The printing gate

The Model "D" and "J" Printers are designed to print any sound or silent film, of 35 mm. or 16 mm. respectively. Five methods of printing are provided by the 5-way printing drum on the Model "D" (35 mm.) Printer. They are:

(a) Silent full aperture pictures or composite picture and sound;
(b) Picture area when negative is led to the aperture "head-first";
(c) Sound track led to the aperture "head-first";
(d) Picture area when negative is led to the printing aperture "tail-first";
(e) Sound track led to the aperture "tail-first."

By the above arrangement, on Model "D" the negatives may, if desired, be run many times without rewinding. On Model "J" four aperture positions are provided for printing, as in (a), (d) and (e) above, plus Sound only, Kodachromes or black and white reversal. Silent 16 mm. films do not require to be rewound for repetition printing, but 16 mm. Sound Films, which have only one row of perforations, must be rewound.

GUIDE TENSION ROLLERS. These are perfectly aligned and adequate in number, a separate tension roller for each film gives correct tension at the Printing-Sprocket.

Particular attention is directed to the absence of sliding surfaces. The use of rolling instead of sliding motion prolongs the life of the films and improves their quality.

The motor normally supplied is capable of continuous operation for 8-hour periods; it is spring mounted, and capable of easy displacement to or from the main drive pulley without disturbing the alignment. The machine is belt driven, by flat belt drive from the main pulley to three auxiliaries, with necessary belt-tensioners.

The Model "D" Printer is recommended for use at a speed of 60 feet of film per minute, but, by means of stepped belt pulleys a speed of 100 feet per minute can be obtained. By changing the motor pulley for the spare pulley carried underneath the worktable, a speed of 40 feet per minute can be obtained. The motor speed does not change. Model "J" operates at 60 feet per minute only.

THE FEED-POOL HUBS are free in motion, and each is flanged and guarded for 1,200 feet of film. They take standard 35 mm. spools, of inside diameter 1 in., and are not keyed. THE TAKE-UP HUBS are friction driven, and in other respects similar to the feed hubs. They can be pulled forward for Film ejection.

The standard motor operates from 230-volt A.C. mains, of 50 cycles, single phase, but motors can be supplied to operate from other mains supplies, full details of which must be specified when ordering.
ELECTRIC SUPPLY

It is recommended that D.C. be used for the printing light, to avoid uneven printing due to interaction between frame lines and current fluctuations. The motor and magnet and blower circuits as supplied are operated from A.C. mains of 230 volts, 50 cycles, single phase. If D.C. is not available for the printer lamp, then a special motor-generator, or a metal Rectifier Unit, will be required. For this, the type of supply and voltage must be specified when ordering.

APPROXIMATE SHIPPING SPECIFICATION

<table>
<thead>
<tr>
<th>Model “D” or “J”</th>
<th>Nett Weight</th>
<th>Gross Weight</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>with standard</td>
<td></td>
<td></td>
<td>5' 1&quot; x 2' 6&quot;</td>
</tr>
<tr>
<td>set of spares</td>
<td>320 lbs.</td>
<td>490 lbs.</td>
<td>x 1' 9&quot;</td>
</tr>
<tr>
<td></td>
<td>(145.36 kilos)</td>
<td>(222.41 kilos)</td>
<td>(1.5 x -0.762 x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.533 metres)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model “D” or “J”</th>
<th>Nett Weight</th>
<th>Gross Weight</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Flange</td>
<td>376 lbs.</td>
<td>530 lbs.</td>
<td>6' 1&quot; x 2' 6&quot;</td>
</tr>
<tr>
<td>Installation and</td>
<td>(170.61 kilos)</td>
<td>(245.41 kilos)</td>
<td>1' 9&quot;</td>
</tr>
<tr>
<td>standard set of</td>
<td></td>
<td></td>
<td>(1.5 x -0.762 x</td>
</tr>
<tr>
<td>spares</td>
<td></td>
<td></td>
<td>-0.533 metres)</td>
</tr>
</tbody>
</table>
Fig. 1. All parts required for installation.
Fig. 2. Parts removed from Printer prior to installation of 300w lamp assembly.
Fig. 3. Installing entire 300w lamp assembly into Printer Lamp Housing.
Fig. 4. Wiring circuit.
Fig. 5. Top view of Lamp Assembly showing method of aligning white mark on head with mark on car's Holder bracket.
Fig. 6. Side view of printer showing rheostat control and motor lead connector.
Fig. 7. Lateral and horizontal adjustment screws
Fig. 8. Removing filter holder for changing gelatin filters.
Fig. 9. Rear view of flanges showing shift-over brackets in place.
The high-intensity printing lamp assembly is shipped with all the parts required for installation, as illustrated in Figure 1. The following instructions will enable the laboratory technician to make the installation with a minimum of effort:

