, thus locking the whole assembly.

h. ASSEMBLY REAR PROJECTOR MOUNTING SUPPORT INTO CARRYING CASE

(1) Assemble rear projector mounting support No. 26904, (figure 7) into the rear (inside) of carrying case using (2) rubber mountings No. 26906 (2) spacers No. 26905, (2) washers No. WAS 514 and (2) fillister head screws No. 26209.

i. INSTALL PROJECTOR IN CASE

(1) It will be found that it is easier to get the projector into the case when the back end is inserted first and the machine is brought back against the inside of the case to allow clearance for the front end of the projector.

(2) Place the projector assembly so the screw holes in each corner of the base are over the screw holes in the support brackets No, 26910 & 26907; then, fasten in place with (4) fillister head screws No. M50480 and Washers No. M50290,(figure 7). Screw up tight.

j. INSTALL AMPLIFIER

(1) Turn the case and projector assembly on its side as shewn in (figure 20).

(2) See that all amplifier valves are firmly seated in their sockets in the amplifier.

(3) First, place the front end of the amplifier into the sound head; then, seat the back end into place. Insert the exciter lamp lead into the socket on the amplifier.

(4) Fasten in place with four knurled head screws No. 12823. (Figure 15).

k. FRONT ARM ASSEMBLY (Figure 6) .

(1) Push oilite bush (17183) into the hole in the casting (16939) and secure with the screw (17182). Ensure that the screw enters the hole in the oilite bush, and does not clamp down on same. Assemble washer (17184) onto spool spindle (01138)and push the shaft of the spool spindle through the oilite bush. Assemble thrust washer (17897) to the shaft protruding through the oilite, secure the shaft in the oilite with the split washer (1375). Place shims (1367) as required, and place the pulley (M50358) with the counter bore side uppermost over the shaft assembling the 18 rollers (5495) between the pulley (M50358) and the shaft of the spool spindle (01133) oiling lightly. Place the ball retainer (10749) into the counter bore of the pulley (M50358) with the extrusions uppermost. Place the clutch cam (5514) over the 2 flats on the end of the spool spindle shaft with the 3 cam faces tapering or thinning in a clockwise direction and the elongated hole accepting the extrusion on the ball retainer plate (10749). Drop 1 ball (5238) into each of the 3 cam faces on the cam plate (5514) being sure that each ball is held between the two extruded ears. Put a few spots of oil on each cam face. Place phosphor bronze shim (15582) over the cam plate, if required and place the cover (12864) over the assembly and secure with the screw (5239)

l. ASSEMBLE TAKE-UP ARM

(1) Place a layer of bearing grease on the ball race inside the large rewind pulley and race assembly No. 03447, (figure 6), and lay (19) ball bearings No. 5238 around the shaft. Lay to one side. Also grease bearing seat of bearing retaining ring No. 11474 and place (19) more of the No. 0239 bearings into the grease. Sufficient grease must be used to hold the bearings in place during assembly.

(2) Assemble rewind pulley and race assembly No. 03447 and take-up arm assembly No. 11481R together so the ball bearings on the inside of the pulley rest against the bearing seat in the take-up arm. Hold together, and screw bearing retaining ring No. 11474 (with balls) on to the end of the shaft. Screw down until the bearings rest against the bearing race in the take-up arm casting; then, back up the retaining ring about one-quarter turn to allow clearance for the free operation of all parts. Screw hexagon nut No. 11475 on to the end of the shaft and against the retaining ring. The nut must be tightened securely so the retaining ring is locked firmly in place.

(3) Lay rewind gear No. 11463 over the end of the shaft, fitting it to the shaft; then fasten securely with fillister head screw No. 9178.

(4) All parts must operate freely and evenly.

m. ASSEMBLE TAKE-UP ARM TO REAR REEL ARM

(1) The complete take-up assembly is assembled to the complete rear arm assembly by means of the hinge pin No. 11468R Fig. 6. This pin is a press fit.

(2) Place fabric take-up belt No. 11478 over the take-up drive pulley, and the rewind pulley assembly.

n. ASSEMBLE REAR ARM (Fig. 6).

(1) Assemble rewind lock lever (03446) to easting (05317R) with screw (11470). This screw acts as a hinge pin as well as a means of securing the lever to the casting. The pin pressed into (05317R) protrudes into the elongated hole of the lock lever (03446) and acts as a limit pin. One end of the coil spring (11466) is trapped under the limit pin, the other end being trapped under the small spigot riveted to the lock lever. With the screw (11470) tight and the spring (11466) in position, the lock lever assembly should have a free spring action when depressed. Assemble the pulley (04523) into the casting (05317R). As this pulley is entered into the hole the tufnol brake pad (12129) with its compression spring (12128) should be trapped between the inside flange of the pulley and the counter bore in the casting (05317R) When the pulley has been completely entered lay the assembly down on the table with the pulley shaft uppermost and assemble the 16 steel rollers (L1471) applying a few spots of projector oil. Take the bearing ring (11472) and lightly drift into position over the rollers. The object of this ring is to ensure that the rollers will remain in position. The last operation is to screw the large pulley (11462) into the shaft of the pulley (04523) remembering that this pulley and shaft have a left-hand thread. Screw oil plug (16941) into the top of the easting.

O. INSTALL TAKE-UP AND REVERSE BELTS

(1) Insert Reverse belt No. 12830 (figure 5), and take-up belt No. 21898, into their respective positions and connect each into an endless loop. The reverse belt goes through the arm holder, down into the gear case where it loops itself around and out again. The take-up belt goes through the rear spool arm holder, loops around the take-up pulley on the governor cap and comes back out through the reel arm holder.

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 3

FINAL ADJUSTMENTS

FINAL ADJUSTMENTS

a. GENERAL

(1) It is important that the projector be carefully tested, and that certain adjustments to various components he made upon completion of repairs which have included any disassembly and reassembly. Besides the following specific adjustments, the final inspection of a repaired machine should include the running of a spool of sound reproduction.

b. ADJUST PRESSURE PLATE

(1) The outer edge of the pressure plate No. 11796, (figure 1) is slotted in order to provide clearance for the shuttle teeth; therefore, it is necessary to centre the plate so the shuttle teeth will not strike either side of the slot. This adjustment can be made during assembly. The pressure plate is a part of Assembly No. 03788 (figure 5).

(2) Close the gate so the pressure plate rests on the aperture plate. Sight along the film channel, and turn the hand setting knob so the shuttle makes a full stroke. The shuttle teeth should be centred in the slot in the pressure plate.

(3) The position of the pressure plate can be adjusted by inserting a screwdriver through the lens carrier, and loosening the (2) screws so the pressure plate carrier can be shifted to the left or to the right, as required. Tighten the screw when the adjustment is correct.

(4) A further adjustment to insure the proper tension on the film is also required. This adjustment can be made only after the gear case has been securely fastened to the blower housing and all screws securely tightened.

(5) Close the gate by moving the gate lever down as far as it will go.

(6) Loosen the locking screw No. 1587, (figure 1), located in the front side of lug on front plate, in which the gate operating lever pivots. With an open end wrench (S-103C9-F1) (figures 10 &. 13) turn the hexagon nut, which is part of an eccentric bushing and which controls the position of the lens carrier, until the gate shoe just comes in contact with the aperture plate. Observe the shoulder of the (2) studs on the back of the gate shoe. When the separation between the stud shoulders and the retaining plate is approximately .008 inch, the adjustment is correct. The lens carrier must be closed all the way. Tighten locking screws to lock adjustment.

(7) Too little or too much pressure may result in an unsteady projected picture.

c. SPEED

(1) The speed adjustment necessarily must be very accurate in order to obtain satisfactory sound quality, and the only accurate method of checking the speed is by means of a tachometer. When using a tachometer, the reading is taken from the hand setting knob No. 10565, (figure 5). At 16 frames per second (silent speed), the reading is 960 revolutions per minute.

(2) In the event that a tachometer is not available, an alternative, but rather difficult and not nearly so accurate a setting, can be obtained by counting the revolutions of the sprocket. At 16 frames per second, (silent speed), the sprocket speed is 120 R.P.M. and at 24 frames per second (sound speed), the sprocket speed is 180 R.P.M.

(3) A somewhat simpler method of timing necessitates the use of an endless film loop exactly 80 frames long (2 feet long). At sound speed the loop will pass through the mechanism 18 times per minute. Count the splice as it passes a predetermined point. At silent speed, the loop will pass through the mechanism 12 times per minute.

(8) The speed is adjusted by means of the set screw located on each set of contact points on the governor. These contacts operate under spring tension, one set of points being for silent, the other for sound speed. The set of points with the weaker spring controls silent speed, and the strong spring controls sound speed.

(5) By turning the set screws, which adjust the gap between the contact points (increasing the gap), the correct speed can be obtained.

d. CLUTCH LEVER-FIRE SHUTTER ADJUSTMENT

(1) The correct clutch lever adjustment is essential to the correct operation of the fire shutter inasmuch as the lever shuts off or releases the flow of air that operates the shutter, through the small hole in clutch side of the gear case.

(2) Loosen fillister head screw No. 5639 (figure 1) and adjust eccentric stud No, 5636 until the following results are obtained. With the projector operating either at 18 or 24 speed, and by operating the clutch lever back and forth, the fire shutter must close (cover aperture opening) before the clutch lever is pulled back far enough to stop the mechanism. Likewise, in releasing the clutch lever, the mechanism must start running before the fire shutter opens.

(3) To facilitate the correct adjustment of the fire shutter, a screw is located in a hole drilled through the top of the blower housing directly above the fire shutter channel, and beneath the pilot light. By turning the screw, either in or out as required, the flow of air to the fire shutter can be controlled, and the shutter made to rise or to drop more quickly.

(4) Any noise resulting from vibrations (while projector is running), in the clutch or clutch lever, can be eliminated by a slight adjustment of the eccentric No. 5636.

(5) The clutch lever spring No. 570 must hold the lever snugly against the air vent.

(6) Correctly adjusted, the fire shutter should operate in relation to the movement of the clutch lever as explained in paragraph (2).

(7) By checking a new machine and studying the relation between the operation of clutch lever and fire shutter, the above explanation will be more readily understandable.

e. ADJUST FILM GUIDES

(1) The (3) film guides No. 11761, (figure 2), are held in place at each sprocket by (2) screws No. 7493.

(2) The clearance between the film guide and the sprocket should be from .012 to .014 of an inch, and under no circumstances should it be set at less than the .012" minimum. To adjust, loosen the (2) screws which hold the film guide in place and slip the gauge (S-15638-N4), (figures 10 & 13) around the sprocket so the thin edge of the gauge (curved to fit contour of sprocket), rests between the shoulder of the film guide and the edge of the sprocket, as shewn in (figure 13). Press the film guide No. 11761 against the gauge and tighten the (2) screws No. 7493.

f. SNUBBER TENSION

(1) The (3) screws No. 5266 (figure 1) that fasten the snubber to the sound head casting must be left loose while the tension of the snubber is being set.

(2) Note that by turning the bearing part of the snubber that extends into the soundhead, the tension of the snubber can be increased or decreased as desired. Turn the bearing until the snubber can be raised about 1/16 of an"inch from the snubber stop before any tension is felt on the snubber. This means that the torsion spring in snubber is at rest when the snubber is in position as shewn in (figure 21 of the Operating Instructions), but upon raising the snubber about 1/16 of an inch, the torsion spring begins exerting pressure on the snubber. As the snubber is raised, the tension will build up strong enough to take care of all conditions.

(3) Once the required setting is attained the (3) screws No. 5266 should be securely tightened.

g. SPROCKET SYNCHRONIZATION

(1) The sound sprocket setting gauge (S-16539-N1), (figure 10), is used to synchronize the second sprocket with the third sprocket. The setting gauge should be handled carefully to avoid damaging the sprocket teeth.

(2) Loosen the screw No. 11757 (figure 1) which holds the safe-lock guard No. 04946 to the third sprocket, so the sprocket can be pulled forward slightly, (it may be necessary to remove stripper), thus disengaging the second and sound sprocket gears and making it possible to turn the sound sprocket independently of the second sprocket.

(3) Place the gauge over the second sprocket, engaging the two slotted fingers of the gauge with two of the sprocket teeth. Thus placed on the second sprocket, the gauge arm will point downward, and the slot in the bottom end of the arm should rest over a sprocket tooth on the third sprocket.

(4) If the teeth on the third sprocket are not in position to match the gauge, pull out the sound sprocket enough to permit its rotation, and turn until one of the teeth engages the slot. Press the sprocket back into position, tighten the screw, and replace the stripper.

h. YOKE AMD ABM ASSEMBLY (OSCILLATORY STABILIZER)

(1) Make an endless loop of "buzz track" sound film, which should be threaded through the second sprocket, the yoke and arm assembly (oscillatory stabilizer and the third sprocket).

(2) With the mechanism running and the amplifier and the speaker turned on, the "stabilizer" should be positioned on the shaft on which it pivots, by moving it in or out as necessary, until the least amount of sound is audible. The "buzz track" sound film has a low frequency along one edge of the sound track and a high frequency on the other edge of the sound track. It is when the "stabilizer" is positioned so that it centres the sound track on the scanning beam that the minimum sound reproduction is audible from both tracks. Thus positioned, the stabilizer is correctly adjusted.

(3) In conjunction with this setting, another adjustment must be made. The spring tension of the "stabilizer" should be adjusted by turning the bearing retaining sleeve in which the two set screws are mounted so that the "stabilizer" comes to rest in its operating position within 2-1/2 seconds after the mechanism has been started.

(4) Only by making these two critical adjustments correctly can the sound reproduction be absolutely true, since it depends upon the oscillatory stabilizer functioning perfectly.

i. OPTICAL SLIT ASSEMBLY

a. If the optical slit assembly No. 02678, (figure 2), was removed or disturbed, it must be repositioned correctly to insure satisfactory sound reproduction. The adjustment of the stabilizer must be done for correct slit scanning across the sound track before making any adjustment on the optical slit.

NOTE: This adjustment of the optical slit assembly must be done in a quiet location.

b. Thread the projector with a strip of 5000-cycle note test film.

c. Turn the amplifier switch on and set the VOLUME control approximately 1/3 of the way up.

d. Look at the optical slit assembly.' Note that one end has two small screws in it. This is the end which must be toward the exciter lamp. Note also that the lens on each end is masked and that there is a rectangular slit cut in each mask. The long sides of the rectangle should be parallel with the horizontal.

e. Grasp the optical slit assembly on the exciter lamp side. DO NOT block the exciter lamp rays. Turn the projector switch to the ON position. Move the optical slit assembly forward and backward until the maximum volume is obtained. The long sides of the rectangular slit should still be parallel with the horizontal when the point of maximum volume is reached.

f. Tighten the set screw No. 8195 (figure 2) , immediately to lock the optical slit assembly in place. Be very careful not to change the setting of the optical slit when tightening the set screw. Seal the set screw in with sealing wax.

g. The optical slit adjustment is a VERY CRITICAL ONE. BE CAREFUL during adjustment.

h. Special tools for making the optical slit adjustment are available.

j. SPRING BELTS

(1) Be certain that the belt ends are joined together securely, that the belts are not kinked, and that the belts do not rub on the case. If the projector is properly located in the ease, the belts should be near to the centre of the openings.

k. FILM RUNNING TEST

(1) Upon completion of repairs and after all the necessary adjustments have been made, it is always advisable to run film through the machine in order to check the mechanical and sound operation of the projector. The film should be in good condition and one on which the sound is known to be satisfactory.

FINAL INSPECTION

a. A final check on the following points should be made after a projector has been repaired.

(1) Check the height of shuttle teeth. See "Assembly" paragraphs (5) (m) (n) (o) (p) and (q).

(2) Check the stroke of shuttle. See Assembly paragraph (5) (t).

(3) Check the adjustment of the pressure plate. See "Final Adjustments," paragraph b.

(4) Check the adjustment of film guides. See "Final Adjustments", paragraph e.

(5) Check the adjustment of the yoke and arm assembly (oscillatory stabilizer. See "Final Adjustments" paragraph d.

(6) Check the operation of the fire shutter. See "Final Adjustments" paragraph d.

(7) Check the synchronization of the third sprocket with relation to the second sprocket See "Final Adjustments" paragraph g.

(8) Check the adjustment of the snubber. See "Final Adjustments" paragraph f.

(9) Check the running speeds of the mechanism. See "Final Adjustments" paragraph c.

(10) Check for smooth operation of the reel arm pulleys.

(11) See that the reverse belt and the take-up belt are properly installed, and that they are in good condition.

(12) Test the operation of the tilting mechanism. See "Assembly" paragraph h.

(13) Make an 18-inch loop of new film, thread it through the mechanism, and turn on the motor switch. Allow it to run through the projector, remove the film and inspect for scratches on the film. It is most likely that if scratches are evident, they will be caused by emulsion which has gathered at the pressure plate. Clean the plate meticulously and repeat the test.

(14) Inspect the projection lens, the 45-50 mm. condenser, the relay condenser, the reflector, and the sound optical lens for cleanliness.

(15) Be certain that all mechanism parts are properly lubricated, using specified lubricants.

(16) Be certain that the film rollers in the carrying ease revolve freely.

(17) Be certain that all screws and nuts are tightened properly.

(18) See that the projector and the amplifier are properly mounted, and that they are secure in the case.

(19) Run a spool of film through the projector to check it mechanical and sound operation.

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 4

AMPLIFIER DATA

AMPLIFIER DATA

a. GENERAL

(1) The amplifier is a resistance couple type using phase inversion to couple the push-pull output valves, and has a photo cell and microphone input. A pentode is used as a R.F. oscillator, (approx. 62 KC) for supplying 0.75 amperes at 4 volts to energise the exciter lamp. Volume on the amplifier is varied by a gain control in the input circuit to the second valve.

(2) The speaker is a permanent magnetic type of high flux density. The output transformer is located on the amplifier chassis and has a tapped secondary winding for matching the impedance of either one or two speakers. i.e. 16 ohms or 8 ohms.

(3) When operating the amplifier out of the projector, it will he necessary to use a shield over the input (EF37A) valve, and if the photo cell is left in, the shield must also prevent any AC light source from striking the cell.

(4) Voltages are all indicated on the amplifier wiring diagram, {figure 17). If a voltmeter having less than twenty thousand ohms per volt is used, some allowance will have to be made when measuring a voltage that is fed through a high value resistor. The photocell voltage can only be measured with a valve voltmeter.

b. NO SOUND

(1) Power supply must be 110V AC 50/60 cycles only.

(2) The fuse located on back of amplifier may be removed by unscrewing centre cap. Use a 1.5 ampere fuse only.

(3) Exciter lamp - install new one or check with ohm meter.

(4) Exciter lamp lead - be sure it is plugged into amplifier.

(5) Speaker lead - examine all connections to plugs and sockets.

e. REMOVE AMPLIFIER

(1) Connect amplifier and have power turned on. Connect exciter lamp if possible. All valves except the EF37A valve and photo electric cell should get hot. Properly operated, the amplifier will hum very loudly when out of projector, but if EF37A valve is shielded the hum will be quite low. An AC light source striking the photo electric cell should produce a loud 100 cycle hum. Tap the tops of valves with the finger nail. Any noise other than microphone ring will indicate a faulty valve. If ring continues, valve is too microphonic for use.

(2) Substitute one valve at a time and allow time to warm up. CAUTION - always have one output valve in amplifier. Substitute speaker and lead if possible, otherwise, check speaker with ohm meter.

