MODEL 104

ACME OPTICAL PRINTER

MANUAL

PRODUCERS SERVICE CORPORATION
1200 Grand Central Avenue
Glendale, California 91201
ACME OPTICAL PRINTER MODEL 104

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PRODUCERS SERVICE CORPORATION
1200 Grand Central Avenue
Glendale, California 91201
Section I

INTRODUCTION

These instructions have been prepared by Producers Service Corporation as an aid to the operation, understanding, and maintenance of the Model 104 Acme Optical Printer.

While special optical effects can be created on this printer, the extent and complexity of such effects bear a direct relationship to the experience and ingenuity of the operator. These instructions, therefore, must be confined to an explanation of the printer controls. No attempt will be made to explain in detail the combination of control functions to create special effects since each operator has the prerogative to be individually creative as he gains mastery of the printer.

The Model 104 printer, depending upon the type of equipment ordered, has the flexibility to accept various film formats, and emulsion types. Because of this capability we must either arbitrarily select a film width and a set of conditions and relate the operating instructions to them in order to prevent confusion in writing and understanding, or continually include references to film size and type.

For these instructions we have assumed a Model 104 printer equipped with a 103mm lens for 1-to-1 work, and running a 35mm positive in the projector to produce a 35mm dupe negative in the
camera. (This could be either color or black-and-white.) Should your particular printer be equipped for another film width, or should you be using it for blow-up or reduction work, merely substitute, while reading, the proper size or the correct nomenclature. Operating instructions, unless specifically noted, will not change because of these substitutions.

We have attempted to write these instructions to cover three levels of experience. A well-rounded optical printer operator might possibly refer to a maintenance paragraph in Section VI. A laboratory man with a basic knowledge of optical printers may wish to refresh his memory with Sections V and VI. The indoctrination routine of Section IV was included to assist those who have had no previous knowledge of optical printers.

Our goal was to establish a specific routine which would help the tyro gain confidence, understanding, and "feel" of the controls and their functions. The routine is not related directly to actual operating procedures since each operator, as experience increases, tends to develop his particular technique in handling controls, and thereby sets his own routine.

Good luck with your new printer. When you have experienced its full capability range, remember - the sophistication of the Model 103 and the even greater Model 102 still lies ahead!
Section II

THEORY

A Model 104 printer can be described in simple terms as a camera mounted to photograph a frame of film which is being illuminated while held in a projector aperture.

The basic elements are identified as the lamphouse, the projector, the copy lens, and the camera. The difference in the amount of control or flexibility of each element is the difference in printer models.

The basic parts of the Model 104 are identified in Figure 1. The lamphouse and projector are rigidly mounted to the base casting. The camera has limited movement, or "travel," toward and away from the projector. The lens mount is capable of movement in three planes; vertical, horizontal, and the longitudinal plane of the camera. These movements provide a means of adjusting focus, image size, and placement.

The main control panel contains all electrical controls for the printer with the exception of the speed control. The printer may be started and stopped from this panel, and placed in continuous run or stop-motion mode.

The operational theory of the Model 104 printer is as follows: The camera is used to photograph, or copy, a film (negative or positive) running in the projector. The copy may be an exact positive copy of a negative, or it may be modified by means of various printer functions.
The projector can be run in a forward or reverse direction, or can be manually disengaged to hold or "freeze" a single frame.

The camera will run in forward or reverse direction, and a dissolving shutter can be used to fade a scene "in", or "out". The camera can be manually disengaged and the projector then operated in forward or reverse mode for viewing purposes, or to bring a specific frame into the aperture.

The combination of these functions will allow the scenes of the film in the projector to be re-arranged in any fashion when copied in the camera. Two scenes can be dissolved into one another, action can be "frozen" and held for any period required, or fades may be inserted at any point. The movement precision allows for various combinations of film to be inserted in the projector for added versatility.

The Producers Service Model 104 printer is constructed to maintain the precision alignment and repeatability of all functions over an extremely long life.
FIGURE 1

1. Main power switch
2. Lamphouse
3. Projector
4. Camera (see Figure 3)
5. Automatic Take-up
6. Control panel (see Figure 4)
7. Speed control panel
8. Copy lens
9. Lens position indicators
10. Shift lever quadrant (see Fig.2)
FIGURE 2 (Rear)

1. Shift lever quadrant (rear)
2. Printer Forward-Reverse shift lever
3. Projector frame counter reset
4. Projector frame counter (rear)
5. Projector Forward-Reverse lever
6. Projector disconnect & threading knob
7. Projector right angle gear box
Section III

INSTALLATION - ELECTRICAL

After undergoing final testing at the Producers Service factory in Glendale, California, USA, the Model 104 printers are normally shipped without dis-assembly of any parts. Upon arrival, the printer should be carefully uncrated and any wooden support bracing removed. **CARE SHOULD BE TAKEN TO ASSURE THAT NO DAMAGE OCCURS AT THIS POINT.** After uncrating, remove all tape and any dirt which may have accumulated during transit, and move the printer to the area assigned.