1. Remove the two screws and card holder bracket illustrated in Figure 2.

2. Remove the present lamp house cover, lamp, socket and adjustment plate. In order to pull the present lamp leads through the lead armour, it is necessary to cut its terminals in the box behind the printer. Push the cork plug in the rear of the terminal box out from the inside to allow entrance of the new cooling-motor lead. Remove the lamp lead armour as it is replaced by a new rubber-covered cord. All the parts eventually discarded preparatory to installation of the new lamp assembly are illustrated in Figure 2.

3. Cap the core hole at the top of the printer pedestal, and visible through the lamphouse casting, with the pedestal hole cap plate and secure with the 4 screws provided. The cap plate and screws are illustrated in Figure 1. Assemble the lamp lead and cooling-motor lead as illustrated in Figure 4.

NOTE:—Figure 4 illustrates the wiring as arranged for operating the lamp-cooling motor when the printer is working from 115-volt alternating current. In many laboratories, the only source of alternating current supply is 220-volt. In this case, introduce a transformer into the wiring circuit to reduce the voltage to 115 volts. This, of course, will change the wiring circuit illustrated in Figure 4. Should the only source of supply be 115-volt direct current, wire the printer as illustrated; however, the direct current will cause the motor to operate somewhat faster than is required.

4. Fasten the card holder shift-over bracket on the top of the front face of the lamphouse casting with two screws. Set the card holder in place and fasten to the top of the bracket with two screws, as illustrated in Figure 7.

5. To provide sufficient clearance for the removal of the filter holder, move the upper film flanges away from the lamphouse with the two adaptors provided for this purpose. Assemble as illustrated in Figure 9.

6. The printer is now ready to take the new 300-watt lamp assembly. Remove the air intake and filter holder unit and insert the lamp assembly into the lamphouse casting as illustrated in Figure 5. (Illustration shows filter holder in the assembly, but it should be removed before assembling.)

7. To align the lamp assembly properly with the printing aperture, adjust the position of the lamp assembly slightly until the white line on the top of the new lamphouse is opposite the white line on the card holder bracket, as illustrated in Figure 5. Then screw the two retaining screws into the lamphouse and tighten securely.

8. Check to see that the Aiko filters are in place in the side of the holder facing the lamp and that the two glass flats are in place on the side facing the printing aperture; then insert the filter holder into the lamp assembly. The printer is now ready for operation and adjustment.

9. The input voltage of the lamp is controlled by a rheostat located below the ammeter. Turn the rheostat control knob in a clockwise direction to increase the voltage to the lamp; turn it counterclockwise to decrease the voltage. The ammeter indicates constantly the amount of current flowing through the lamp filaments. When operating at the lamp's capacity of 120 volts, the ammeter should indicate approximately 2.6 amperes. The maximum voltage should not be exceeded, as it will cause an excess amount of heat, resulting in reduced lamp life and possible damage of the gelatine filters.

10. IMPORTANT: Before turning on the lamp, check to see that the printer magnet coil lead is plugged into its source of supply, as it is necessary for the air-cooling motor to commence operation when the printer switch is turned on.

Before adjusting the lamp, pull back the printer gate shoe and set the aperture for full width printing. Remove the gate lock rod, to give sufficient clearance, and place any good exposure meter over the printing aperture; adjust the reflector horizontally and vertically to secure the maximum meter reading at the printing aperture by manipulating the lateral and horizontal adjustment screws illustrated in Figure 7. When the maximum reading has been established, lock the upper screw in place. Then turn the reflector tilt-adjustment screw, Figure 6, secure the maximum meter reading by tilting the reflector, and lock reflector in place. The reflector is now adjusted to give the maximum illumination at the aperture and is ready for a test print. Usually a fine density print is run off and checked on a densitometer for even density across the film. After making these tests, it may be found necessary to make further minor adjustments of the reflector to secure the optimum results.

Instructions for printing Anseco and Kodachrome colour films may be secured from these companies upon request. They make available colour filter combinations as specified in their printing instructions. Each laboratory should, through practice, be able to work out combinations of filters which will give the finest possible colour balance, following the instructions of the film manufacturer.

11. Replacement Parts: The only parts requiring replacement are printer lamps and brushes for the cooling motor. The lamps are rated at approximately 25-hours operation at full capacity. However, many physical circumstances affect this; while no guarantee as to lamp life is made, experience indicates that because of the higher voltage at which printing lamps are operated their rated life is greatly exceeded.