(3) Above tests are basic and should be used first in all cases of "no sound". The trouble will either be corrected during this procedure, or the amplifier will operate so that the trouble may be isolated by further checking.

d. LOW VOLUME

(1) Check exciter lamp adjustment. Filament must be parallel to the sound drum and must be on same plane with the lenses in optical lens assembly.

(2) Make sure the optical lens assembly and the mirror located in the rear of sound drum are clean. Mirror must be in good condition.

(5) Have the amplifier connected as in paragraph c (1). Remove one output valve if volume or hum level rises. Check grid coupling condenser - may be positive voltage on grid. Try both valves one at a time. Volume should decrease on removal of either of the valves.

(4) If coupling condensers are not faulty as in paragraph d (3), install a new set of valves; especially check the phase inverter and output valves.

e. EXCITER LAMP

(1) May not have proper brilliance. VOLTAGE ON THE EXCITER LAMP CAN BE MEASURED ONLY WITH A VALVE VOLTMETER. The lamp is rated at 4 VOLTS. If a valve voltmeter is not available, a comparison should be made using 3.5 volts from a transformer or storage battery.

On some amplifiers the exciter lamp voltage will be found to be only 3.5 volts. Adjustment of the trimmer condenser (C24) (figures 17 and 18) will adjust the voltage as required. The recommended voltage being 3.8v.

(2) If the voltage is low, try interchanging the oscillator valve with one of the output valves, as some valves are not efficient oscillators. If changing valves does not affect the voltage, cheek all voltages. They should be within approximately 5 volts as indicated on amplifier diagram. If all check, and valve is known to be good, it must be assumed that the oscillator coil has failed and must be changed as no definite method has been devised to check them accurately. Measurement of the frequency will not indicate their condition. Coils usually break down from shorted oscillator valves.

f. PHOTO ELECTRIC CELL

(1) As a rule the sensitivity of the photo electric cell does not fall off enough through use to cause low volume. Unless the cell is noisy, it can usually be assumed that it is in order. The only way it can be checked is in an amplifier or by substitution.

(2) Voltage on photo electric cell should be approximately 90 volts. Measure the voltage at pins 2 and 4 (figure 17) on the cell holder. Unless the valve voltmeter is used the reading will not be accurate.

g. FADING

(1) After amplifier is thoroughly heated (30 minutes or more), volume gradually fades. This is probably caused by excessive leakage of one of the condensers, each of which should be carefully tested. Check valves; emission may have dropped.

h. NOISE

(1) Noise can be caused by any valve, photo electric cell, worn or dirty, volume control, also broken wires in speaker leads.

i. FUSE BLOWING

(1) Use only 1.5 ampere fuse
(2) Line must be 110 volts 50/60 cycles A.C.
(3) Check speaker lead
(4) Check rectifier valve
(5) If fuse still blows on inserting new rectifier tube, test main smoothing condenser, C20-21-22 (figures 17 and 18).
(6) If condensers are perfect remove all valves. Then if fuse still blows, the power transformer may be shorted.

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 5

CONDENSED FAULT TRACING GUIDE.

MODEL 621 PROJECTOR

CONDENSED FAULT TRACING GUIDE

COVERING SIMPLE ADJUSTMENTS

TROUBLE	PROBABLE CAUSE	REMEDY
A. Projector motor will not run, lamp does not light, and amplifier does not operate.	1. Current supply lead not making proper contact with the power outlet	1. Check and make certain all leads are properly connected and making good contact.
	2. No current at the supply outlet.	2. Check outlet with ordinary lamp.
	3. Open circuit in line lead.	3. Check with another lead known to be good.
	4. Line switch defective.	4. Replace defective switch with new one.
B. Lamp lights hut motor does not run.	1. Faulty direction or speed switch.	1. Check switch and if necessary, replace.
	2. Dirt in governor contacts.	2. Remove governor cap and clean governor breaker points.
C. Speed varies or projector runs too fast.	1. Dirty Governor contacts.	1 Clean Governor contacts.
	2. Motor brushes worn.	2 Replace brushes when worn to less than 1/8" in length.

NOTE: The 621 should operate at 24 frames per second on sound speed and 16 frames per second on silent speed. A loop of film 80 frames in length (2 feet) should pass through the projector 18 times per minute when operated at 24 speed and 12 times per minute when operated at 16 speed.

D. Motor and amplifier satisfactory hut projection lamp does not light.	1. Lamp burned out.	1 Replace lamp.
	2. Lamp switch not turned on.	2 Check switch to see that it is in the "on" position.
	3. Lamp switch burned out.	3. Replace defective switch with new one.
E. Edge of aperture opening uneven and fuzz projecting into picture area.	1. Dirt in aperture opening.	1. Use brush supplied with projector and lightly but thoroughly clean the edges of aperture opening. Carbon tetrachloride or alcohol can be used as a solvent. If the brush is not available, a pipe cleaner can be used. Be sure the projector is not running when cleaning the aperture.
F. Picture not sharp on screen. One side of picture only or the entire picture may not be sharp. Picture may go in and out of focus.	1. Lens or condenser elements may be dirty, oily or finger spotted.	1. Use lens tissue and thoroughly clean surface of lens and condenser elements. If all dirt cannot be removed in this manner, lens cleaning fluid should be wiped on the lens surface and followed by a thorough cleaning with lens tissue.
	2. Film clearance between aperture plate and pressure plate too loose or too tight.	2. Set gate so that when closed, the pressure plate seats perfectly flat against the aperture plate just tight enough to lift the pressure plate off its seat on the yoke from .002" to .003".

	3. Loose lens mount.	3. Tighten or replace spring retainers.
	4. Loose lenses	4. Tighten lens retainers.
G. Picture out of frame.	1. Framer knob not adjusted properly.	1. Turn framing knob until picture is properly framed.
	2. Film out of frame.	2. Check projector framing with film known to have proper frame line.
H. Film does not wind up tight on take-up reel.	1. The fabric take-up belt on take-up arm may be slipping.	1. Remove belt and thoroughly clean in carbon tetrachloride. If necessary replace belt with. new one.
	2. The spring belt which runs from the governor cap to the pulley on take-up arm may be stretched, kinked, oily or worn.	2. Slipping may be temporarily corrected by thoroughly cleaning the spring belt with carbon tetrachloride. However, if belt is stretched or kinked it should be replaced with a new one.
I. Take-up arm binds or jerks.	1. Spring take-up belt stretched, kinked, oily or worn.	1. Wash belt with carbon tetrachloride or replace if needed.
	2. Fabric take-up belt worn or oily.	2. Wash belt with carbon tetrachloride or replace if necessary.
	3. Bent spool and flanges.	3. Straighten where necessary.
J. Film loses lower loop.	1. Torn or split perforations in film.	1. Check film carefully and remove all torn or split perforations.
	2. Poorly made splice.	2. Resplice film.
	3. Film clearance between aperture plate and pressure plate too loose or too tight.	3. Set gate so that when closed, the pressure plate seats perfectly flat against the aperture plate - just tight enough to lift the pressure plate off its seat on the yoke .002" to .003".
	4. Too much clearance between sprocket and film guide.	4. Adjust film guide so there is from .012" to .014" clearance between the inner shoulder of film guide and the inner edge of sprocket.
	5. Sprocket guard out of adjustment.	5. Replace spring or tighten retaining screw.
	6. Sprocket does not turn.	6. Check screws on hub of gear.
	7. Worn intermittent parts.	7. Replace intermittent parts.
	8. Shuttle does not protrude far enough through aperture plate or stroke is insufficient.	8. Check aperture plate position and counter-gear and shuttle shafts for proper heights or replace parts if worn.
K. Picture unsteady.	1. Film clearance between aperture plate and pressure plate too loose.	1. Set gate so that when closed, the pressure plate seats perfectly flat against the aperture plate - just tight enough to lift the pressure plate off its seat on the yoke from .002" to .003".
	2. Film perforations damaged.	2. Remove all damaged portions of film.

	3. Photographed image not steady on film.	3. Project film on another projector to check. Adjusting the projector cannot correct unsteadiness if film is at fault.
L. Film scratched.	1. Dirt or emulsion accumulated in film channel or around sprockets and guards.	1. Brash away as much of the free dirt as possible. Use a brush and carbon tetrachloride to remove dirt which adheres to the parts. Draw a clean cloth through the film channel. Only a hard wood or bone scraper must be used to remove emulsion from any part in the film path.
	2. Worn film-handling parts such as aperture plate, gate plate, film guards, rollers.	2. Replace worn parts.
M. Safety shutter sticks or operates sluggishly.	1. Leakage of air from channel leading to fire shutter.	1. Often can be corrected by putting heavy paint or shellac where gear case rests against blower housing. Adjust bleed screws.
	2. Dirt, or damaged Fire Shutter.	2. Clean guides or replace fire shutter.
N. Poor illumination.	1. Line voltage lower than lamp voltage rating.	1. Use lamps with voltage rating equal to voltage of line supply.
	2. Lamp old, black and about ready to burn out.	2. Use new lamp.
	3. Lamp inserted in lamphouse crooked.	3. Insert lamp in lamphouse properly and screw cap up tightly.
	4. Safety shutter does not rise.	4. See trouble "M" above.
	5. Condensers and lens dirty or oil covered.	5. Clean all lens elements thoroughly.
	6. Reflector mirror tarnished.	6. Replace reflector mirror or polish it.
O. No sound - exciter lamp fails to light.	1. Burned out exciter lamp. 2. Amplifier not turned on.	1. Check by replacing with new 2. one. Check position of amplifier switch.
	3. Fuse blown.	3. Examine fuse and replace with new one if necessary.
	4. Defective valve or valves in amplifier.	4. See that all valves are in their correct sockets. Test each valve and replace any that test defective.
	5. Amplifier switch burned out.	5. Replace switch.
	6. Pin jack between amplifier and exciter lamp may not be connected.	6. Make certain the pin jack is properly connected, and makes good contact.
P. No sound but exciter lamp lights.	1. Volume control not advanced sufficiently toward the high position.	1. Check position of volume control and gradually advance to the high position.
	2. Exciter lamp not aligned properly.	2. Replace lamp.
	3. Film incorrectly threaded.	3 Recheck threading.
	4. Grid clip not attached to the top of EF37A valve.	4. See that grid clip is in good contact with the top of EF37A valve.

	5. Dirt, dust, oil or other foreign matter obstructing the sound optical system.	5. Roll a small piece of lens cleaning tissue on a toothpick and clean the lens and mirror.
	6. Absence of sound record on film.	6. Remove the film, turn on the amplifier. Turn the volume control to the high position. Pass a card swiftly back and forth between the sound lens and the sound drum. If a loud thumping sound is heard from the speaker, the amplifier is operating properly and the lack of sound would be due to the film.
	7. Speaker cable not plugged in at both ends.	7. Check all cable connections. See that they make proper contact.
	8. Defective valves or P.E. cell.	8. Test all valves and P.E. cell and replace defective ones.
	9. Exciter lamp damping shield not aligned.	9. Adjust damping shield so that opening in shield is in line with lens of optical slit.
Q. Inadequate volume.	1. Volume control not advanced far enough.	1. Advance volume control until sufficient volume is obtained.
	2. Poorly made or dirty film.	2. Compare with sound from film known to be clean and with adequate volume.
	3. Dirt, oil, or other foreign matter partly obstructing the sound optical system.	3. Roll a small piece of lens cleaning tissue on a toothpick and clean the lens tube and mirror.
	4. Defective valves.	4. Have all valves tested and replace defective ones.
	5. Defective, dirty or poorly adjusted exciter lamp.	5. Clean the exciter lamp with a piece of cloth. As all exciter lamps are fitted with a pre-focus cap the lamp must be changed if it is out of focus.
	6. Snubber or oscillatory stabilizer misaligned.	6. Align snubber or stabilizer on the shaft on which it pivots until both the high and low notes reproduce satisfactorily. Use buzz track film for testing (if not available, good quality musical recording).
	7. Dirt on optical system.	7. Clean optical slit lenses and sound shaft mirror with tooth-pick wrapped with lens tissue.
	8. Sound drum binds.	8. Check according to instructions.
	9. Film has improper traction around sound drum.	9. Check oscillatory stabilizer sound sprocket, and sound drum retaining screws.
	10. Optical sound system out of adjustment.	10. Check focus on optical system with 5000 cycle focussing film.
E. Unsatisfactory sound quality.	1. Speed switch set in silent position.	1. Turn switch to sound position.
	2. Defective valves.	2. Replace with new valves.

	4. Speaker not properly-positioned.	4. Experiment with position of speaker to obtain best distribution of sound. It should be mounted above the leads of the audience and slightly inclined to about three quarters of the way up the auditorium except where there is a balcony.
	5. Poor sound track.	5. Check by comparison with a copy of known quality.
	6. Poor acoustic properties.	6. Test equipment in an auditorium known to be good acoustically. Obtain expert advice on the acoustic properties of the auditorium.
	7. Film not properly threaded through soundhead.	7. Check to see that the lacing of the film through the soundhead and stabilizer is correct and the film is under tension.
s. Crackle.	1. Loose grid connection on the EF37A valve.	1. Bend connecting clip so that it makes good contact.
	2. Grid lead to EF37A valve fouling sound drum shaft.	2. Move lead away from shaft.
	3. Static pick-up due to dirt or oil on spring retainer (13661) bearing on end of sound drum shaft.	3. Clean and replace retainer (13661) and compression spring (13659) (figure 2).
	4. Badly worn motor brushes (12918) or governor brushes (4664) (figure 3).	4. Replace brushes and clean motor commutator and governor slip rings.
	5. Loose connection in amplifier.	5. Check all connections and re-solder as necessary.
	6. Faulty connection to lead.	6. Examine all connections to external leads and remake.
U. Slight shocks from projector.	1. Projector not earthed.	1. Ensure that Projector is efficiently earthed by third lead in mains cable.

G. B. BELL & HOWELL

MODEL 621 PROJECTOR

SERVICE INSTRUCTIONS

SECTION 6

SPARE PARTS LIST

SPARE PARTS LIST FOR MODEL 621 PROJECTOR

Part No.	Part Description	
0500	Condenser Assembly, Relay,	
0772	Plate & Shaft Assembly.	
01033	Hat & Ring, Motor Clutch Jaw Adjusting.	
01078	Lubricator Assembly.	
01138	Spindle Assembly Spool.	
01477	Oiler Assembly,	
01846R	Screw, Lamp Look (complete).	
01847	Condenser Assembly 45mm/50mm.	
02003	Projector Lamp.	
02247	Roller Assembly, Idler.	
02252	Spring-Roller Assembly, Motor Clutch.	
02678	Slit Assembly Optical.	
02691R	Housing Assembly, Blower.	
02789	Cap Assembly, Governor.	
02794	Shaft & Drive Blade Assembly, Worm.	
02799	Cap & Ball Race Assembly, Governor.	
03037	Lock Lens,	
03084	Unit Assembly, Pilot Light.	
03085R	Block Contact (complete).	
03135	Gear & Shaft Assembly, Counter.	
03446	Lock Lever & Stud Assembly, Rewind.	
03447	Pulley Assembly, Spindle & Take up.	
03460R	Worm Wheel Assembly, Sprocket.	
03461	Sprocket Assembly.	
03462	Clip Assembly, Film Tension (Upper),	
03463	Clip Assembly, Film Tension (Lower).	
03464	Shaft & Knob Assembly, Frame.	
03573	Knob Assembly.	
03574	Extension & Link Assembly, Clutch.	
03575	Manipulator, Clutch (complete).	
03687	Roller Assembly, Stabilizer (Flanged).	
03688	Roller Assembly, Plain.	
03690	Stabilizer Assembly.	
03788	Plate Assembly, Pressure.	
03864R	Reflector Assembly,	
03927	Shutter Assembly, Fire.	
03941	Tube, Air Circulating (complete).	
03979	Roller.	
04169	Bearing & Shaft Assembly, Sound Drum.	
04206R	Cover & Pin Assembly.	
04233	Plate, Lug Mounting Assembly,	
04454	Shaft Assembly, Pulley.	
04523	Pulley & Shaft Assembly, Take up Drive.	
04883	Fan Assembly, Blower.	
04946	Guard Assembly, Sprocket.	
05317	Ann & Race Assembly, Spool (Rear).	
05319R	Arm & Take Up Assembly, Spool (Rear).	
05321	Arm Assembly, Spool (Front).	
05551	Snubber Assembly.	
M025000	Holder Governor Brush Assembly.	
M025001	Brush Holder, Cap & Lead Assembly.	
M025015	Switch Assembly, SPST.	
M025033	Lever & Roller Assembly Clutch Operating,	
M025111	Terminal Cover Assembly.	
M025120	Socket Assembly, Exciter Lamp,	
M025121	Lamp Lead.	
M025123	Switch Cover Assembly.	
M025129	Contact Washer, Assembly,	
M025144	Lamp Switch D.P.S.T.	
M025145	Line Switch D.P.S.T.	
M025149	Switch Assembly DPDT.	
M025154	Brush Holder Cap & Lead Assembly.	
M025176	Clutch Lever Assembly,	
M025177	Gear Case Assembly.	
M025201	Box Assembly, Terminal.	
M025202	Lamp House and Motor Assembly,	
61	Screw 6-32 Set.	
112	Screw 5-40 x 1/2 Fillister Head	
145	Ball, Steel	(per 100)

Part No.	Part Description.
374	Screw 4-48 Dowel.
570	Spring, Clutch lever.
873	Screw 5-40 x 365 Fillister Head.
890	Gear Idler.
891	Shaft, Idler Gear.
965	Lever, Gate Operating.
966	Bushing, Eccentric.
967	Plate, Gate Operating.
971	Screw 5-40 x 3/16 Fill Head.
985	Spring, Friction.
986	Hut 5/16-27.
987	Socket Light,
988	Pilot Lamp 120v 6w.
1367	Washer, Shim.
1369	Spacer, Condenser Lens.
1375	Washer, Split Retaining.
1561	Holder Condenser.
1587	Screw, 8-32 Oval Head.
1589	Pin, Dowel.
1738	Screw 4/36 Fillister Head.
2347	Bearing, 7mm, Radial.
2464	Bearing, 6mm. Radial.
3089	Hut, 6-32 Hexagon.
3164	Screw 6-32 x *1* Fillister Head.
3914	Screw 5-40 x 3/16 Fillister Head.
3983	Pin Dowel.
4255	Spring, Film Gate Thrust.
4258	Washer.
4460	Screw 2-56 x 1/8 Fillister Head.
4664	Brush, Governor.
5012	Holder Relay Condenser,
5014	Spring Relay Condenser Lens Retaining.
5021	Screw, 2-56 Fillister Head.
5110	Shutter.
5111	Support, Shutter.
5112	Hut 5-16-32 Hexagon.
5113	Pin, Dowel.
5123	Screw 10-32 x f Special Fillister Head,
5148	Screw 6-32 x 3/32 Fillister Head.
5160	Block, Gate Operating.
5162	Washer, Armature Spring.
5173	Dowel Pin.
5188	Jaw, Motor Clutch.
5189	Pin, Motor Clutch Operating.
5191	Spring, Motor Clutch Operating.
5193	Washer Motor Pinion.
5200	Stud, Field Retaining,
5201	Hut, Field Retaining.
5206	Spring, Condenser Friction.
5211	Screw 5-40 Fillister Head.
5212	Screw 5-40 x 7/16 Fillister Head.
5238	Ball, Steel (Grade "A").
5239	Screws, 8-32 Fillister Head.
5247	Guide, Fire Shutter.
5248	Screw 2-56 x 3/16 Fillister Head.
5266	Screw 5-40 x 9/32 Fillister Head.
5267	Screw 5-40 Fillister Head.
5296	Bearing, Shutter and Countershaft.
5306	Lens, Condenser.
5322	Shaft, Shutter.
5469	Block, Lubricator Felt (Small).
5495	Roller, Bearing.
5514	Cam, Clutch.
5618	Spring, Ball Retaining,
5626	Retainer, Relay Condenser Spring.
5636	Stud, Clutch Lever.
5639	Screw 4-40 Pilot,
5641	Rail Guide.
5692	Spacer,
5863	Washer, Terminal,
5866	Retainer, Condenser Lens,