The suggested **minimum** space requirement for a Model 104 printer is \(4\frac{1}{2} \times 7\) feet. If possible, however, additional space for maintenance requirements and operator comfort should be allocated. The minimum space requirement does not allow for shelves or work space for film containers. The power switch box is at the left end of the printer and this should also be considered in a room layout.

After the printer has been moved to its assigned location, and correctly positioned, it should then be leveled to eliminate any rocking or vibration. Leveling screws are provided in the four printer feet, and one or more of these should be adjusted in the event the floor is not level.

When the printer is firm and solid, the single electrical connection should be made. A 220 volt single phase electrical supply is required.
The main power switch is located on the left side of the printer. An 8-foot, 14-4S, heavy duty, rubber covered flex cable ending in a 4-prong Hubbell #7411-G male twist-lock connector is wired into this box, normally ready for immediate connection to the Hubbell #7413 female twist lock receptacle.

For foreign installations, or when the male twist-lock connector is replaced with another type, the red and the black wires are to be connected to the 220 volt, single phase, power supply. The white wire is neutral, and the green wire is equipment ground. (Always check local electrical codes.)

When supplied, a voltage regulator within the printer maintains a steady current supply to the printing lamp. If the incoming electrical supply fluctuates by ± 10%, the lamp voltage is maintained within ± 1%. If line variations exceed this amount, additional regulation may be required to keep annoying current surges to a minimum.

NOTE - Packing material is sometimes placed inside the lamphouse to prevent damage to the optics. Before turning on the lamp for the first time, be sure to remove the top of the lamphouse and check for packing. Remove any such material found in the lamphouse.
INSTALLATION - MECHANICAL TEST

After completing the electrical connection the printer is ready to operate. Before turning on power for the first time, however, it is advisable to conduct the following preliminary mechanical check.

Move the Forward-Reverse shift lever (Figure 2) to the center of the quadrant. This position is not marked because it is not used in normal printer operation. With the quadrant lever in this position it should be possible to grasp the drive shaft leading to the camera or projector and manually turn this shaft. It should turn smoothly, under even tension, and there should be no binding.

Should the shaft appear to bind, check both camera and projector interiors for possible impediments. Check the quadrant lever position and move it from Forward to Reverse several times while turning the shaft to help "find" the center position. If binding continues, the possibility of transit damage must be investigated.

If there is no mechanical binding it can be assumed that no mis-alignment occurred during transit and this test need not be repeated. Check to see that the camera and projector are firmly connected to the drive shaft (check Figures 2-6 and 3-5) and proceed to Section IV.
FIGURE 3

-1 Reflex viewer eyepiece  
-2 Automatic take-up  
-3 Camera door latch  
-4 Shutter segment indicator (degrees)  
-5 Camera disconnect & threading knob  
-6 Shutter position indicator  
-7 Shutter manual control knob  
-8 Shutter locking knob  
-9 Camera frame (or footage & frame) counter  
-10 Counter reset
- 1 Lamp voltmeter
- 2 Lamp voltage control
- 3 Lamp on-off switch
- 4 Printer start-stop switch
- 5 Focus adjustment
- 6 Motor stop-start switch
- 7 Fade length selector
- 8 Fade direction control
- 9 Visual run button (viewer override control)
- 10 Operational mode control switch
Section IV

INDOCTRINATION ROUTINE

The following schedule of operations has been designed to provide an inexperienced operator with first-hand knowledge of printer functions, and a "feel" for the controls, in a routine manner without wasting film or damaging equipment.

1. Check the control panel and place the following toggle switches in the "OFF" position - TAKE-UP, ACCESSORY, LAMP.

2. Place the main power switch (box on lower left side of printer) in the "ON" position. Figure 1-1.

3. Throw the 220V motor circuit breaker switch (lower left front) to the "ON" position.

4. Do the same with the 110V relay circuit switch.

5. Do the same with the 110V lamp circuit switch.

6. Turn the speed selector indicator to the lowest speed, i.e. 2.5 feet per minute or 40 frames per minute (may be marked in either manner). Figure 1-7.

7. Move the quadrant shift lever to the "FORWARD" position.

8. Place the toggle switch marked "STOP MOTION" and "CONT" into the CONT (continuous) position. Figure 4-10.
9. Push the motor start button (black). Figure 4-6.

10. Push the camera start button (black). Camera should now be running very slowly, but continuously at 40 frames per minute. Figure 4-4.