Since each of the special projection-type lamps is fitted with a prealignment gauge, it should not be necessary to readjust the reflector when replacing a lamp. To replace a lamp, remove the entire lamp assembly from the printer casting. Replace the burned-out lamp, and return the entire assembly to position in the printer casting.

Since damage may possibly occur to the glass flats that hold the gelatine filters, or to the Aiko heat filters themselves, these items are listed as replacement parts.

REPLACEMENT PARTS

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>26459</td>
<td>300-watt, 120-volt Printing Lamp</td>
</tr>
<tr>
<td>SP-7695</td>
<td>Heat Filter Unit</td>
</tr>
<tr>
<td>SP-7696</td>
<td>Glass Gelatine Filter Retainers (2 required)</td>
</tr>
<tr>
<td>5072</td>
<td>Motor Brushes (2 required)</td>
</tr>
</tbody>
</table>
SECTION III

DESCRIPTION

A. GENERAL

1. The Bell & Howell-Gaumont Semi-Automatic Continuous Film Printer 35mm Model D figure 2A and 16mm Model J figure 2, are designed to print all sound or silent motion picture films.

2. Five methods of printing are possible.

(a) To print on one positive film the picture area and sound track from two separate negatives. This method necessitates two separate operations, in which the positive film is run through the printer twice.

(b) To print the picture area and sound track in two operations, even though both the picture area and sound track are on the same negative film.

(c) Or, as it rarely if ever occurs, to print both the picture area and sound track simultaneously if the two records are on the same negative film.

(d) To print the picture area only.

(e) To print the sound track only.

3. The printer's film moving mechanism is designed to unwind the positive and negative films from the feed hubs, and move them past the printing aperture without longitudinal or horizontal slippage onto their respective take-up hubs. All this action is a continuous uniform motion which will cause no undue strain on the perforations.

4. A 300-watt lamp furnishes the illumination for exposures. The light intensity is mechanically controlled in order to ensure instantaneous light changes that can be duplicated exactly on all prints. Predetermined changes in light intensity enable the operator to be one step ahead of the operation. Hence, the designation "Semi-Automatic."

5. The pedestal to which the complete printing mechanism and motor is mounted is of sufficient size and weight to prevent it from tilting or tipping, and can readily be moved from one location to another. Holes have been drilled into the base so that it can be anchored to the floor when a permanent installation is desired.

B. DETAILED

1. Electric Motor. (figure 2.)

(a) The printer is ordinarily driven by a 230-volt constant speed, 50-cycle, single phase induction motor. However, motors of other electrical specifications are sometimes used. The electrical specifications for the motor are governed by the current supply available.

(b) The motor is capable of continuously operating the film moving mechanism under normal operating conditions for a period of eight hours without loss of efficiency.

(c) The motor is spring mounted (located under the wooden work table), and the mount permits easy displacement toward or away from the main drive pulley while maintaining proper alignment.

(d) The motor is started by a switch mounted on the pedestal, and is connected by a belt to a main drive pulley. The main drive pulley is in turn connected to three auxiliary pulleys by a single flat belt. An adjustable take-up pulley and a belt tightener are provided for controlling the belt friction on the auxiliary pulleys.

2. Combination Interlocking Switch and Starting Lever (figure 2.)

(a) The combination interlocking switch and starting lever is hand operated and in the same circuits with the magnets and printing lamp, and controls the flow of current to the operating parts of the printer independent of the motor. Thus the motor will run at all times and will not lose efficiency (because of cooling) even though the printer mechanism is not operating. When the lever switch is pointed downward it is in the "off" position and when moved one-quarter turn to the right it is in "operating" position.

(1) The lever switch performs three distinct operations, when the lever is moved one-quarter turn to the "operating" position: 1, the component parts for each operation are assembled to the lever shaft in such a manner and position that the printing light and blower motor are turned on; 2, electric current is transmitted to the circuit interrupter; 3, the belt tension pulley engages the drive belt at the proper time.

(2) When the starting lever is shifted from the "operating" position to the "off" position, the belt tension pulley shifts and releases the tension on the drive belt, a stop engages the brake arm, causing the mechanism to stop instantly, and the current to the printing lamp and magnets is cut off.
3. FILM MOVEMENT MECHANISM (figure 3)

(a) The film moving mechanism includes a feed sprocket, a printing sprocket, and a take-up sprocket. All the sprockets are positively geared together and so driven as to move the film at a uniform linear speed (normally 40, 60 or 100 feet per minute for the Model D Printer; the Model J 16 mm Printer runs at 60 feet per minute only). The alterations in speeds are obtained by means of stepped belt-pulleys; for 40 fpm a spare motor belt-pulley is slipped underneath the worktable.