Part No.	Part Description.
5893	Screw 10-32 Set.
6129	Screw 4-36 Fillister Head.
6419	Washer Spring.
6715	Ball 1/16 Steel.
6716	Screw 2-56 x 5/32 Fillister Head.
6926	lens, Condenser.
6964	Screws 6-32 Fillister Head.
7493	Screws 4-40 x 3/16 Fillister Head.
7495	Screws, 3-48 Fillister Head.
7764	Screw 6-32 x 3/8 Fillister Head.
8066	Condenser 47mm Auxiliary.
8195	Screw 6-32 x 1/8 Cup Point.
8918	Screw 5-40 Shoulder.
8933	Shuttle, Double Tooth.
9117	Nut, 217-40 Hex.
9178	Screw 6-32 x 1/4 Fillister Head.
9207	Pinion, Motor.
9208	Bearing, Roller.
9209	Bearing, Roller.
9260	Ball, 1/16 Steel.
9412	Spring, Torsion.
9414	Plate, Snubber Bearing.
9415	Bearing, Snubber.
9426	Felt, Oil.
9427	Felt, Oiler.
9428	Governor, Motor.
9558	Baffle, Oil.
9567	Washer, Shakeproof Look.
9718	Screw 6-40 Fillister Head.
10308	Mirror.
10314	Nut, Hexagon f-24.
10325	Tip, Standard Phone.
10349	Screw 6-32 Fillister Head.
10350	Spacer.
10356	Bearing 6mm Radial.
10388	Cap Bearing Retaining.
10390	Washer, Looking.
10540	Pulley, Take-up (Upper).
10547	Washer.
10551	Screw 1/4 - 24 Fillister Head.
10554	Hut, Special.
10565	Knob, Counter Gear Extension,
10598	Washer.
10749	Retainer, Clutch Ball.
10750	Spring Compression.
11054	Clamp Spring.
11055	Screw 10-32 Flat Head.
11056	Resistor, 10000 ohm 1 watt.
11110	Spring, Compression.
11114	Screw 8-32 x 222 pilot.
11116	Stud, Pilot Light Fastening.
11117	Screw 6-32 Headless Set.
11118	Spring Compression.
11119	Housing Pilot Lamp.
11120	Valve, Pilot Light Docket.
11123R	Housing Pilot Lamp.
11147	Washer.
11268	Screw 10-32 Headless Set.
11269	Screw 10-32 Headless Set.
11276	Worm R.H.
11279	Extension, Worm Drive Gear.
11280	Collar.
11281	Screw 8-40 Socket Set.
11282	Screw 8-40 Socket Set,
11462	Gear Rewind Drive.
11463	Gear, Rewind,
11466	Spring.
11468R	Shaft, Take up Arm.
11470	Screw 5-40 Shoulder.
11471	Roller, Bearing.
11472	Bearing Ring.
11474	Ring. Bearing Retainer.
11475	Nut 3/8 - 40 Hexagon.

Part No.	Part Description.
11478	Fabric Clutch Belt.
11481R	Arm Take Up.
11521	Screw.
11713	Washer.
11748	Washer, Felt.
11750	Carrier, Film Gate & Lens.
11757	Screw 6-40 Fillister Head.
11758	Shaft, Sprocket.
11761	Guide, Film,
11762	Stripper Film.
11795	Hut, Pressure Plate Adjustment.
11796	Plate Pressure.
11799	Retainer, Lens Carrier.
11852	Plate, Aperture,
11859	Screw 8-32 Headless Set.
11867	Gear 8 Tooth Sprocket Driving.
11868	Gear, Upper.
11888	Cap, Motor Brush.
11908	Spacer, Terminal Cover.
12071	Spring, Compression.
12075	Screw 2-56 Fillister Head.
12077	Bracket, Mounting.
12081	Hut, Shoulder.
12087	Hut 10-32 Hexagon.
12128	Spring, Compression.
12129	Plunger.
12141	Plate, Name.
12145	Shield, Light Control.
12223	Washer, Brush Holder.
12246	Bearing 6mm Radial.
12248	Screw 3-48 Headless Set.
12332	Screw 8-40 Socket Set (Cup Point).
12458	Reflector Mirror.
12501	Screw 2-56 Fillister Head.
12502	Washer.
12503	Stud Roller.
12504	Spring Torsion.
12506	Yoke.
12507	Stud, Pivot.
12508	Washer,
12509	Screw 4-40 Fillister Head.
12510	Arm,
12511	Stud, Mounting.
12512	Bearing, Main (Top).
12513	Retainer, Main Bearing.
12514	Pilot, Torsion Spring.
12515	Screw 4-40 Pilot.
12661	Washer No.8 look.
12719	Carrier, Pressure Plate.
12720	Yoke, Pressure Plate.
12762	Ring, Bearing Retainer,
12776	Cup, Spring.
12778	Screw, 3-56 Fillister Head.
12830	Reverse Belt.
12864	Cover Spool Drive Clutch.
12909	Spring, Bush.
12918	Motor Brush.
13426	Ring Heat Conducting.
13428	Cover, Lamphouse.
13499	Washer.
13525	Spindle, Pin Roller.
13656	Cap, Bearing Retaining.
13659	Spring, Compression.
13661	Retainer Spring.
13665	Strip, Insulating.
13738	Plate, Name.
13739	Plate, Name.
13741	Screw 5-40 x £ Oval Head.
13788	Switch, SPDT Sound Silent (less leads
13812	Strip Terminal,
13813	Switch DPDT, Reverse (less leads).

Part No.	Part Description.
11478	Fabric Clutch Belt.
11481R	Arm Take Up.
11521	Screw.
11713	Washer.
11748	Washer, Felt.
11750	Carrier, Film Gate & Lens.
11757	Screw 6-40 Fillister Head.
11758	Shaft, Sprocket.
11761	Guide, Film.
11762	Stripper Film.
11795	Hut. Pressure Plate Adjustment.
11796	Plate Pressure.
11799	Retainer, Lens Carrier.
11852	Plate, Aperture.
11859	Screw 8-32 Headless Set.
11867	Gear 8 Tooth Sprocket Driving.
11868	Gear, Upper,
11888	Cap, Motor Brush.
11908	Spacer, Terminal Cover.
12071	Spring, Compression.
12075	Screw 2-56 Fillister Head.
12077	Bracket, Mounting.
12081	Hut, Shoulder.
12087	Hut 10-32 Hexagon.
12128	Spring, Compression.
12129	Plunger,
12141	Plate, Name.
12145	Shield, Light Control.
12223	Washer, Brush Holder.
12246	Bearing 6mm Radial.
12248	Screw 3-48 Headless Set.
12332	Screw 8-40 Socket Set (Cup Point).
12458	Reflector Mirror.
12501	Screw 2-56 Fillister Head.
12502	Washer.
12503	Stud Roller.
12504	Spring Torsion.
12506	Yoke,
12507	Stud, Pivot.
12508	Washer.
12509	Screw 4-40 Fillister Head.
12510	Arm.
12511	Stud, Mounting.
12512	Bearing, Main (Top).
12513	Retainer, Main Bearing.
12514	Pilot, Torsion Spring.
12515	Screw 4-40 Pilot.
12661	Washer Ho.8 look.
12719	Carrier, Pressure Plate.
12720	Yoke, Pressure Plate.
12762	Ring, Bearing Retainer,
12776	Cup, Spring.
12778	Screw, 3-56 Fillister Head.
12830	Reverse Belt.
12864	Cover Spool Drive Clutch.
12909	Spring, Bush.
12918	Motor Brush.
13426	Ring Heat Conducting.
13428	Cover, Lamphouse.
13499	Washer,
13525	Spindle, Pin Roller.
13656	Cap, Bearing Retaining.
13659	Spring, Compression.
13661	Retainer Spring.
13665	Strip, Insulating.
13738	Plate, Name.
13739	Plate, Name.
13741	Screw 5-40 x 1/2 Oval Head.
13788	Switch, SPDT Sound Silent (less Leads).
13812	Strip Terminal.
13813	Switch DPDT, Reverse (less Leads).

Part No.	Part Description.
13982	Resistor, 100 ohm.
13983	Clamp, Resistor,
14014R	Condenser A.C. Line Filter,
14175	Washer, Look No.6.
14176	Hut, 6-32 Cap.
14407	Washer.
14835R	Housing, Motor.
14842	Holder, Motor Brush (complete).
14849	Stub, Snubber.
14862	Collar, Bearing.
14863	Cap Bearing.
14864R	Worm Wheel.
15003	Washer Spring.
15199	Case, Gear.
15203	Screw, 4-40 Pilot.
15244	Motor Field.
15582	Washer.
15589	Handle, Condenser,
16184	Circlip.
16198	Bushing.
16199	Motor Armature.
16207	Spacer.
16243	Spring.
16244	Washer, Tension.
16840R	Sound Head.
16939	Arm Spool (Front).
16941	Screw, 10-32 Knurled.
17182	Retainer, Bearing.
17183	Bearing.
17184	Washer.
17303R	Cap, Brush Holder.
17305R	Holder, Top Spool Arm.
17306R	Holder, Rear Spool Arm.
17309	Retainer, Spring.
17310	Lever, Snubber,
17311	Stud, Idler Roller,
17312	Spacer.
17325	Shield, Exciter Lamp.
17327	Lamp 4 volt 75 amp Exciter.
17348	Flywheel.
17897	Washer,
21796	Screw, 8-32 Fillister Head.
21898	Belt, spring, take up.
26588	Oil Tube.
26589	Back Plate, Spool Arm Holder (Front).
26590	Back Plate, Spool Arm Holder (Rear).
26591	Screw.
M50000	Insulating Sleeve.
50025	Screw Special.
M50027) (ECA21121)	Plug
M50030	Switch and Condenser Insulator.
M50090	Holder, Plug.
M50093	Insulating Sleeve.
H50101	Lead.
M50108	Switch DPDT Lamp & Motor (Less Leads).
M50275	Spring Clip.
M50289	Screw 0.BA x 1/2 CH'Hd.
M50290	Washer.
M50358	Pulley.
M50392	Bracket, terminal strip.
M50395	Screw, 6-32 Fillister.
M5039?	Shield Screening.
M50408	Spring Compression.
M50409	Cover, Exciter Lamp.
M50418	Screw 8-32 Knurled.
M50449	Spacer.
M50478	Screw Pilot.

SPARE PARTS LIST MODEL 621 PROJECTOR CASE.

Part No.	Part Description.
26901	Screw 4BA x 13/16" Rd Hd.
26902	Screw 5BA x 3/8" Rd Hd.
26903	Foot, Rubber.
26904	Bracket Projector mounting (L.H.).
26905	Spacer.
26906	Mounting Rubber.
26907	Bracket, sling (R.H.).
26908	Washer packing.
26909	Screw.
26910	Bracket sling (L.H,),
26911	Bar, foot.
26912	Bracket projector mounting (R.H.).
26913	Foot rubber 5/8" x 1".
26914	Strap, Rear Spool Arm.
26915	Strap, cleaning brush.
26916	Strap, Exciter Lamp and oil can.
26917	Door, assembly.
26918	Flap, lens.
26919	Flap, assembly.
26920	Retaining plate.
26921	Dowel.
26922	Screw No. 8 x 3/4".
26923	Washer 1/4" diameter.
26924	Grill frame.
26925	Grill bar.
26933	Oiler Assembly.
02832	Tilt Knob.
03114	Friction Cup Complete,
03115	Tilt Pinion.
6182	Washer.
10736	Friction Band.
10738	Nut.
10739	Screw.
11168	Tilt Rack.
11170	Tilt Pinion Washer.
11283	Blade Spring.
11649	Screw.
17327	Exciter Lamp.
21898	Spare T.U. Belt.
26205	Spare Fuse.
26303	Gate Cleaning Brush.
5384R	Oil Can.
M025118	Oil Bottle.
M50290	Washer.
M50480	Screw.
204201	Handle.
204201B	Handle Box.
204205	Corner,
204206	Catches.
M025134	Case.
SCR1/4166	Screw 2BA x 11/16" Raised Hd.
WAS9/405	Washer B.A.
WAS514	Washer 1/4" Shakeproof.
TH74/591	Hut, 4BA Tee.
WA03/2	Cup Washer, 2BA.

SPARE PARTS LIST FOR

MODEL 621/601 MAINS TRANSFORMER 1.25 K.V.A.

Part No.	Part Description.
26382	Mains Input Socket.
26404	Output Socket.
26518	Chassis Cover.
26527	Handle.
26528	Screw.
26529	Voltage Tapping Strip.
26537	Same Plate,
26592	Transformer.
26593	Chassis.
SC.284	Voltage Tapping Screws.
WAS.1/508	Washer 26A.

SPEAKER CASE. MODEL 621.

Part No.	Part Description.
26926	Panel Front.
269S7	Shelf.
26928	Led Assembly, Case.
26929	Grille lid.
26930	Case Assembly Complete.
26931	Grille Baffle.
26932	Screw 2BA x If.
203205	Look, Case.
203205B	Catch, Lock.
203036	Speaker Unit.
203203	Clip, Spool.
203206	Key, Case,
203217	Spigot, Spool.
203012) (ECA12938)	Lead, Y 6ft.
203014	Lead, Speech 50ft.
203016	Lead, Transformer Mains 25ft.
204201	Handle, Case.
204201B	Clip Case.
204205	Corner, Case,
26451	Spool 1600ft.
26430	Film, Practice.
26230	Spool 400ft,
26212	Manual, Instruction.
Nut 3	2 BA Full Nut.
WAS1/508	2 BA Washer, Shakeproof.
WAC3/2	2 BA Washer, Countersunk.

SPARE PARTS LIST FOR MODEL 621 AMPLIFIER

Part No.	Part Description.
12823	Screw 8/32 Knurled.
201000	Microphone Jack.
202000	Amplifier complete.
202004	Base Plate Amplifier.
202006	Insulator.
202011	Insulator.
202013	Insulator, Disc.
202015	Tag Cord Assembly for Switch Set.
202016	Tag Cord Assembly for Condenser Bracket,
202017	Tag Cord and Resistor Assembly for Switch Set, Bracket.
202018	Tag Cord and Resistor Assembly for Condenser Bracket.
202019	Tag Cord Assembly, Oscillator Coil.
202021	Insulating Piece,
202022	Insulator.
202023	Rod, Actuating.
202025	Valve holders.
202026	Transformer Mains 110v.
202027	Cap, Condenser Clip Assembly.
202028	Mains Input Plug & Shroud Assembly,
202031	Condenser Bracket Assembly,
202033	Cableform, Exciter Supply Socket.
202034	Transformer, Output.
202035	Grid Top Cap Assembly.
202036	Base Plate Assembly.
202037	Screws, Fixing,
202039	Shroud.
202040	Tag Card for Oscillator Coil.
202041	Switch Set Assembly,
202043	Washer, Insulating.
202044	Socket Cover,
202045	Cell Holder.
202051	Transfer Valve 6V6GT.
202052	" " ECC35.
202053	" " EF37A.
202056	Oscillator Coil & Condenser.
202073	Condenser 16 plus 16 plus 8 Mfd.
202251) (ECA.FHL356)	Mains Fuse Holder.
202252	Grommetts, G.50.
A1374	Control Knob.
202256	Cell, Photo Electric Type GS46.
202258	Valves 6V6GT.
202259	" 5Z4GT.
202260	" ECC35
26461	" EF37A
202261	Mains Switch S.P.S.T.
202077	Potentiometer 50,000 ohm.
202263	Socket$_5$ Speaker.
202264	Socket.
202265	Potentiometer 500,000 ohm.
202266) (ECA19098)	Plug, 4 Pin,
202267	Top Cap Connector and Cirolip.
202268	Cell Holder Assembly,
202270	Condenser .001 mfd.
202271	Condenser .0001 mfd.
202272	Condenser .05 mfd.
202273	Condenser .25 mfd.
202274	Condenser .005 mfd.
202275	Condenser .01 mfd.
202278	Condenser 4 mfd 350v.
202279	Condenser 25 mfd 25v.
202280	Condenser 50 mfd 25v.

Part No.	Part Description.
202S81	Resistance 3000 ohm No.8.
RMY1152	" 1500 ohm Type RMY1152.
202283	" 250 ohm Type AX.3515.
202284	" 5600 ohm No.16.
202285	" 2,7 meg.ohm No.16,
202286	" 20 meg.ohm No.8.
20228?	" 5.6 meg.ohm No.16.
202288	" 1 meg.ohm No.16.
202289	" 82,000 ohm No.16.
202290	" 2700 ohm No.16.
202291	" 270,000 ohm No.16.
202292	" 470,000 ohm No.16.
202293	" 15,000 ohm No.16.
202295	" 47,000 ohm No.18.
202296	" 2.2 meg.ohm No.16,
202297	" 100,000 ohm No,16.
202298	" 22,000 ohm No.16.
202300	" 820,000 ohm No.8.
202301	" 270,000 ohm No.8.
202302	" 220,000 ohm No.8.
202303	" 33,000 ohm No.16,
202305	Condenser 250 pf.
202307	Resistance 4,700 ohm No.16.
BEX16102	Resistance 1,000 ohm Ho.16.
0S2204	Condenser .0005 mfd.
CS3086	Condenser .1 mfd.
CS3084	Condenser .05 mfd.
CS2855	Condenser .02 mfd.

The

G.B.-Bell & Howell

16mm Sound-Film Projector

MODEL 621

ILUSTRATIONS

G. B. BELL & HOWELL

MODEL 631 PROJECTOR

GEAR CASE ASSEMBLY

FIGURE 1.