11. Move the speed selector indicator from 40 to 80. Note increase in printer speed. Figure 1-7.

12. Move speed selector indicator from 80 to 120. Again note speed increase.

13. Move speed selector indicator from 120 to 160. Note speed increase.

14. Move speed selector indicator from 160 to 240. Wait 5 to 10 seconds.

15. Push camera "STOP" button (red).

16. Push camera "START" button. Camera should be running at 240 frames per minute or 15 feet per minute.

17. Move speed selector indicator from 240 to 320.

18. Push camera "STOP".

19. Push camera "START".

20. Move speed selector indicator to highest speed of 640 frames.
21. Push camera "STOP". DO NOT BECOME ALARMED - camera will NOT stop.

22. Push motor "STOP" button. Camera will stop.

23. Move speed selector to 160 or lower and push camera "STOP". Then select next speed desired, in this instance 240.

24. Push motor "START" button. NOTE: Unless speed indicator is turned to 160 and camera STOP actuated, the camera is still engaged and will start with the motor START button.

25. Push camera "START" button. Run about 5 seconds.

26. Move speed selector indicator to 320, wait a few seconds, move indicator to 640. Camera is now running maximum speed.

27. Turn speed selector indicator back to 160 and then push camera "STOP" button. Camera will stop.

NOTE This is a built-in safety feature to prevent a high-speed, one-frame, stop from putting too great a strain on the stop-motion mechanism. (See note after procedure 36.)

28. Set speed selector indicator at 40 frames and move the toggle switch up from "CONT" to "STOP MOTION".

29. Push in and release the camera "START" button. The camera will make a single exposure. (Watch frame counter on camera.)
30. Now push in and hold the camera start button. The camera will continue making exposures at the indicated 40 frame per minute rate as long as the start button is held in.

31. Move the speed selector indicator to 80 frames and make a single exposure. Make four or five separate exposures.

32. Move the speed selector indicator to 120 and again make a series of single exposures by successively pushing the camera "START" button. Try to develop a rhythm.

33. Move the speed selector indicator to 160 and repeat the above procedure. Increase the speed to 240 and again repeat the procedure.

34. Increase the speed to 320 and again repeat the procedure. Watch the frame counter on the camera. Notice that as the frame rate increases, the hold-in time of your finger on the start button must be decreased, and at 320 it becomes delicate. Too long a hold-in will produce more than a single exposure. NOTE: This is the maximum rate possible for stop motion single exposures.

35. You have been controlling single exposures, or stop motion, at frame rates of 40 to 320 per minute. Now move the speed selector indicator to the highest rate of 640. DO NOT BECOME ALARMED when the printer goes into continuous run at high speed.
36. Reduce the speed rate to 160. Camera should stop.

NOTE Procedures 23, 27, and 36 call attention to a built-in safety feature. Except at 640 speed, the printer always stops within one frame. At 640 an electrical interlock requires the speed selector to be moved to 160 (or less) before the single-frame-stop solenoid can be used to de-clutch the main drive. If the motor STOP is used, the speed selector must additionally be moved to 160 and the camera STOP actuated before normal operation is re-established. An accidental indicator move to 640 while in STOP MOTION can be overcome by resetting the speed indicator to 160 (or less). A 640 speed in CONTINUOUS can be stopped by resetting the speed to 160 and using the normal camera STOP, or alternatively by using the motor STOP, then resetting the speed to 160, and pushing the camera STOP. This latter method may also be used for the STOP MOTION mode.

37. Start the printer on CONTINUOUS at 120 frames. While running, grasp the knurled top of the detent pin at the shift lever quadrant, pull upward and move to the Reverse position. Note frame counters. Printer is now running in reverse.
38. With the printer still running at 120, try shifting forward and reverse to get the feel of this gear-shift lever. Figure 2-2.

39. Reduce speed to 40 and repeat the above procedure.

NOTE While the shift lever can be operated at these speeds we do not recommend its use above 120 frames per minute. Beyond this rate it subjects the mechanism to excessive wear, and serves no operational purpose.

40. Change the speed to 80 with the printer remaining in the continuous run mode. Again move the quadrant shift lever to either forward or reverse. Without regard to the direction, now grasp the knurled top of the detent pin on the right-angled gear box directly behind the projector. Move from R to F. Notice that the projector can be run in forward or reverse direction independently of the camera direction.