(b) In the printer, care has been taken to avoid frictional contact between the film and the mechanism employed to move it. The film feed sprocket, located below the feed reels, receives the film from the reels, and, working in synchronization with the aperture sprocket, maintains a loop between the feed sprocket and the tension rollers. These rollers, mounted on a weighted lever, are automatically adjusted to exert sufficient tension on the film to keep it taut at all times. The weighted rollers maintain a proper degree of tension against the teeth of the printing aperture sprocket, thereby providing the means for the correct registration and eliminating a possibility of creepage or slippage between the negative and positive films. The tension is in direct proportion to the pressure exerted upon the films. It is sufficient to take all curl from the film and to keep it in perfect alignment. The rollers in conjunction with the printing sprocket, the teeth of which engage with the film as it comes from the tension rollers, bring the film into proper registration before the printing aperture. This method assures steady pictures.

(c) The film is accurately registered just before it reaches the printing aperture, and remains thus until printing is accomplished. The film loops between the printer and the take-up sprocket absorb any jerking motion of the film, and the adjustable clutch take-up ensures smooth winding of the film onto the take-up flanges, making impossible any transmission of jerky motion to the printing aperture.

(d) Further to ensure smoothness of the film take-up action, the driving belts are constructed of a continuous, seamless, flat fabric, and are kept under tension by means of adjustable pulleys, while the motor belt tension is adjustable through the motor support bracket.

(e) It is self-evident that proper threading of the film is essential. The threading operation has been made as simple and fool-proof as is possible.

(f) All rollers and sprockets are properly aligned. The rollers are flanged, and the feed and take-up sprockets are equipped with film guards.

4. Film Gate (figure 3)

(a) The positive and negative films are held in close contact at the printing sprocket by means of a film gate.

(b) The gate is pivoted in the centre to permit the passage of splices, and is mounted on a hinged lever to permit ease in opening for the purpose of threading films on the printing sprocket.

(c) The film gate has a gate shoe shaped to fit the printing sprocket, and is highly polished to eliminate the possibility of scratching, abrading, or otherwise injuring the films.

(d) The film gate is interlocked with the combination switch lever, which prevents an accidental opening while the mechanism is in operation and the printing light turned on. To open the film gate it is necessary to stop the printing mechanism, which automatically turns out the printing light. The switch lock for the film gate is assembled to the front of the printer with one end attached to the lower portion of film gate casting and the opposite end resting in the casting which houses the shaft of the interlocking switch and starting lever.

5. Film Rollers (figure 3)

(a) A sufficient number of rollers is used to confine the film to its proper path. The guide rollers are perfectly aligned, and present a minimum of friction to the passage of the film.

(b) A tension roller is provided for each film to produce the proper tension at the printing sprocket.

6. Feed Hubs (figure 2)

(a) Two freely rotating feed hubs are mounted on the printing frame above the feed sprocket. The feed hubs are equipped with flanges and guards, sufficient to accommodate 400 feet of film. Flanges to accommodate 1700 feet of film are standard on Model D and are also available for Model J, with 400 ft. flanges. The hubs will accommodate commercial film specks having an inside diameter of one inch. The feed hubs have neither key nor key ways.
7. Take-up Hubs. (Figure 2)

(a) Two belt-driven take-up hubs are mounted on the printer frame below the take-up sprocket and are equipped with flanges and guards which will accommodate 400 feet of 16 mm film for the Model J (1200 ft. flanges are also available for the Model D); or 1200 feet of 35 mm film for Model D.

(b) The take-up mechanism is equipped with adjustable friction take-up spindles and flat belt pulleys.

(c) The take-up hubs will accommodate commercial film spools having an inside diameter of one inch, and are fitted with 1/4-inch key slot so the flanges can be pulled outward to strip the rolls of film from the hubs.

(d) The take-up assembly is so designed that the tension necessary to take up the film is adjustable. This is accomplished by seven steel driving and six canvas friction discs which operate under spring tension, and the amount of tension applied is adjustable by a screw cap which covers the driving discs.

8. Footage Counter (Figure 2)

(e) The film footage counter is a film measuring device and is connected with the film sprockets automatically registering every foot of film that passes through the mechanism. It is of great value in checking the progress of the printing operation, as the footage registered is made to check with the footage indicated for each scene on the printing index card.

(b) The counter has a reset knob and registers up to 10,000 feet of film.