Part No.	Description
0778	Plate & Shaft Assembly
01078	Lubricator Assembly
01477	Oiler Assembly
03037	Lock Lens
03135	Gear & Shaft Assembly, Counter
03460R	Worm Wheel Assembly, Sprocket
03461	Sprocket Assembly
03462	Clip Assembly, Film Tension (Upper)
03463	Clip Assembly, Film Tension (Lower)
03464	Shaft & Knob Assembly, Frame
03573	Knob Assembly
03574	Extension & Link Assembly, Clutch
04206R	Cover & Pin Assembly
04946	Guard Assembly, Sprocket
M025033	Lever & Roller Assembly Clutch Operating
112	Screw 5-40 x 1/4 Fillister Head
145	Ball, Steel
570	Spring, Clutch Lever
873	Screw 5-40 x 365 Fillister- Head
890	Gear Idler
891	Shaft, Idler Gear
965	Lever, Gate Operating
966	Bushing, Eccentric
971	Screw 5-40 x 3/16 Fill Head
1587	Screw, 8-32 Oval Head
1589	Pin, Dowel
3914	Screw 5-40 x 3/16 Fillister Head
4255	Spring, Film Gate Thrust
4258	Washer
4460	Screw 2-56 x 1/8 Fillister Head
5021	Screw 2-56, Fillister Head
5110	Shutter
5111	Support, Shutter
5112	Nut 5-16-32 Hexagon
5113	Pin, Dowel
5123	Screw 10-32 x 3/8 Special Fillister Head
5148	Screw 6-32 x 3/32 Fillister Head
5160	Block, Gate Operating
5266	Screw 5-40 x 9/32 Fillister Head
5267	Screw 5-40 Fillister Head
5296	Bearing, Shutter and Countershaft
5322	Shaft, Shutter
5469	Block, Lubricator Felt (Small)
5618	Spring, Ball Retaining
5636	Stud, Clutch Lever
5639	Screw 4-40 Pilot
5641	Rail Guide
6419	Washer, Spring
6715	Ball 1/16 Steel
7493	Screws 4-40 x 3/16 Fillister Head
8918	Screw 5-40 Shoulder
8933	Shuttle, Double Tooth
9260	Ball, 1/16 Steel
9426	Felt, Oil
9427	Felt, Oiler
9558	Baffle, Oil
10565	Knob, Counter Gear Extension
11054	Clamp Spring
11055	Screw 10-32 Flat Head
11110	Spring, Compression
11147	Washer
11269	Screw 10-32 Headless Set
11276	Worm, R.H.
11279	Extension, Worm Drive Gear
11280	Collar
11881	Screw 8-40 Socket Set
11282	Screw 8-40 Socket Set
11713	Washer
11750	Carrier, Film Gate & Lens
11757	Screw 6-40 Fillister Head
11758	Shaft, Sprocket
11761	Guide, Film
11762	Stripper Film
11795	Nut, Pressure Plate Adjustment
11796	Plate Pressure
11799	Retainer, Lens Carrier
11852	Plate Aperture
11859	Screw 8-32 Headless Set
11868	Gear, Upper
12071	Spring, Compression
12075	Screw 2-56 Fillister Head
12077	Bracket, Mounting
12081	Nut, Shoulder
12087	Nut 10-32 Hexagon
12719	Carrier, Pressure Plate
12 720	Yoke , Pressure Plate
12776	Cup, Spring
12778	Screw, 3-56 Fillister Head
15199	Case, Gear
15203	Sorew, 4-40 Pilot
16198	Bushing
16807	Spacer
16243	Spring
16844	Washer, Tension
26588	Oil Tube

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL M
GEAR CASE

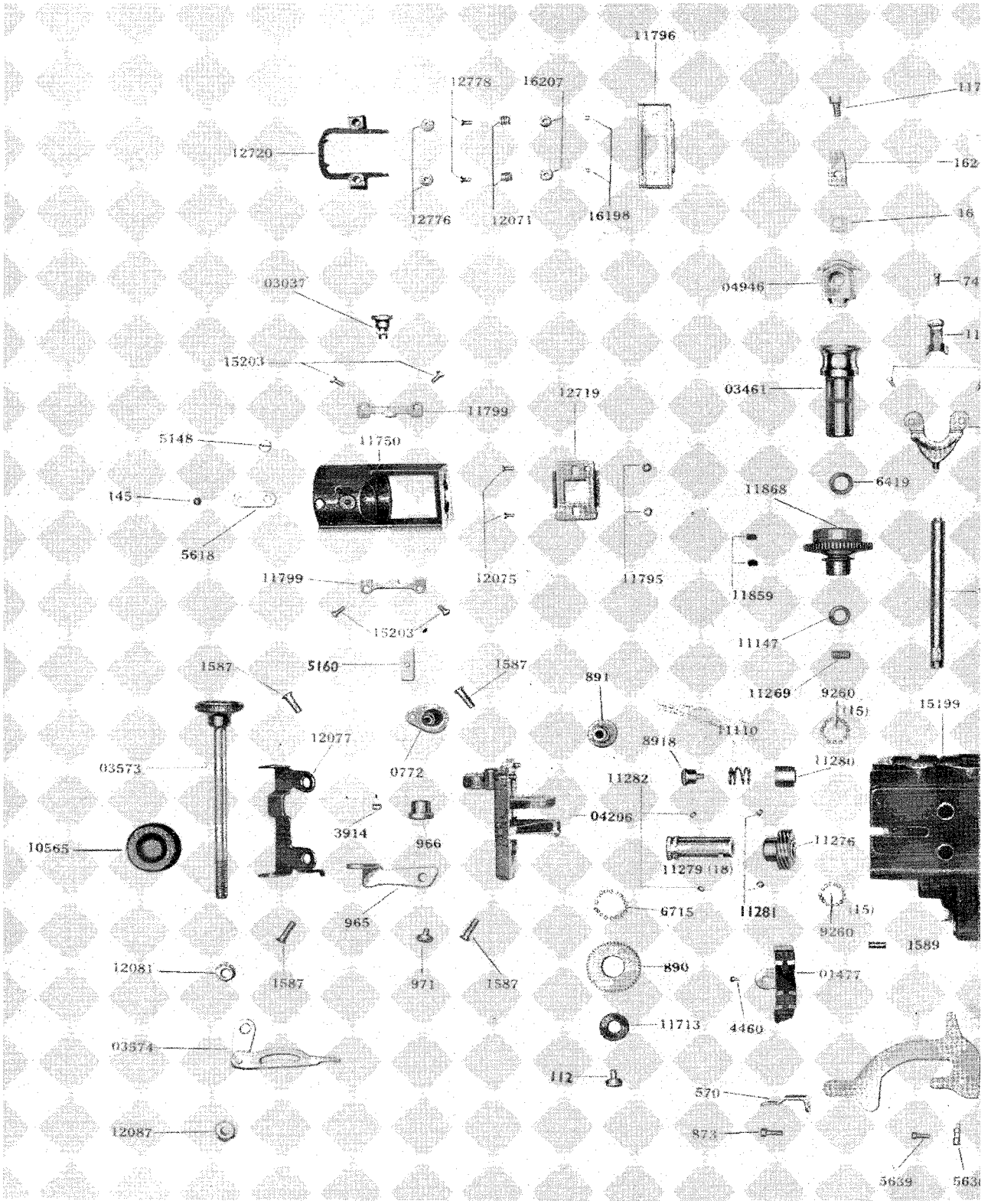
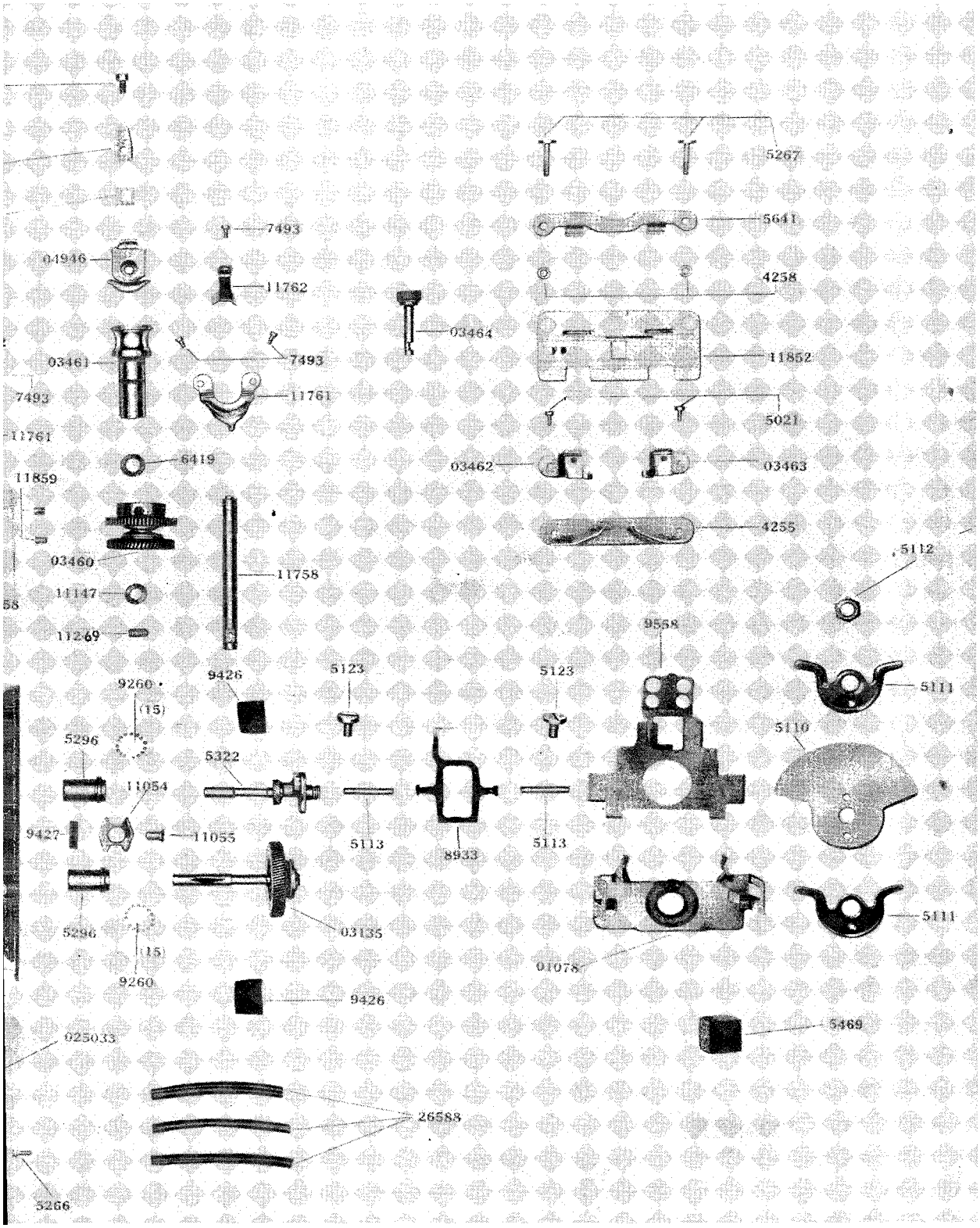


FIG.

ODEL 621 PROJECTOR ASSEMBLY



MODEL 631 PROJECTOR

SOUNDHEAD ASSEMBLY

FIGURE 2.

Part No.	Description
2247	Roller Assembly, Idler
2678	Slit Assembly Optical
3461	Sprocket Assembly
3687	Roller Assembly, Stabilizer (Flanged)
3688	Roller Assembly, Plain
4169	Bearing and Shaft Assembly, Sound Drum
4946	Guard Assembly, Sprocket
M025015	Switch Assembly, SPST
M025111	Terminal Cover Assembly
J1025120	Socket Assembly, Exciter Lamp
M025123	Switch Cover Assembly
M025129	Contact Washer, Assembly
M025144	Lamp Switch DPST
M025145	Line Switch DPST
M025149	Switch Assembly DPDT
3089	Nut, 6-32 Hexagon
5266	Screw 5-40 x 9/32 Fillister Head
6419	Washer, Spring
7493	Screws 4-40 x 3/16 Fillister Head
7764	Screw 6-32 x 3/8 Fillister Head
8195	Screw 6-32 x 1/8 Cup Point
9178	Screw 6-32 x 1/4 Fillister Head
9412	Spring, Torsion
9414	Plate, Snubber Bearing
9415	Bearing, Snubber
9567	Washer, Shakeproof Lock
10314	Nut, Hexagon 3/8 - 24
10325	Tip, Standard Phone
10598	Washer
11056	Resistor, 10000 ohm 1 watt
11147	Washer
11268	Screw 10-32 Headless Set
11757	Screw 6-40 Fillister Head
11758	Shaft, Sprocket
11761	Guide, Film
11762	Stripper Film
11859	Screw 8-32 Headless Set
11867	Gear 8 Tooth Sprocket Driving
11908	Spacer, Terminal Cover
12087	Nut 10-32 Hexagon
12141	Plata, Name
12145	Shield, Light Control
12246	Bearing 6 mm Radial
12248	Screw 3-48 Headless Set
12501	Screw 2-56 Fillister Head
12502	Washer
12503	Stud Roller
18504	Spring Torsion
12506	Yoke
12507	Stud, Pivot
12508	Washer
12509	Screw 4-40 Fillister Head
12510	Arm
12511	Stud, Mounting
12512	Bearing, Main (Top)
12513	Retainer, Main Bearing
12514	Pilot, Torsion Spring
12515	Screw 4-40 Pilot
12661	Washer No.8 lock
13656	Cap, Bearing Retaining
13659	Spring, Compression
13661	Retainer Spring
13738	Plate, Name
13739	Plate, Name
13741	Screw 5-40 x 1/4 Oval Head
138L2	Strip Terminal
14014	Condenser A.C. Line Filter
14175	Washer, Lock No.6.
14176	Nut, 6-32 Cap
14849	Stub, Snubber
16243	Spring
16244	Washer, Tension
16840R	Sound Head
17309	Retainer, Spring
17310	Lever, Snubber
17311	Stud, Idler Roller
17312	Spacer
17325	Shield, Exciter Lamp
17327	Lamp 4 volt 75 amp. Exciter
17348	Flywheel
21769	Screw, 8-32 Fillister Head
quote(Please	21796 when ordering)
1150025	Screw Special
M50027	Plug
M50030	Switch and Condenser Insulator
M50090	Holder, Plug
5450101	Lead
M50392	Bracket, terminal strip
M50395	Screw, 6-32 Fillister Head
M50397	Shield Screening
M50408	Spring Compression
M50409	Cover, Exciter Lamp
M50418	Screw 8-32 Knurled
M50449	Spacer
M50478	Screw Pilot

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
SOUNDHEAD ASSEMBLY

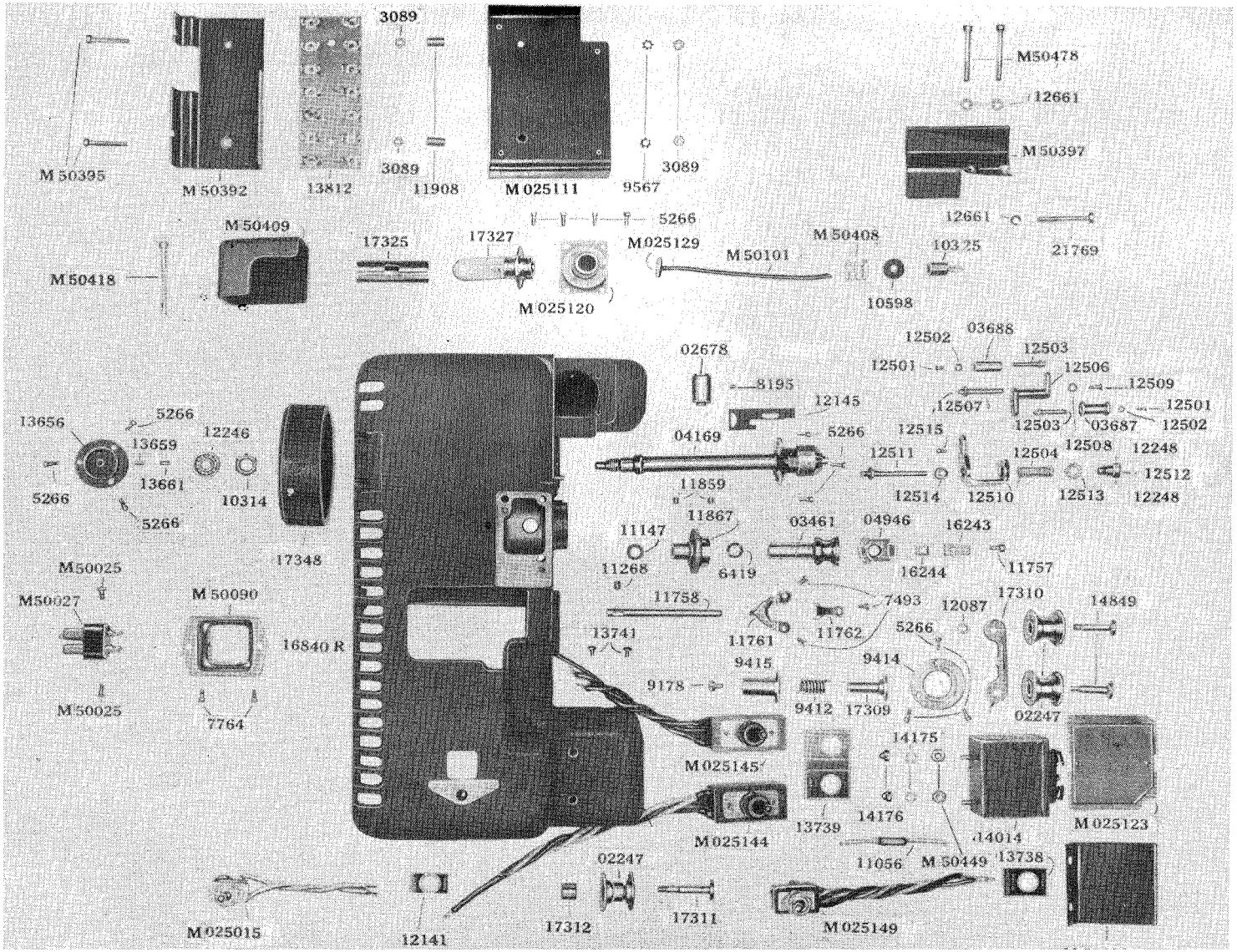


FIG. 2

G.B. BELL & HOWELL MODEL 621 PROJECTOR
MOTOR ASSEMBLY

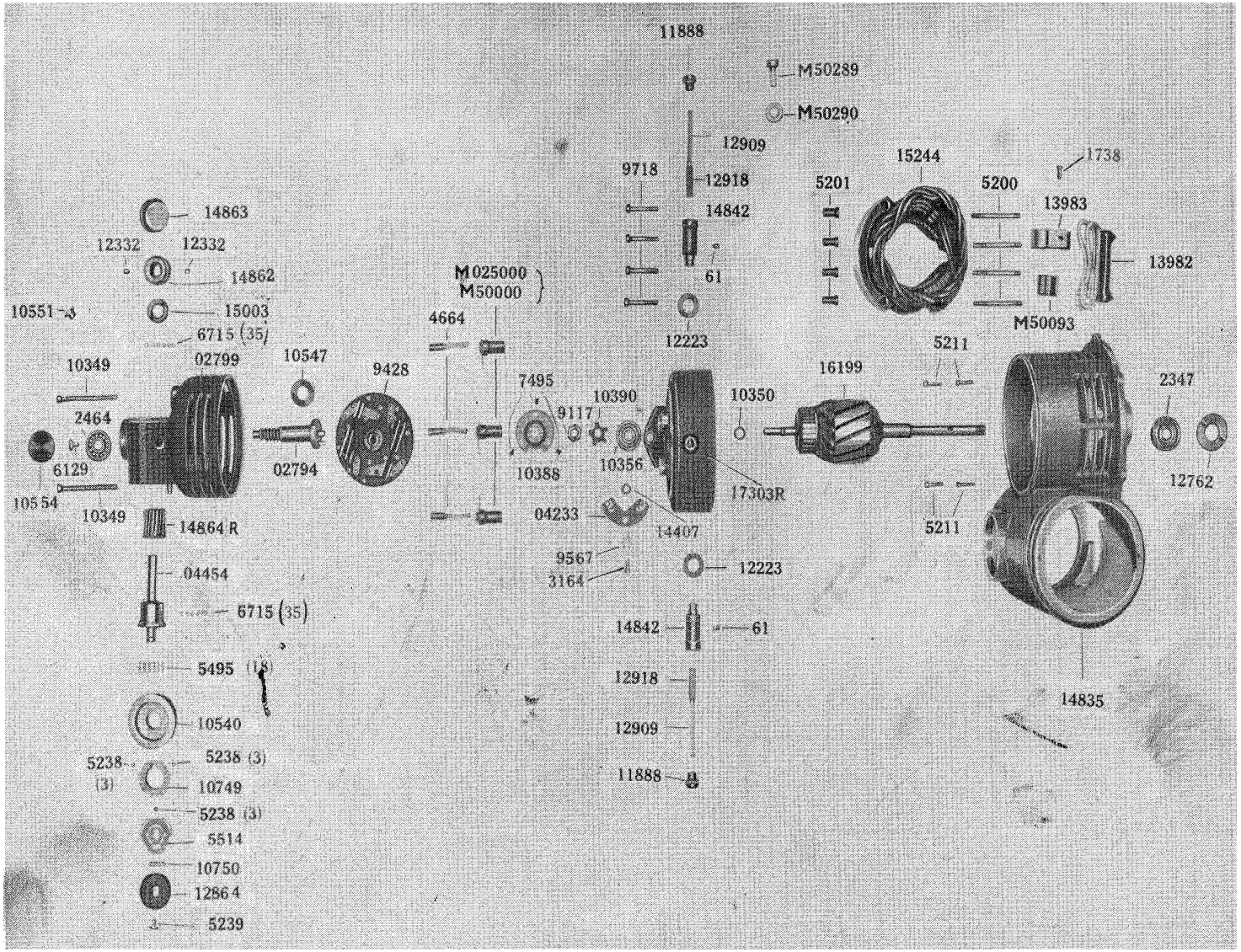


FIG. 3

MODEL 631 PROJECTOR

MOTOR ASSEMBLY

FIGURE 3.

Part No.	Description
2794	Shaft and Drive Blade Assembly, Worm
2799	Cap and Ball Hace Assembly, Governor
4233	Plate, Lug Mounting Assembly
4454	Shaft Assembly, Pulley
M025000	Holder Governor Brush Assembly
61	Sorew 6-32 Set
1738	Screw 4-36'Fillister Head
2347	Bearing, 7 mm Radial
2464	Bearing, 6 mm. Radial
3164	Screw 6-32 x 1/4 Fillister Head
4664	Brush, Governor
5200	Stud, Field Retaining
5201	Hut, Field Retaining
5211	Screw 5-40 Fillister Head
5238	Ball, Steel (Grade "A")
5239	Screws, 8-32 Fillister Head
5495	Roller, Bearing
5514	Cam, Clutch
6129	Screw 4-36 Fillister Head
6715	Ball 1/16 Steel
7495	Screws, 3-48 Fillister Head
9117	Hut, 217-40 Hex
9428	Governor Motor
9567	Washer, Shake proof Lock
9718	Screw 6-40 Fillister Head
10349	Screw 6-32 Fillister Head
10350	Spacer
10356	Bearing 6mm Radial
10388	Cap Bearing Retaining
10390	Washer, Locking
10540	Pulley, Take-up (Upper)
10547	Washer
10551	Screw 1/4-24 Fillister Head
10554	Nut, Special
10749	Retainer, Clutch Ball
10750	Spring Compression
11888	Cap, Motor Brush
12223	Washer, Brush Holder
12332	Screw 8-40 Socket Set (Cup Point)
12762	Ring, Bearing Retainer
12864	Cover Heel Drive Clutch
129 09	Spring, Bush
12918	Motor Brush
139 82	Resistor, 100 ohm.
139 83	Clamp, Resistor
14407	Washer
14835R	Housing, Motor
14843	Holder, Motor Brush (complete)
14862	Collar, Bearing
14863	Cap Bearing
14864R	8 Worm Wheel
15003	Washer Spring
15244	Motor Field
16199	Motor Armature
17303R	Cap, Brush Holder
M50000	Insulating Sleeve
M50093	Insulating Sleeve
M50289	Screw 0.BA x 1/2 CH'Hd
M50290	Washer

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

LAMPHOUSE, BLOWER AND PILOT LAMP ASSEMBLIES

FIGURE 4.

Part No.	Description
1033	Hut and Ring, Motor Clutch Jaw Adjusting
01846R	Screw, Lamp Lock (complete)
2003	Projector Lamp
02691R	Housing Assembly, Blower
2789	Cap Assembly, Governor
03085R	Block Contact (complete)
03864R	Reflector Assembly
3927	Shutter Assembly, Fire
3941	Tube, Air Circulating (complete)
4883	Fan Assembly, Blower
K025154	Brush Holder Cap and Lead Assembly
M025201	Box Assembly, Terminal
374	Ball, Steal
985	Spring, Friction
986	Hut 5/16-27
987	Socket Light
988	Pilot Lamp 120v.6w.
1369	Spacer, Condenser Lens
1561	Holder Condenser
5012	Holder Relay Condenser
5014	Spring Relay Condenser Lens Retaining
5162	Washer, Armature Spring
5188	Jaw, Motor Clutch
5189	Pin, Motor Clutch Operating
5191	Spring, Motor Clutch Operating
5193	Washer Motor Pinion
5206	Spring, Condenser Friction
5211	Screw 5-40 Fillister Head
5212	Screw 4-50 x 7/16 Fillister Head
5247	Guide, Fire Shutter
5248	Screw 2-56 x 3/16 Fillister Head
5306	Lens, Condenser
5626	Retainer, Relay Condenser Spring
5692	Spacer
5863	Washer, Terminal
5866	Retainer, Condenser Lens
5893	Screw 10-32 Set
6716	Screw 2-56 x 5/32 Fillister Head
6926	Lens, Condenser
6964	Screws 6-32 Fillister Head
8066	Condenser 47 mm Auxiliary
9207	Pinion, Motor
9208	Bearing, Roller
9209	Bearing, Roller
11114	Screw 8-32 x 222 Pilot
11116	Stud, Pilot Light Fastening
11117	Screw 6-32 Headless Set
11118	Spring Compression
11119	Housing Pilot Lamp
11120	Tube, Pilot Light Socket
11123R	Housing Pilot Lamp
13426R	Ring Head Conducting
13428	Cover, Lamphouse
13665	Strip, Insulating
14835R	Housing, Motor
15589	Handle, Condenser
16199	Motor Armature

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
LAMPHOUSE, BLOWER AND PILOT LAMP ASSEMBLIES

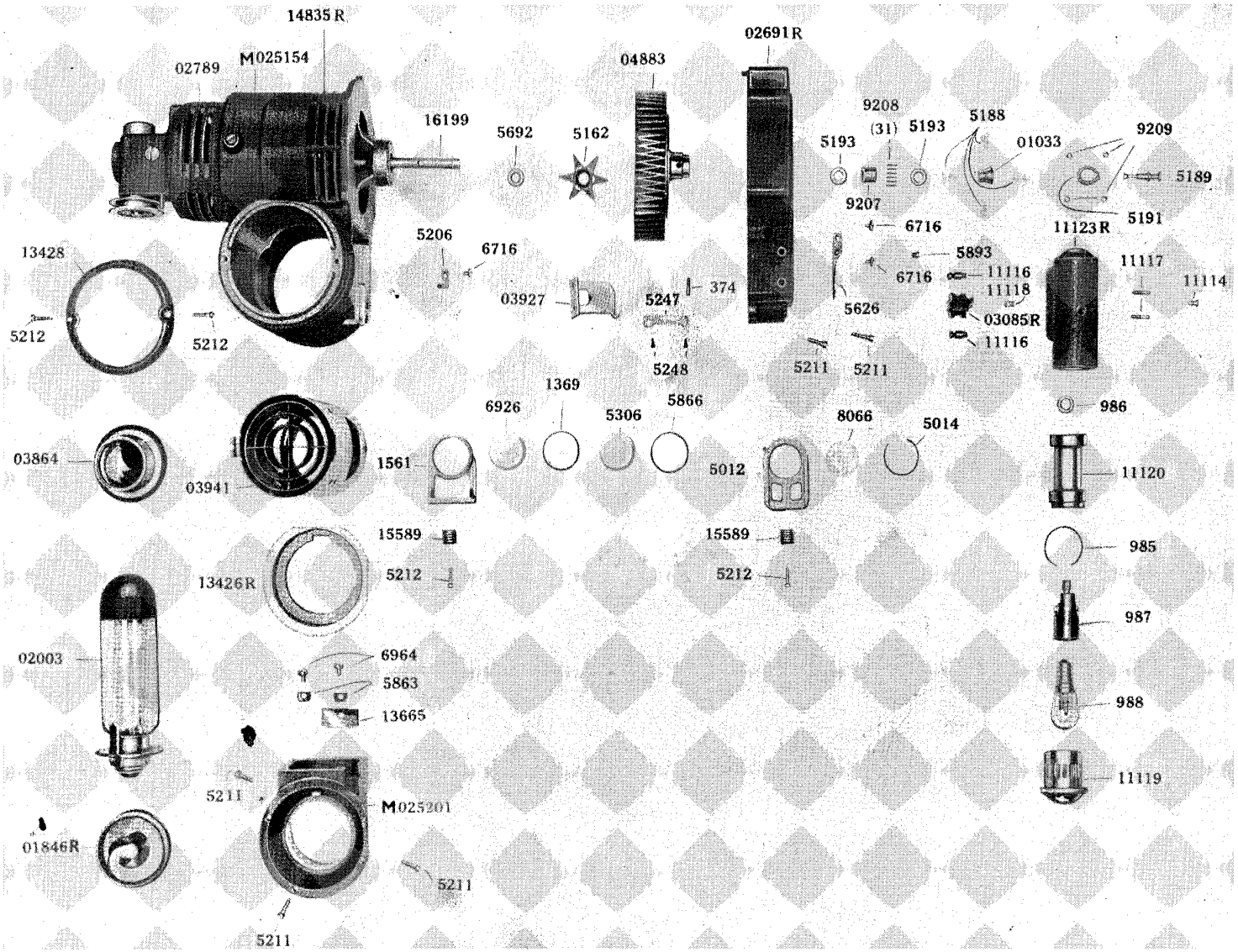


FIG. 4

G.B. BELL & HOWELL MODEL 621 PROJECTOR
MECHANISM & SOUNDHEAD ASSEMBLY

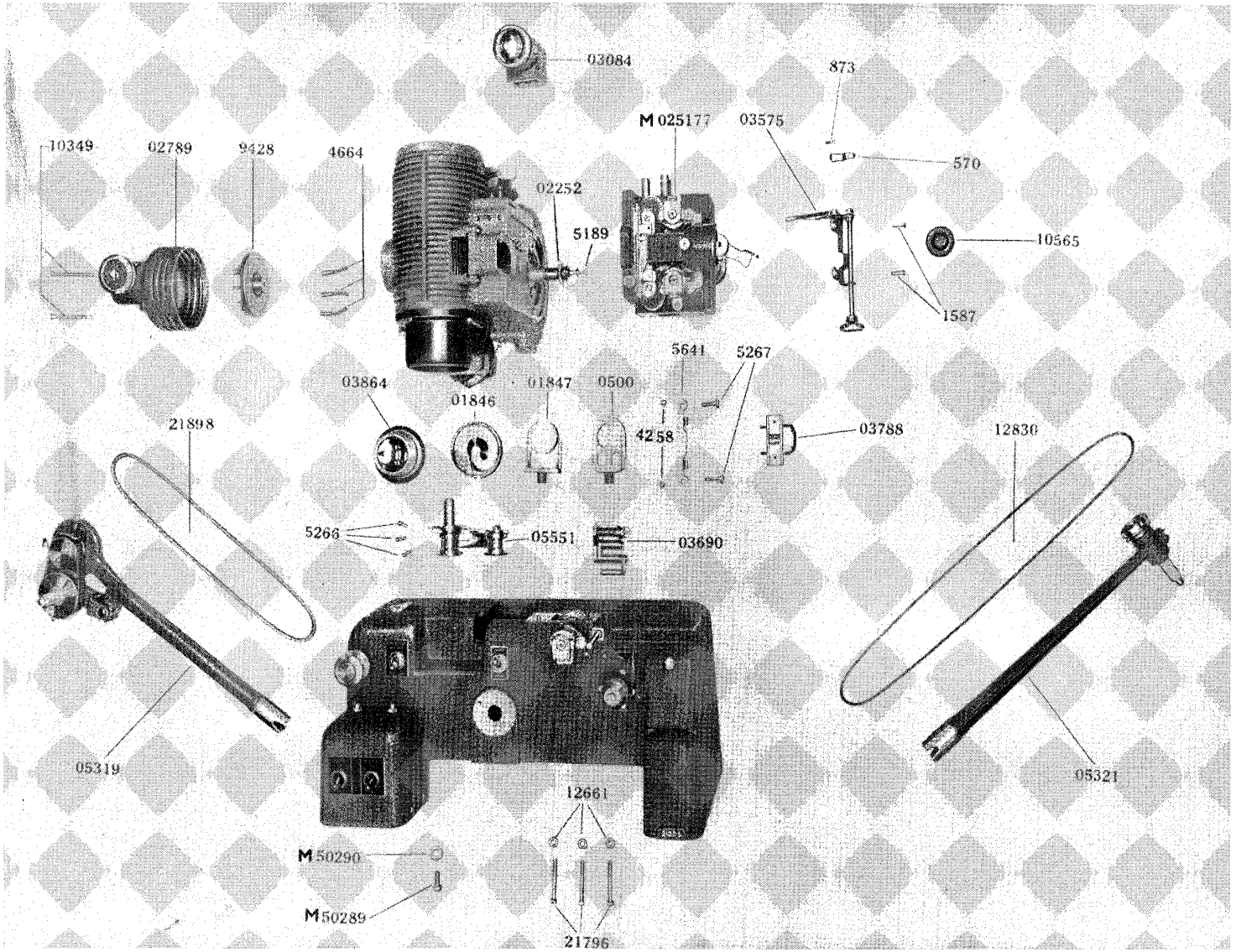


FIG. 5

MODEL 631 PROJECTOR

MECHANISEM & SOUNDHEAD ASSEMBLIY

FIGURE 5.

Part No.	Description
500	Condenser Assembly, Relay
01846R	Screw, Lamp Lock (complete)
1847	Condenser Assembly 45 mm/50 mm.
OS252	Spring-Roller Assembly, Motor Clutch
2789	Cap Assembly, Governor
3084	Unit Assembly, Pilot Light
3575	Manipulator, Clutch (complete)
3690	Stabilizer Assembly
3788	Plate Assembly, Pressure
03864R	Reflector Assembly
05319R	Arm & Take-up Assembly, Spool (Rear)
5321	Arm Assembly, Spool (Front)
5551	Snubber Assembly
MO25177	Gear Case Assembly
570	Spring, Clutch Lever
873	Screw 5-40 x 365 Fillister Head
1587	Screw, 8-32 Oval Head
4258	Washer
4664	Brush, Governor
5189	Pin, Motor Clutch Operating
5266	Screw 5-40 x 9/32 Fillister Head
5267	Screw 5-40 Fillister Head
5641	Rail Guide
9428	Governor, Motor
10349	Screw 6-32 Fillister Head
10565	Knob, Counter Gear Extension
12661	Washer No. 8 lock
12830	Reverse Belt
21796	Screw, 8-32 Fillister Head
21898	Belt, spring, take up
M50289	Screw O.BA x 1/2 CH'Hd.
M50290	Washer

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

SPOOL ARM ASSEMBLIES

FIGURE 6.

Part No.	Description
1138	Spindle Assembly Spool
3446	Look Lever and Stud Assembly, Rewind
3447	Pulley Assembly, Spindle and Take-up
3979	Roller
4523	Pulley and Shaft Assembly, Take-up Drive
5317	Arm and Race Assembly, Spool (Rear)
1367	Washer, Shim
1375	Washer, Split Retaining
5238	Ball, Steel (Grade "A")
5239	Screws, 8-32 Fillister Head
5495	Roller, Bearing
5514	Cam, Clutoh
9178	Screw 6-32 x 1/4 Fillister Head
10749	Retainer, Clutoh Ball
11462	Gear Rewind Drive
11463	Gear, Rewind
11466	Spring
11468R	Shaft, Take-up Arm
11470	Sorew 5-40 Shoulder
11471	Roller, Bearing
11474	Ring, Bearing Retainer
11475	Nut 3/8-40 Hexagon
11478	Fabric Clutch Belt
11481R	Arm Take Hp
11521	Screw
12128	Spring, Compression
12129	Plunger
12864	Cover Spool Drive Clutch
13525	Spindle, Pin Roller
15582	Washer
16939	Arm Spool (Front)
16941	Screw, 10-32 Knurled
17182	Retainer, Bearing
17183	Bearing
17184	Washer
17305R	Holder, Top Spool Arm
17306R	Holder, Rear Spool Arm
17897	Washer
26589	Back Plate, Spool Arm Holder (Front)
26590	Back Plate, Spool Arm Holder (Rear)
26591	Screw
M50358	Pulley