9. Illumination. (See Supplement)

10. Light Control Shutter

(a) An automatic curved light shutter encloses the lamp side of the printing sprocket. The shutter has twenty-two exposure positions which vary from adjacent positions by approximately 10%. This range of exposures is sufficient to permit printing all normal negatives.

(b) Control of exposure is obtained by varying the volume of light allowed to reach the film, rather than by varying the brilliance of the light by means of a resistance in the light circuit. In other words, light control is by means of a variable shutter instead of an electrical control on the light intensity.

(c) As a result of this arrangement, the printing lamp is constantly burning at full candle power, and extreme changes of illumination at the printing aperture, as from minimum to maximum, are accomplished instantaneously.

(d) This method of light changes ensures a range of light steps representing an increase of 10% for each succeeding step, thus permitting the application of sensitometric procedure without consideration to color variations of the lamp filament from step to step as would be the case with an electrical control.

(e) All normal adjustments of the light volume are taken care of by the shutter, set by means of the manually operated index pointer on the index dial, which is marked with the 22 shutter opening positions. The actual change in the size of shutter opening is actuated by a circuit interrupter which rides against the edge of the shutter, by thus setting of the shutter is always one step ahead of the actual operation, and an instantaneous change in the light volume is made as soon as the scene changes.

(f) The shutter is located approximately half-way between the lamp and the actual printing aperture, just in front of the ground glass diffuser. The advantage of controlling the light at this point is to obtain even distribution over the entire printing aperture. The operating range of the light shutter is divided into twenty-two steps. The actual opening of the first step (No. 1. on index dial) is set at .350 of an inch on Model J and .356 of an inch on the Model D.

11. Magnetic Clutch and Circuit Interrupter. (Figure 2)

(a) The chief function of the magnetic clutch is to complete instantaneous and automatically the operation of regulating the size of the light control shutter aperture. It consists of an electro-magnet, the structure of which, when in operation, releases the shutter operating mechanism at the desired instant, thus allowing the shutter to occupy the position previously determined by the setting of the time regulator index dial.

(b) The circuit interrupter is mounted just above the printer aperture and is so mounted as to permit accurate adjustment toward and away from the printing aperture while maintaining proper alignment. The circuit interrupter consists of a set of tungsten points, actuated by a roller which rides against the edge of film. As soon as the roller engages a notch in the edge of film, the two points close and transmit an electrical impulse to the magnetic clutch (230-volt A.C. coil) and the 230-volt A.C. coil which operates the index card pointer. It is mounted on a holder just above the printer aperture, and can be pivoted so the distance between the roller and aperture can be set to ensure its engaging the notch in the edge of film at the time when a light change is to take place at the aperture.
(c) Upon coming in contact with a notch, the roller of the circuit interrupter follows the indentation of the negative film, closing the circuit and causing the magnetic clutch to trip, which in turn trips the light shutter control mechanism and automatically sets the shutter to its predetermined position.

12. **Printing Aperture Jaw (figure 3A) (Model J)**

(a) The printing aperture jaw is located inside the drum portion of gear case as shown in figure 3A. A sliding jaw, operated by the aperture jaw setting knob permits the locating of three individual aperture openings in printing position. The purpose of each opening is as follows:

1. When the knob is set so the pointer is at "Sound Only," the width of the printing aperture permits the printing of only the sound tracks.

2. When the knob is set so the pointer is at "Picture Only," the width of the printing aperture permits the printing of only the picture area. This opening is used for printing the picture area from either sound or silent negatives.

3. When the knob is set so the pointer is at "Sound Picture," the width of the opening permits the printing of the sound track and picture area simultaneously. It is obvious that the simultaneous printing of picture and sound track can be done only from master 16mm sound negatives in which the density of the sound and picture area have been matched to permit their being run through the printer at one light setting.

(b) The opening of each printing aperture is 9/64 of an inch high.

(c) A slot is milled in the main casting at the left of the aperture and main sprocket to permit printing the footage markings and trade-marks (key printing) which identify each roll of negative film.

5-Way Aperture Ring (figure 3) (Model L)

(a) The aperture ring is mounted inside the printing sprocket. The five apertures permit printing silent pictures, sound pictures forward, sound pictures backward, sound records forward, and sound records backward. An auxiliary aperture is provided on one side of the printing aperture to permit printing key number forward or backward.

(b) The locating of the printing aperture is controlled by the ring assembly which is made to rotate to set any of the five different apertures at its printing position by means of an aperture ring lever with 5 carefully located positions.

1. The five apertures correspond to:
   a. Full width picture and sound aperture.
   b. Masking out sound track at right side.
   c. Masking picture area at right side.
   d. Masking sound track at left side.
   e. Masking picture area at left side.