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
REEL ARM ASSEMBLIES

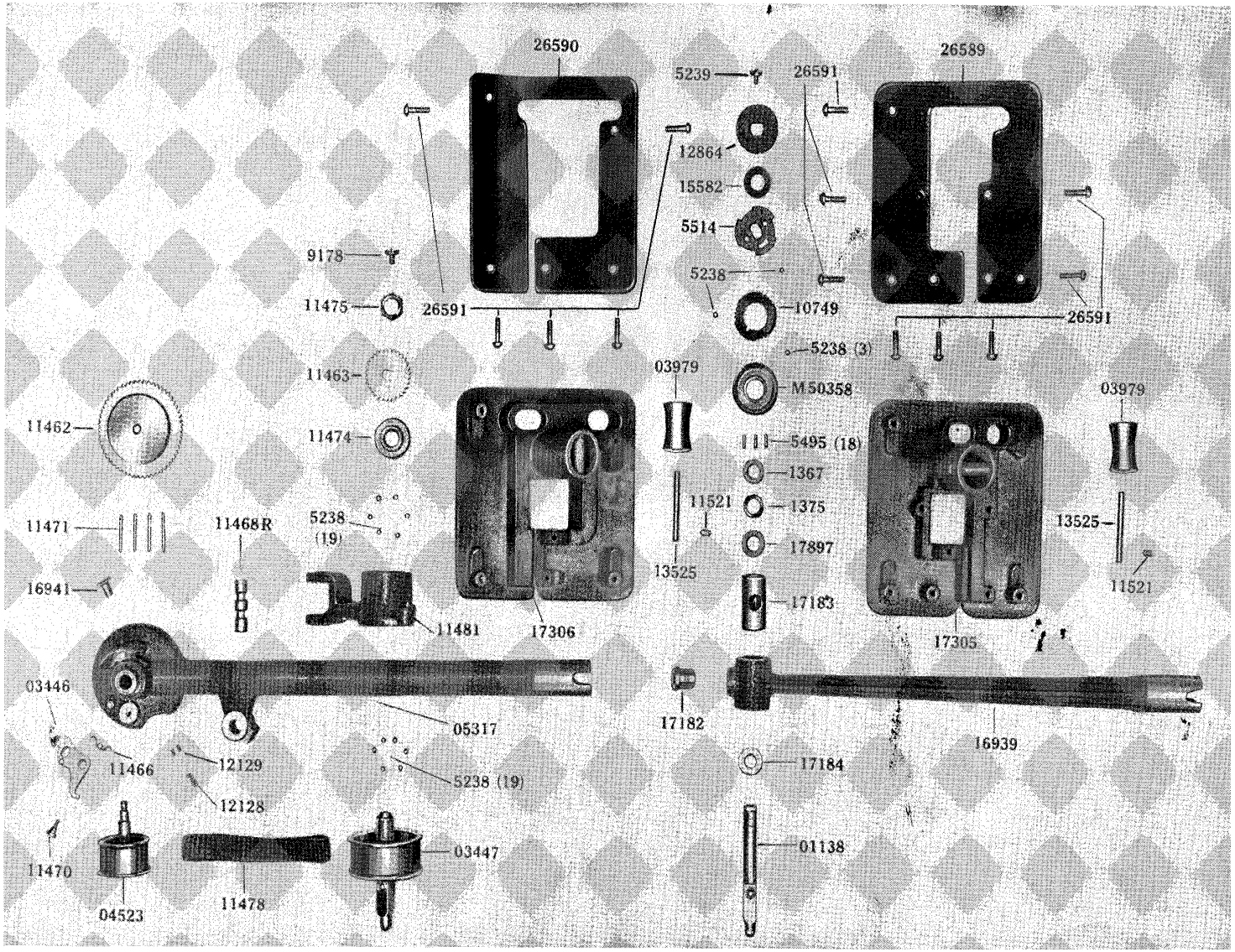


FIG. 6

G.B. BELL & HOWELL MODEL 621 PROJECTOR
PROJECTOR CASE

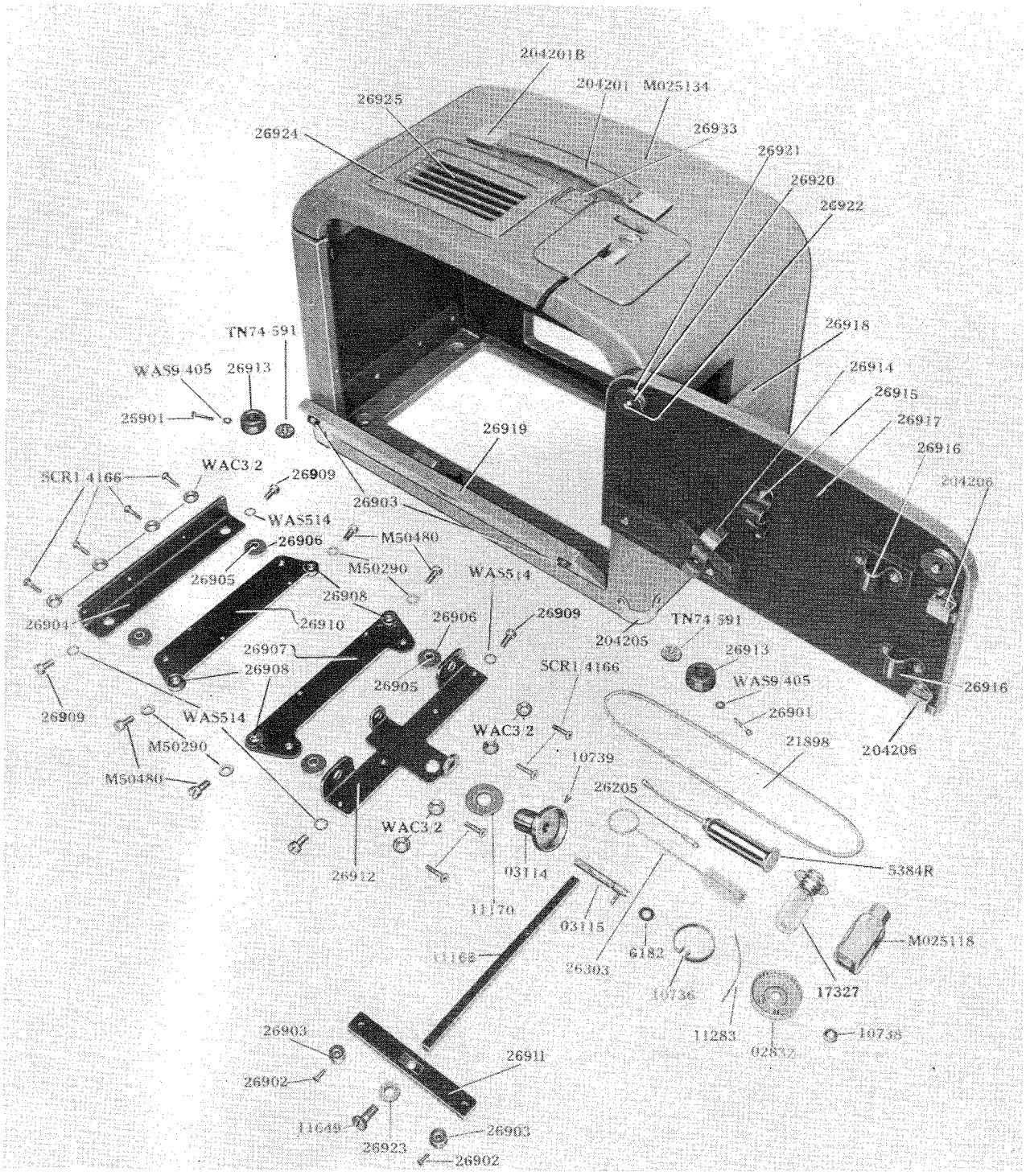


FIG. 7

G. B. BELL & HOWELL

MODEL 631 PROJECTOR

PROJECTOR CASE

FIGURE 7.

Part No.	Description
26901	Screw 4BA x 13/16" Rd. Hd.
26902	Screw 5BA x 3/8" Rd. Hd.
26903	Foot, rubber
26904	Bracket Projector mounting (L.H.)
26905	Spacer
26906	Mounting Rubber
26907	Bracket, sling (R.H.)
26908	Washer packing
26909	Screw
26910	Bracket sling (L.H.)
26911	Bar, foot
26912	Bracket projector mounting (R.H.)
26913	Foot rubber 5/8" x 1"
26914	Strap, Rear spool arm
26915	Strap, cleaning brush
26916	Strap, Exciter Lamp and oil can
26917	Door, assembly
26918	Flap, lens
26919	Flap, assembly
26920	Retaining plate
26921	Dowel
26922	Screw No. 8 x 3/4"
26923	Washer 1/4" diameter
26924	Grill Frame
26925	Grill bar
26933	Oiler Assembly
2823	Tilt Knob
3114	Friction Cup Complete
3115	Tilt Pinion
6182	Washer
10736	Friction Band
10738	Nut
10739	Screw
11168	Tilt Rack
11170	Tilt Pinion Washer
11283	Blade Spring
11649	Screw
17327	Exciter Lamp
21898	Spare Take-up Belt
36205	Spare Fuse
26303	Gate Cleaning Brush
5384R	Oil Can
M025118	Oil Bottle
M50290	Washer
M50480	Screw
204201	Handle
204201B	Handle
204805	Corner
204206	Catches
M025134	Case
SCK1/4166	Screw 2BA x 11/16" Raised Head
WAS 9/405	Washer B.A.
WAS 514	Washer 1/4" Shake proof
TN.74/591	Nut, 4BA Tee
WAC.3/2	Cup Washer, 2BA.

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

SPEAKER CASE

FIGURE 8.

Part No.	Description
26926	Panel Front
26927	Shelf
26928	Lead Assembly, case
26929	Grille Lid
26931	Grille, baffle
26932	Screw 2 BA x 1 3/4"
203205	Lock, case
203205B	Catch, Lock
203036	Speaker Unit
203203	Clip, spool
203206	Key, case
203217	Spigot, spool
203012 E.C.A.Ho.12938)	Lead, Y ft.
203014	Lead, Speech 50 ft.
203016	Lead, transformer mains 25 ft
204201	Handle, Case
204201B	Clip, Case
204205	Corner, ease
26451	Spool 1600 ft.
26430	Film, practice
26230	Spool, 400 ft.
26212	Manual, Instruction
NUT 3.	2 BA Full nut
WAS 1/508	2 BA Washer, Shakeproof
WAC 3/2	2 BA Countersunk Washer

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR

SPEAKER

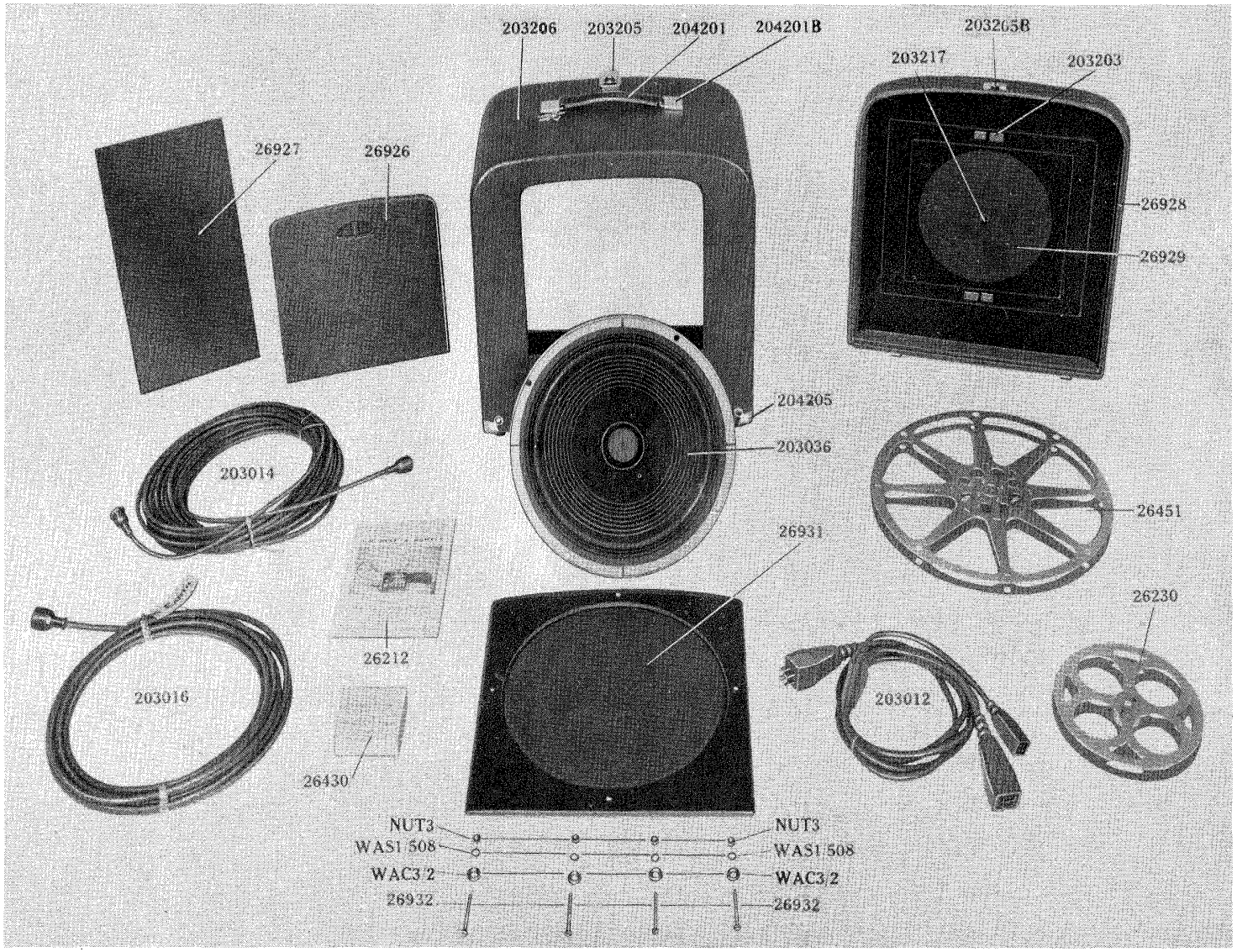


FIG. 8

G.B. BELL & HOWELL MODEL 621 PROJECTOR
MAINS TRANSFORMER

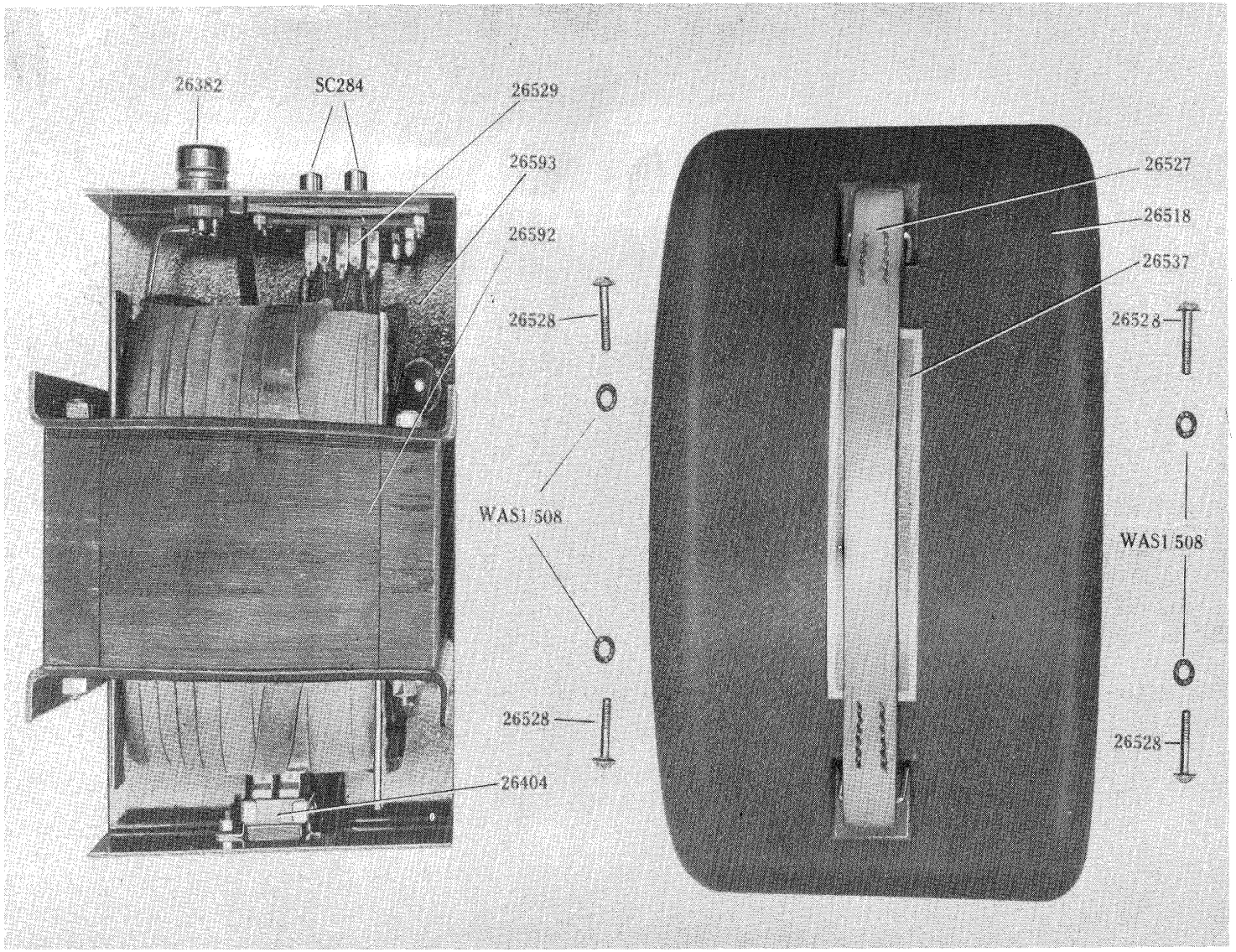


FIG. 9

MODEL 631 PROJECTOR

MAINS TRANSFORMER

FIGURE 9.

Part No.	Description
26382	Mains Input Socket.
26404	Output Socket.
26518	Chassis Cover.
26527	Handle.
26528	Screw.
26529	Voltage Tapping Strip.
26537	Name Plate.
26592	Transformer.
26593	Chassis.
SC.284	Voltage Tapping Screws.
WAS. 1/508	Washer 2BA.

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

SERVICING TOOLS

FIGURE 10

Part No.	Description
S-16931-H1	Shuttle Stroke Gauge
S-10127-F4	Tfrenoh
S-10127-F3	Wrench
S-10441-H7	Sprocket Guide Gauge
S-4529-13	Shuttle Tooth Height Gauge
S-5649-H1	Film Clearance Gauge
S-10309-PI	Wrenoh
S-5649-U2	Film Clearance Gauge
S-15638-N4	Sprocket and Film Guide Clearance Gauge
S-1Q310-F2	Offset Gauge (for holding shuttle shaft when removing shutter)
S-14878-F1	Drift Punch (for removing hearing from gear case)
S-4007-F5	Plain Sleeve (for reassembly of counter gear and shuttle shaft to gear case)
S-4Q07-F6	Knurled Sleeve (for assembly of steel halls to counter gear and shuttle shafts)
S-4007-F11	Holding Block (for assembly of steel balls and felt to counter gear and shuttle shafts)
S-4007-F14	F.14 Quills (for assembly of counter gear and shuttle shafts to gear ease)
S-4007-F15	Assembly Fixture
G.167-F8	Handle for Allen Key
G.165-F1	Handle for Allen Key
S-15177-M1	Sprocket Shaft Spacer
S-15177-N2	Sprocket Shaft Adjusting Tool
S-15177-F3	Sprocket Assembly Cone
S-15177-H4	Shim (for gear adjustment)
S-16539-W1	Sound Sprocket Setting Gauge
STK-1459	Spring Clips (for Quills)
1001/49	Carrying Case
	2 BA Angle Allen Key
	2 BA Straight Allen Key
	3 BA Angle Allen Key
	3 BA Straight Allen Key
	4 BA Angle Allen Key

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
SERVICE JIG AND TOOLKIT

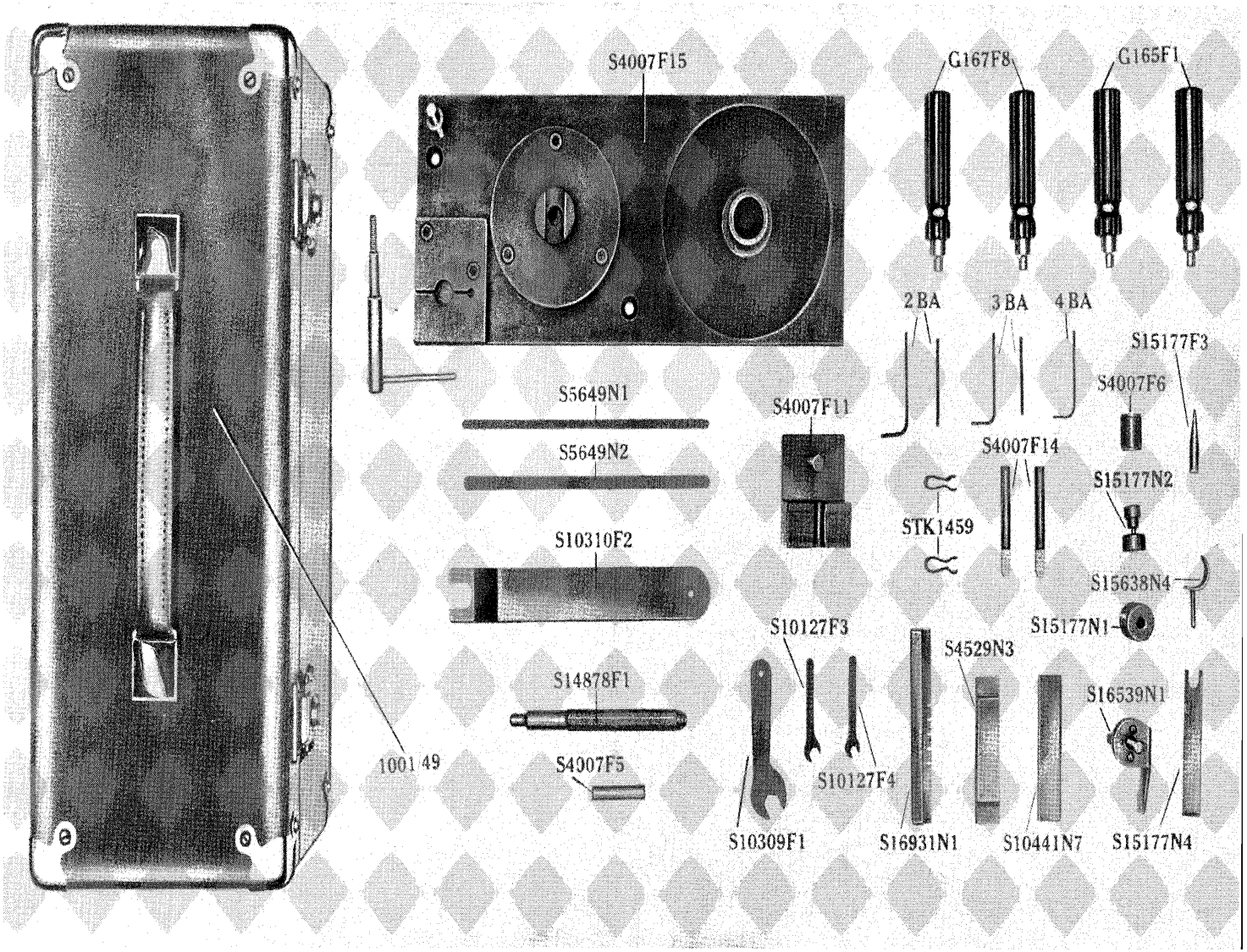


FIG. 10

G.B. BELL & HOWELL MODEL 621 PROJECTOR
SERVICE JIG AND TOOLKIT

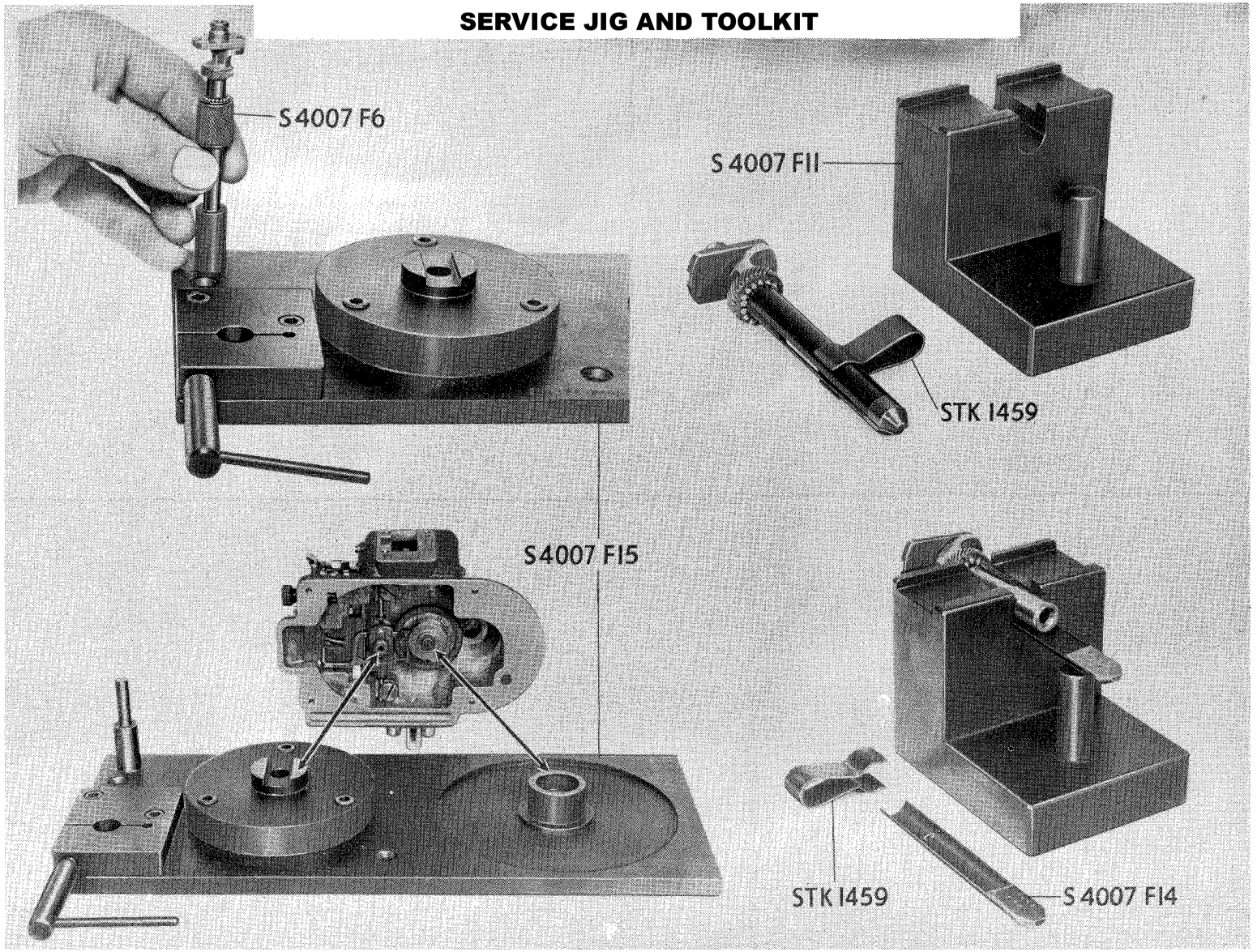


FIG. 11

MODEL 631 PROJECTOR

SERVICING TOOLS

FIGURE 11

Part No.	Description
S-4007-F6	Knurled Sleeve (for assembly of steel balls to counter gear and shuttle shafts).
S-4007-F11	Holding Block (for assembly of steel balls and felt to counter gear and shuttle shafts).
S-4007-P14	F.14 Quills (for assembly of counter gear and shuttle shafts to gear case).
S-4007-F15	Assembly Fixture.
SEK-1459	Spring Clips.

MODEL 631 PROJECTOR

SERVICING TOOLS

FIGURE 12

Part No.	Description
S-10310-F.2.	Offset Gauge.
S-14878-F.1.	Drift Punch.
G.167-F.8.	Handle for Allen Keys.
G.165-F.1.	Handle for Allen Keys.
S-15177-N.1.	Sprocket Shaft Spacer.
S-15177-N.2.	Sprocket Shaft Adjusting Tool.
S-15177-F.3.	Sprocket Assembly Cone.
S-15177-N.4.	Shim.

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
SERVICE JIGS & TOOLS

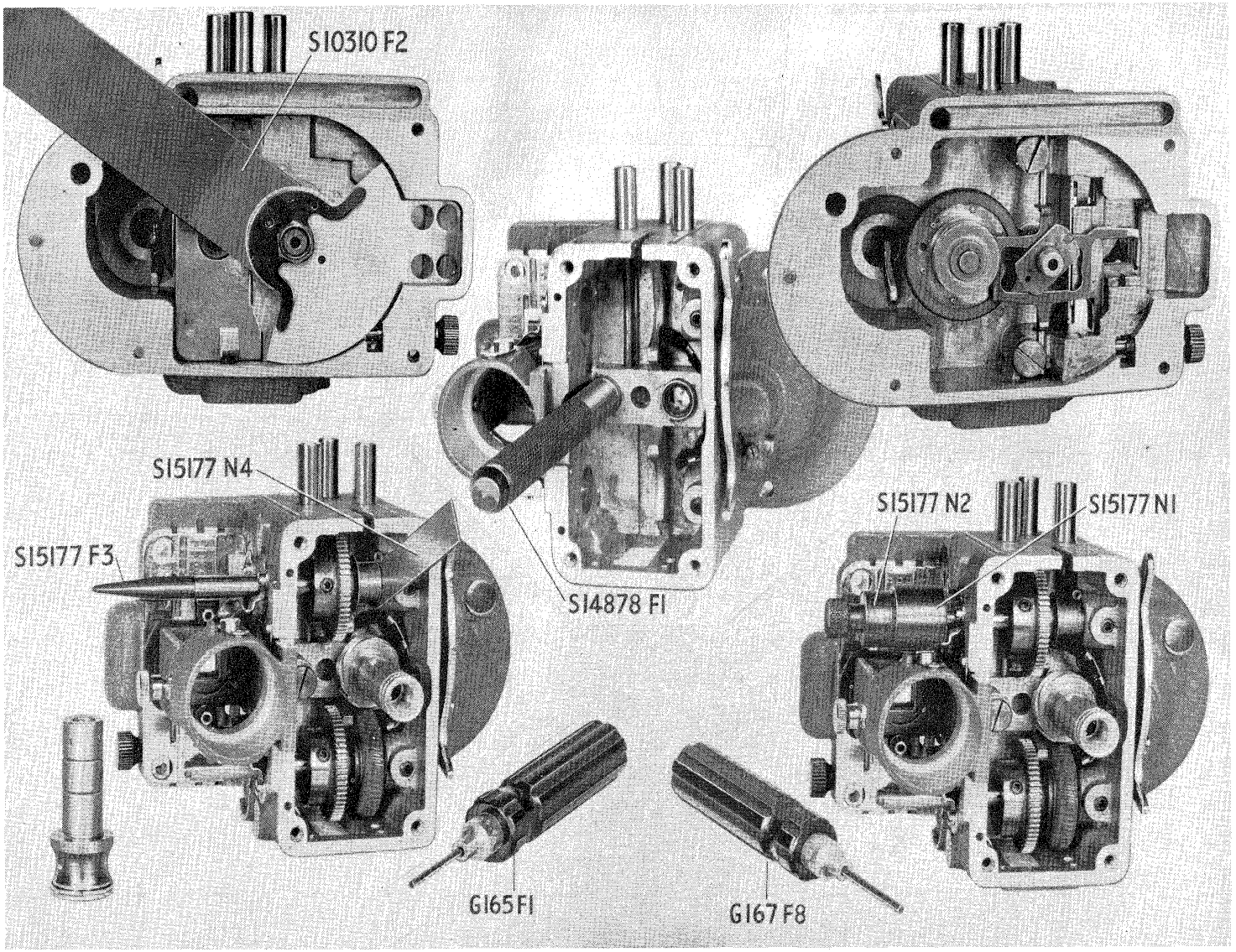


FIG. 12

G.B. BELL & HOWELL MODEL 621 PROJECTOR
SERVICE JIGS & TOOLS

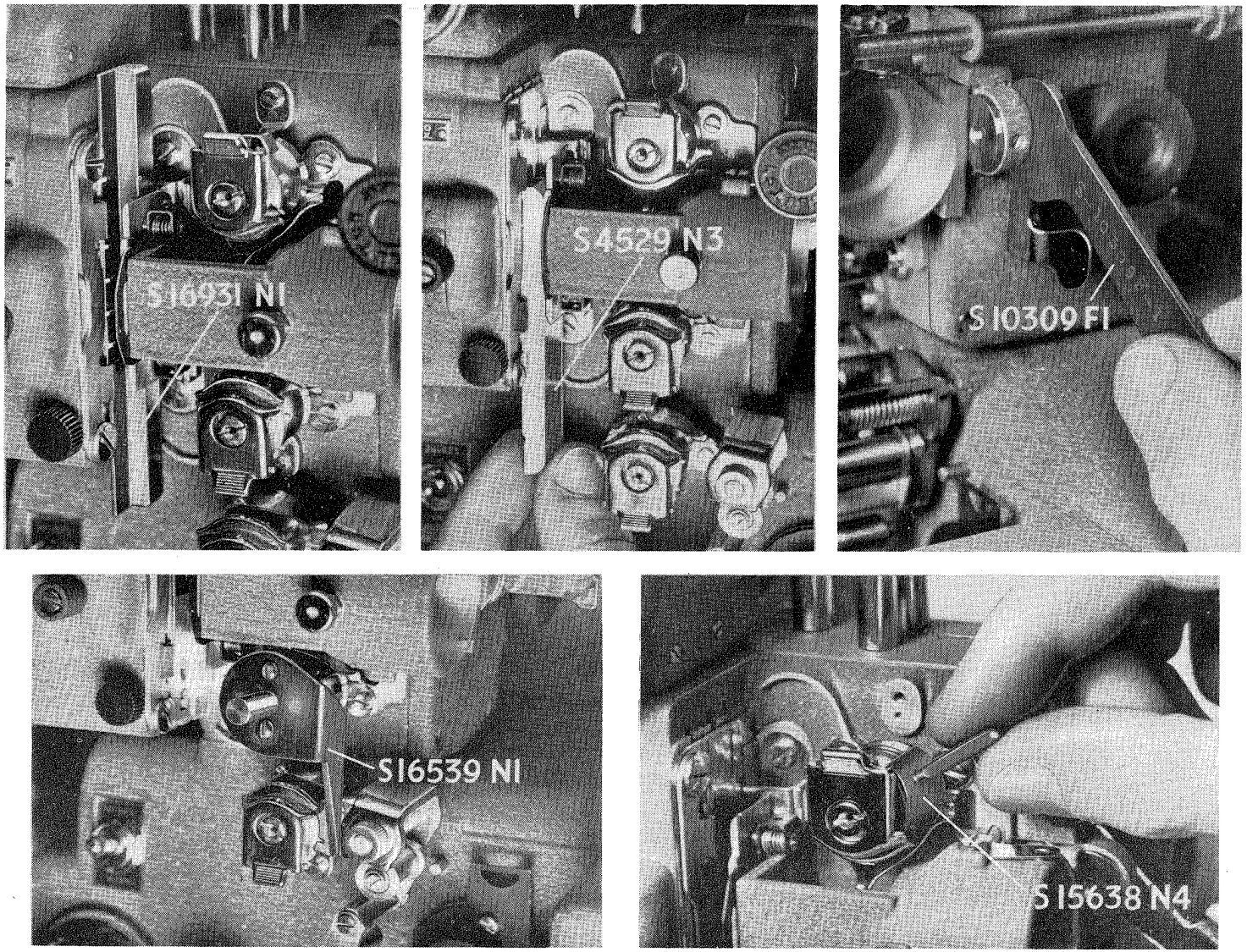


FIG. 13

MODEL 631 PROJECTOR

SERVICING TOOLS

FIGURE 13

Part No.	Description
S-16931-N1.	Shuttle Stroke Gauge.
S-4529-N3.	Shuttle Tooth Gauge.
S-10309-P1.	Wrench.
S-15638-N4.	Gauge.Sprocket and Film Guide Clearance
S-16539-N1.	Sound Sprocket Setting Gauge.

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

BASE VIEW

FIGURE 14

Part No.	Description
11859	Screw 8-32 Headless Set
21796	Screw 8-32 Fillister Head
M50289	Screw 0BA x 1/2 CH'Hd
M50S90	Washer
M50480	Screw