2. The combination of apertures permits printing:
   a. Silent full aperture pictures or composite picture and sound.
   b. Picture area when negative film is led to the aperture head first.
   c. Sound track led to the aperture head first.
   d. Picture area when negative is led to the printing aperture tail first.
   e. Sound track led to the aperture tail first.

(c) The above arrangement of aperture openings permits running the negative many times in succession without rewinding. Each picture aperture is 5/16 inch high and each sound aperture 1/8 inch high and located to permit printing the whole width of the film at setting as indicated in paragraph (1) a. to print a narrow baffle line between picture and sound track at settings as described in paragraphs (1) b. c. d. and e.

(d) A slot is milled in the main casting at the left of the aperture and main sprocket to permit printing the footage markings and trade-marks (key printing) which identify each roll of negative films.

13. **Card Holder and Indicator (figure 2)**

(a) A printing card holder is mounted on the printer housing just above the light control shutter index dial. Above the card holder is the footage counter.

(b) The index card holder consists not only of a holder for the card but also a register bar to indicate the light change of scenes, and is controlled by a 220 volt A.C. coil which receives its electrical impulse from the circuit inter-
7. Take-up Hubs. (Figure 2)

(a) Two belt-driven take-up hubs are mounted on the printer frame below the take-up sprocket, and are equipped with flanges and guards which will accommodate 400 feet of 16 mm film for the Model J (1200 ft. flanges are also available for the Model J); or 1200 feet of 35 mm film for Model D.

(b) The take-up mechanism is equipped with adjustable friction take-up spindles and flat belt pulleys.

(c) The take-up hubs will accommodate commercial film spools having an inside diameter of one inch, and are fitted with 1/8-inch key slot so the flanges can be pulled outward to strip the rolls of film from the hubs.

(d) The take-up assembly is so designed that the tension necessary to take up the film is adjustable. This is accomplished by seven steel driving and six canvas friction discs which operate under spring tension, and the amount of tension applied is adjustable by a screw cap which covers the driving discs.

8. Footage Counter (Figure 2)

(a) The film footage counter is a film measuring device and is connected with the feed sprocket shaft, automatically registering every foot of film that passes through the mechanism. It is of great value in checking the progress of the printing operation, as the footage registered is made to check with the footage indicated for each scene on the printing index card.

(b) The counter has a reset knob and registers up to 10,000 feet of film.

9. Illumination - (See Supplement)

10. Light Control Shutter

(a) An automatic curved light shutter encloses the lamp side of the printing sprocket. This shutter has twenty-two exposure positions which vary from adjacent positions by approximately 10%. This range of exposures is sufficient to permit printing all normal negatives.

(b) Control of exposure is obtained by varying the volume of light allowed to reach the film shutter, rather than varying the brilliance of the light by means of a resistance in the light circuit. In other words, light control is by means of a variable shutter instead of an electrical control on the light intensity.

(c) As a result of this arrangement, the printing lamp is constantly burning at full candle power, and extreme changes of illumination at the printing aperture, as from minimum to maximum, are accomplished instantaneously.

(d) This method of light changes ensures a range of light steps representing an increase of 10% for each succeeding step, thus permitting the application of sensitometric procedure without consideration to color variations of the lamp filament from step to step as would be the case with an electrical control.

(e) All normal adjustments of the light volume are taken care of by the shutter, set by means of the manually operated index pointer on the index dial, which is marked with the 22 shutter opening positions. The actual change in the size of shutter opening is actuated by a circuit interrupter which rides against the edge of this sensitive. Thus the setting of the shutter is always one step ahead of the actual operation, and an instantaneous change in the light volume is made as soon as the scene changes.

(f) The shutter is located approximately half way between the lamp and the actual printing aperture, just in front of the ground glass diffuser. The advantage of controlling the light at this point is to obtain even distribution over the entire printing aperture. The operating range of the light shutter is divided into twenty-two steps. The actual opening of the first step (No. 1 on index dial) is set at .250 of an inch on Model J and .150 of an inch on the Model D.

11. Magnetic Clutch and Circuit Interrupter. (Figure 2)

(a) The chief function of the magnetic clutch is to complete instantaneously and automatically the operation of regulating the size of the light control shutter aperture. It consists of an electro-magnet, the armature of which, when in operation, releases the shutter operating mechanism at the desired instant, thus allowing the shutter to occupy the position previously determined by the setting of the time regulator index dial.

(b) The circuit interrupter is mounted just above the printer aperture and is so mounted as to permit accurate adjustment toward and away from the printing aperture while maintaining proper alignment. The circuit interrupter consists of a set of tungsten points, actuated by a roller which rides against the edge of film. As soon as the roller engages a notch in the edge of film, the two points close and transmit an electrical impulse to the magnetic clutch (230-volt A.C. coil) and the 230-volt A.C. coil which operates the index card pointer. It is mounted on a holder just above the printer aperture, and can be pivoted so the distance between the roller and aperture can be set to ensure its engaging the notch in the edge of film at the time when a light change is to take place at the aperture.
(c) Upon coming in contact with a notch, the roller of the circuit interrupter follows the indentation of the negative film, closing the circuit and causing the magnetic clutch to trip, which in turn trips the light shutter control mechanism and automatically sets the shutter to its predetermined position.

12. Printing Aperture Jaw (Figure 3A) (Model J)

(a) The printing aperture jaw is located inside the drum portion of gear case as shown in figure 3A. A sliding jaw, operated by the aperture jaw setting knob permits the locating of three individual aperture openings in printing position. The purpose of each opening is as follows:

(1) When the knob is set so the pointer is at "Sound Only," the width of the printing aperture permits the printing of only the sound tracks.

(2) When the knob is set so the pointer is at "Picture Only," the width of the printing aperture permits the printing of only the picture area. This opening is used for printing the picture area from either sound or silent negatives.

(3) When the knob is set so the pointer is at "Sound Picture," the width of the opening permits the printing of the sound track and picture area simultaneously. It is obvious that the simultaneous printing of picture and sound track can be done only from master lomas sound negatives in which the density of the sound and picture area have been matched to permit their being run through the printer at one light setting.

(b) The opening of each printing aperture is 9/64 of an inch high.

(c) A slot is milled in the main casting at the left of the aperture and main sprocket to permit printing the footage markings and trade-marks (key printing) which identify each roll of negative film.

5-Ray Aperture Ring (Figure 3) (Model L)

(a) The aperture ring is mounted inside the printing sprocket. The five apertures permit printing silent pictures, sound pictures forward, sound pictures backward, sound records forward, and sound records backward. An auxiliary aperture is provided on one side of the printing aperture to permit printing key number forward or backward.

(b) The locating of the printing aperture is controlled by the ring assembly which is made to rotate to set any of the five different apertures at its printing position by means of an aperture ring lever with 5 carefully located positions.

(1) The five apertures correspond to:

a. Full width picture and sound aperture.

b. Masking out sound track at right side.

c. Masking picture area at right side.

d. Masking sound track at left side.

e. Masking picture area at left side.

(2) The combination of apertures permits printing:

a. Silent full aperture pictures or composite picture and sound.

b. Picture area when negative film is led to the aperture head first.

c. Sound track led to the aperture head first.

d. Picture area when negative is led to the printing aperture tail first.

e. Sound track led to the aperture tail first.

(c) The above arrangement of aperture openings permits running the negative many times in succession without rewinding. Each picture aperture is 5/16 inch high and each sound aperture 1/8 inch high and located to permit printing the whole width of the film at setting as indicated in paragraph (1) a. and to print a narrow baffle line between picture and sound track at settings as described in paragraphs (1) b.c.d. and e.

(d) A slot is milled in the main casting at the left of the aperture and main sprocket to permit printing the footage markings and trade-marks (key printing) which identify each roll of negative films.

13. Card Holder and Indicator (Figure 2)

(a) A printing card holder is mounted on the printer housing just above the light control shutter index dial. Above the card holder is the footage counter.

(b) The index card holder consists not only of a holder for the card but also a register bar to indicate the light change of scenes, and is controlled by a 250 volt A.C. coil which receives its electrical impulse from the circuit inter-
2. Set the index pointer, figure 7, so the pointer rests at the No. 1. position on face of index dial. Use a small metal gauge, .250 of an inch thick for Model J and .156 of an inch for Model D and insert (through the top of lamp housing) into the back shutter opening so that it rests between the top edge of mask and the top edge of light shutter. To remove the end movement of light shutter, grip the shutter operating lever until all movement has been taken up. Hold the shutter securely in position, and lock the split end of shutter operating lever around the end of shutter shaft with the square head light shutter locking screw.

3. The light shutter opening can be increased or decreased in size to permit a larger or smaller volume of light to reach the printing aperture if the printing conditions warrant such a change in light volume.