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
BASE VIEW

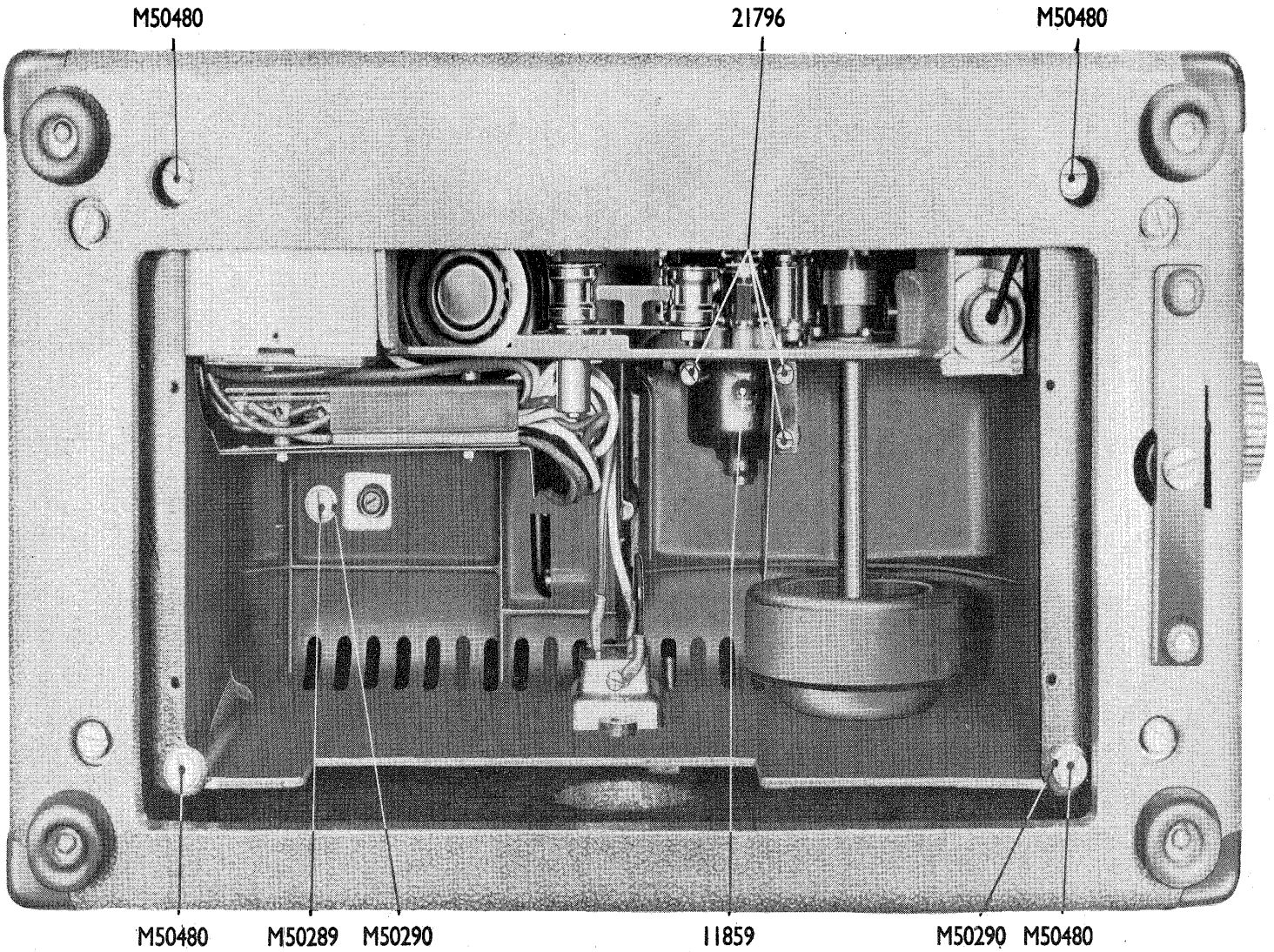


FIG. 14

G.B. BELL & HOWELL MODEL 621 PROJECTOR
AMPLIFIER

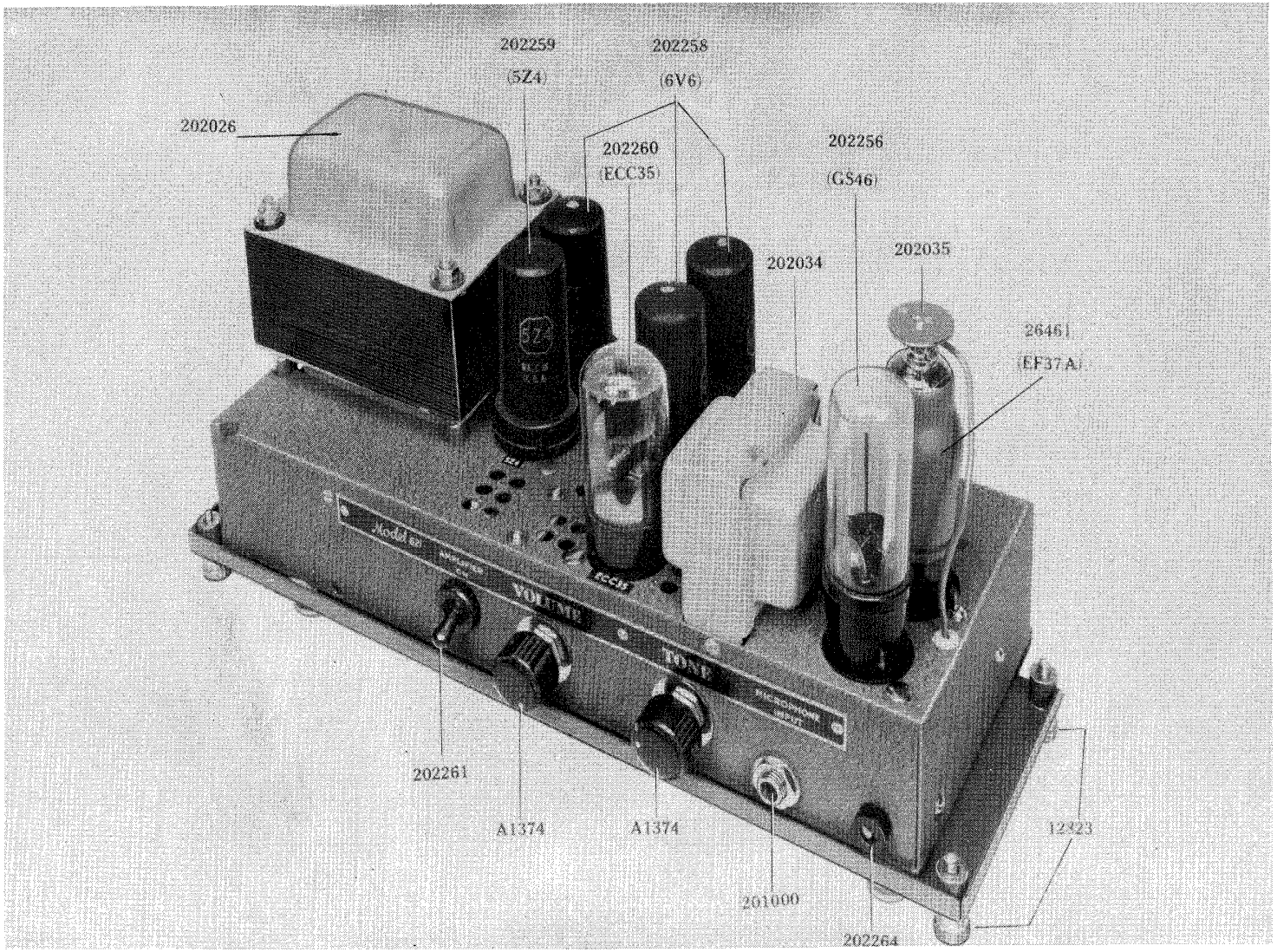


FIG. 15

MODEL 631 PROJECTOR

AMPLIFIER

FIGURE 15

Part No.	Description
12823	Screw 8/32 Knurled
201000	Microphone Jack
202026	Transformer Mains 110 v.
802034	Transformer, Output
202035	Grid Top Gap Assembly
A1374	Control Knob
202256	Cell, Photo Electric Type GS.46.
202258	Valves 6V6GT.
202259	Valves 5Z4GT.
202260	Valves ECC 35.
26461	Valves EF 37A.

Serial No. and type must always be quoted when ordering spares.

MODEL 631 PROJECTOR

REAR VIEW

FIGURE 16

Part No.	Description
M50090	Holder, plug
M50027 (EGA. 2112)	Plug
202039	Shroud
202251 (ECA. PHI.356)	Mains Fuse Holder
202263	Socket, speaker
202264 (ECA. 202266)	Socket

Serial No. and type must always be quoted when ordering spares.

G.B. BELL & HOWELL MODEL 621 PROJECTOR
REAR VIEW

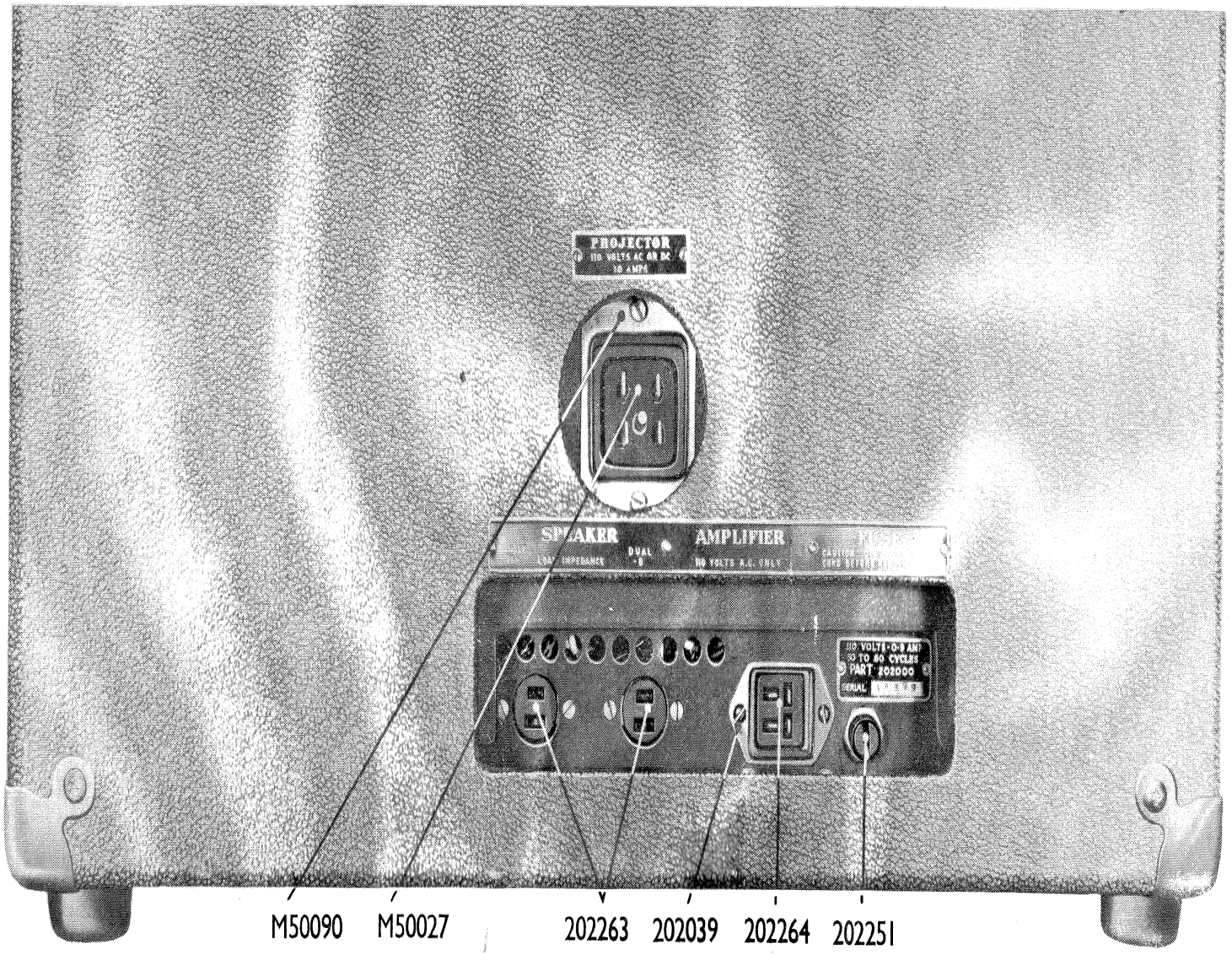
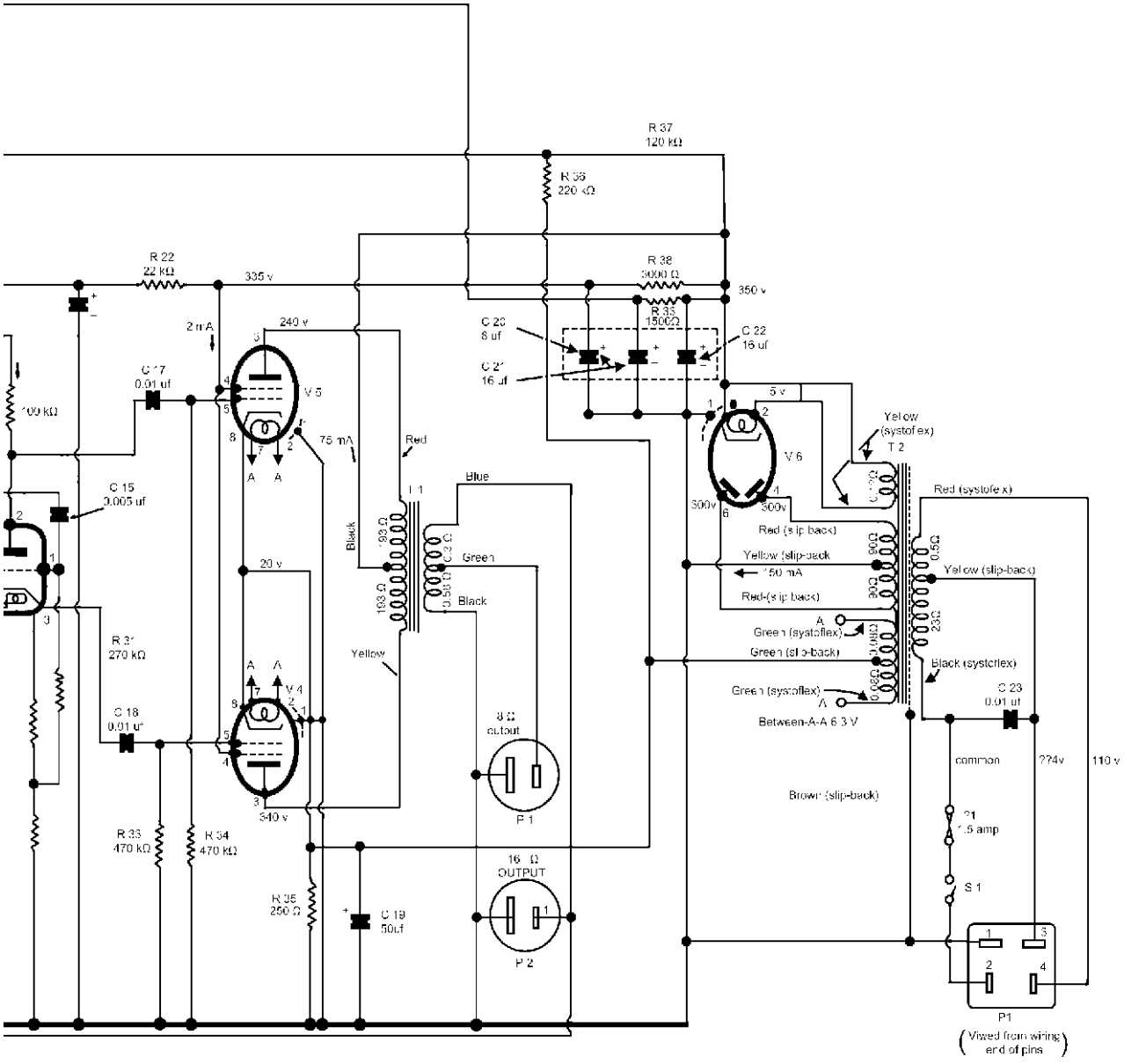


FIG. 16

Howell
ojector

CIRCUIT



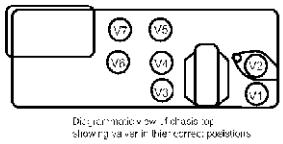


Diagram made view of chassis top
showing valves in their correct positions

G.B. Bell &
"621" Pr

AMPLIFIER

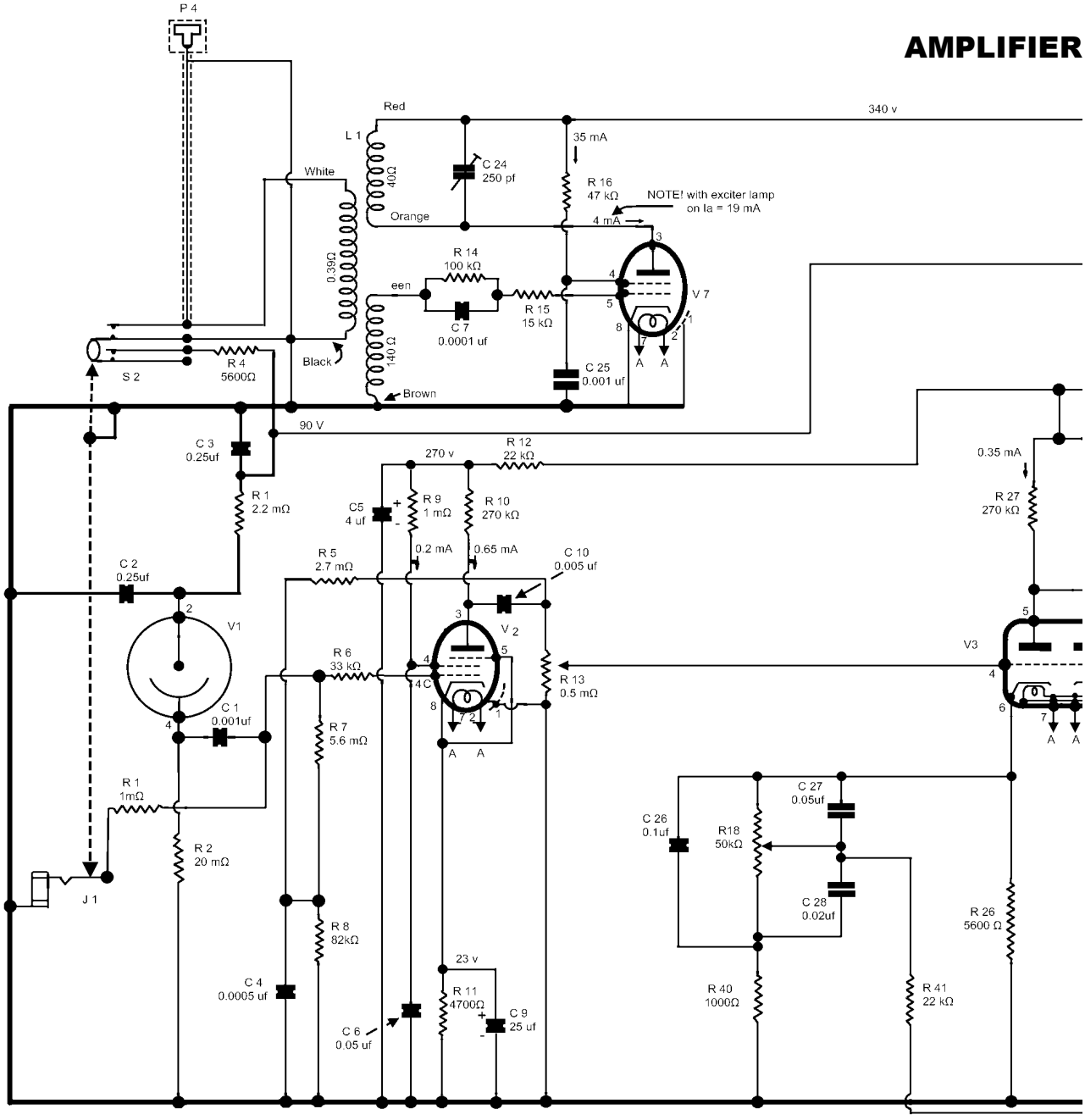


Fig.

G. B. BELL & HOWELL MODEL 621 PROJECTOR

AMPLIFIER

FIGURE 18

Part No.	Description	Circuit Ref.
201000	Microphone Jack	J1
202025	Valve holders	V2,3,4,5,6,7
202026	Transformer Mains 110v	T2
202041	Switch Set Assembly	S2
202045	Cell Holder	V1
202056	Oscillator Coil & Condenser	L1.C24
202073	Condenser 16 plus 16 plus 8 mfd	C20,21,22
202251	Mains Fuse Holder	F1
(ECA No. FHL.356)		
202261	Mains Switch S.P.S.T.	S1
202077	Potentiometer 50,000 Ohms	R.18
202263	Socket, Speaker	P.2, P.3
202265	Potentiometer 500,000 Ohms	R13
202266	Plug, 4 pin	P1
(ECA No. 19098)		
202270	Condenser .001 mfd.	C1 and 25
202271	" .0001 mfd.	C7
202272	" .05 mfd.	C6
202273	" .25 mfd.	C2 and 3
202274	" .005 mfd.	C10-15
202275	" .01 mfd.	C17-18-23
202278	" 4 mfd 350v.	C5 and 16
202279	" 25 mfd. 25v.	C9
202280	" 50 mfd. 25v.	C19
202281	Resistance 3000 ohm No. 8	R38
RMY 1152	" 1500 ohm Type RMY 1152	R39
202283	" 250 ohm Type AX.3515	R35
202284	" 5,600 ohm No. 16	R4 and 26
202285	" 2.7 meg.ohm No. 16	R5
202286	" 20 meg.ohm No. 8	R2
202287	" 5.6 meg.ohm No. 16	R7
202288	" 1 meg.ohm No. 16	R1 and 9
202289	" 82,000 ohm No. 16	R8
202290	" 2,700 ohm No. 16	R29
202291	" 270,000 ohm No. 16	R10 and 27
202292	" 470,000 No. 16	R33 and 34
202293	" 15,000 ohm No. 16	R15
202295	" 47,000 ohm No. 16	R16
202296	" 2.2 meg.ohm No. 16	R3
202297	" 100,000 ohm No. 16	R14-28 and 30
202298	" 22,000 ohm No. 16	R12 and 41
202300	" 820,000 ohm No. 8	R37
202301	" 270,000 ohm No. 8	R31
202302	" 220,000 ohm No. 8	R36
202303	" 33,000 ohm No. 16	R6
202305	Condenser 250 p.f.	C24
202307	Resistance 4,700 ohm No. 16	R11
REX.16102	" 1,000 ohm No. 16	R40
CS2204	Condenser .0005 mfd.	C4
CS3086	" .1 mfd.	C26
CS3084	" .05 mfd.	C27
CS2855	" .02 mfd.	C28

Serial number and type must always be quoted when ordering Spares.

G.B. EQUIPMENTS LTD.
MORTIMER HOUSE,
37-41 MORTIMER STREET, LONDON, W.1