D. REPLACEMENT AND ADJUSTMENT OF SWITCH BRUSH ASSEMBLY

1. The switch brush assembly No. 0487 should be considered as a unit and replaced as such. As the switch brush assembly is placed on the shaft, positioned for proper location of contact blades and then drilled for the taper pin (all of this being done without the use of special fixtures or gauges), it is necessary in the replacement of the switch brush assembly that the following precautions be taken and the procedure as outlined be carefully followed in order to ensure accurate alignment and the correct positioning of the new assembly on the starting lever shaft.

2. Before removing the old assembly from shaft, use a pointed instrument or scribe and mark the hub of the switch brush assembly and the shaft at corresponding points. A direct line from the hub onto the shaft is the most satisfactory method of marking.

3. Use a drift punch and drive the taper pin from hub and shaft. The switch brush assembly can now be withdrawn from end of shaft. Do not destroy the old switch brush assembly No. 0487, but lay to one side until ready for reassembly.

4. Refer to the old switch brush assembly removed and scribe on the replacement assembly the alignment mark in exactly the same location as the mark on the old part. This ensures the proper location of the contact blades when the assembly is placed on and matched to the mark which was made on lever shaft.

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FIGURE 11  INTERLOCKING SWITCH ASSEMBLY
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5. Place switch brush assembly onto the lower shaft and match the alignment marks. Refer to figure 11 and space the assembly so that the outer edge of the switch brush assembly hub is 1.596 inches (.002 inch) from the large diameter of starting lever. Hold securely in this position and drill and ream a hole diagonally to the old hole in shaft. The hole is to receive a No.1-0 taper pin.

E. REPLACEMENT AND ADJUSTMENT OF CLUTCH MAGNET (Figure 12)

1. The clutch magnet No. 01711 should be replaced as a complete assembly when necessary.

2. If the original clutch magnet No. 01711 is installed it is necessary only to slip it into the cylinder so that the hole drilled into the brass end is lined up with the hole in cylinder wall. Secure in place with the keyed taper pin. However, if the magnet is replaced with a new assembly, it is necessary that it be properly located in the cylinder to ensure correct operation. Slip the magnet into the cylinder until the contact end of magnet is .066 of an inch in from the end of cylinder casting. A hole can now be drilled into the brass end of magnet, through the hole in cylinder wall, to receive a No.1 taper pin.

3. The replacement of the clutch magnet necessitates adjustment of the light shutter aperture change mechanism. Make sure all screws are securely tightened.

4. Screw A adjusts the stroke on armature which holds the aperture change mechanism rod. Screw B is the lock screw for same. To lengthen stroke of armature, re-
lease screw B and turn screw A clockwise a fraction of a turn; to shorten stroke, turn screw A counterclockwise a fraction of a turn. Do not fail to tighten screw B before making test. The length of the armature travel should operate best with about a 1/16-inch stroke.

5. The air dampening plunger C has a screw which controls the air escaping and entering the cylinder chamber.

6. The best way to check this adjustment is to make a film loop from six feet of film and notch it at short intervals. Start the machine and operate the aperture change pointer, setting it from 1 to 22 and from 22 to 1. Make adjustment as previously instructed until plunger completes its stroke on one notch.

7. Make sure no foreign matter interferes with the plunger in the cylinder chamber, also inspect the locking rod for rough places and see that all moving parts are well lubricated.

**FIGURE 12 - ADJUSTMENT OF CLUTCH MAGNET**

**V. REPLACEMENT AND ADJUSTMENT OF CONTACTS IN CIRCUIT INTERRUPTER**

1. The replacement of the upper and lower contact supports (O1462 and O1463) can very easily be accomplished. However, it is essential that the points and position of circuit interrupter be accurately adjusted.

2. To adjust, use a test loop of film notched with a Bell & Howell film notcher and thread through the printer in the usual manner.

3. With the film roller on circuit interrupter resting against the edge of the film (not in the notch) adjust the two sets of contact points by slightly and carefully bending the copper point holders until the contact points are evenly spaced, thus assuring a simultaneous make and break of the circuit.

4. Move the lower contact and support assembly by turning the knurled screw on back of interrupter until there is between 1/32 and 1/16 of an inch clearance between the upper and lower contact points.

5. The printer mechanism should now be operated by means of the main drive pulley until the interrupter roller engages and rests in the notch in edge of film. When in this position, the roller should rest on the bottom of the notch, and the upper contact points should be in contact with the lower contact points and force the lower points slightly to the back of the case. This action can best be seen by turning the main drive pulley so the roller rides in and out of the notch. A further adjustment can now be made to ensure positive contact, keeping in mind that the interrupter roller must ride against the bottom of the notch when the points are in contact and must have sufficient clearance when the roller rides against the inner edge of film so that any slight waviness or unevenness in the edge of film will not cause the two points to make contact.