41. Stop the printer and try operating the forward-reverse shift lever on the quadrant. It may be necessary to slightly turn the drive shaft by hand to assist in proper gear mesh. Try the right-angled projector forward-reverse shift lever at this time. Figure 2-5.
42. Leaving the speed at 80, set the shift lever in the forward position, and the operating mode to Stop Motion. Grasp the knurled disconnect knob at the rear of the camera and pull it out until it rotates freely. This is also termed a threading knob. Now make a few single exposures, watching the camera frame counter. Being disconnected, no actual exposures are being made but the projector is responding. This is a way of bringing a specific frame into the aperture. Figure 3-5.

43. Push "IN" the camera disconnect coupling (rotate it until this can be accomplished) and pull "OUT" a similar disconnect coupling on the shaft between the forward-reverse quadrant and the projector. Try several single exposures. The projector is holding a single frame while the camera is being used to make as many exposures as desired. This is a means of holding or "freezing" a frame of action.

NOTE These disconnect couplings should NOT be operated while the printer drive shaft, to the camera and projector, is rotating.

44. Turn the voltage control counter-clockwise to zero and place the lamp toggle switch in the "ON" position. Move the voltage control clockwise while watching the expanded scale voltmeter. The needle indicates lamp voltage. The lamphouse
should illuminate the projector aperture and the blower, providing lamphouse cooling, should be on. To prolong lamp life, use the voltage control to bring the lamp voltage to 80.

45. With the lamp "ON", set the mode switch to CONT (continuous run), and the speed selector indicator to 160. Clutch direction should be forward, and threading (disconnect) couplings should be engaged. Check the smaller knurled locking knob in the center of the dissolve dial on the camera door. It should be loosened by turning left or counter-clockwise. With the smaller knurled knob in the loosened position, the larger fluted knob can be turned by hand to any desired shutter opening between closed or $0^\circ$ and full open or $170^\circ$. Calibration is in $5^\circ$ segments of opening. Set the shutter at "OPEN" or $170^\circ$. Now place the fade frame-length indicator, at the right side of the control panel, on 16. (Six fade lengths are optionally available, the shortest usually being 16 frames.) Start the printer. Figures 3-8, 3-7, 4-7.

46. Position yourself so that you can look into the camera aperture which is being illuminated. Grasp the "DISSOLVE" switch below the fade length selector and move it to the left or "OUT" and hold it there while watching the shutter close. Release the DISSOLVE lever when it is closed.
47. Notice the position of the shutter dial indicator. Now, watching this dial, move the "DISSOLVE" lever to the right, or IN. Stop when the dial indicates 170° or open.

48. With the printer running, move the fade length selector to any of the other indicated lengths and again operate the "DISSOLVE" lever "out" and "in". The large fluted knob can also be used to manually adjust the shutter opening and the small locking knob can be tightened to prevent accidental movement. Notice also that the start of a fade can be related to a specific frame. The accuracy of a fade start is obviously improved as the printer speed is reduced.

49. Stop the printer with the camera stop button. This concludes the indoctrination routine without film in the printer. To understand the balance of the printer controls and adjustments, the projector should be loaded, preferably with a processed positive print. Refer to the projector loading instructions in Section V if you are not familiar with threading Acme movements. After threading the projector (print should read correctly when viewed from the front of the projector looking toward the lamp), it may be found beneficial to again run through the procedures from #10 to #44 but with the lamp "ON". Be sure that the positive film is properly framed in the aperture.
50. Grasp the prism viewer position lever between thumb and forefinger of the left hand and swing the lever toward you. (This lever is located on the front of the camera, facing the projector, and is partially hidden from the operator's view by the lens tube.) Normal "OUT" position of the lever is approximately the 8:00 o'clock position, moving counterclockwise to a stop at about the 5:30 o'clock position. Look into the reflex viewer eyepiece. If not sharp, move the eyepiece in or out (friction fit only) to the sharpest focus position for your eye. It is assumed the focus adjustment has not been moved since leaving the factory and the projected image is at maximum sharpness. Adjust the lamp intensity variac until the illumination is comfortable for viewing.

51. Leaving the viewer prism in the optical path (for visual checking of the projector image) place the speed indicator on 160 and the mode control on Continuous run. With the motor running, push in the camera start button. The printer will not run. Move the viewer position lever to the 8:00 o'clock position and again try camera start.

52. Stop the printer with the camera stop button. An interlock is provided to keep the printer from operating while the viewer is preventing exposure from reaching the camera rawstock. In the event that it is necessary to advance the projector while viewing, the following procedure should be followed.
53. Place the camera disconnect in the threading position (procedure 42). Leaving the operating mode as set up in procedure 51, move the viewer prism lever to place the prism in the viewing position (procedure 50).

54. Position the right thumb so that you can push in the black "VISUAL RUN" button and hold it in. Figure 4-9.

55. Holding the "VISUAL RUN" button "in" with the right thumb, use the right forefinger to punch the camera start button. The projector will run while you are viewing the action. Keeping the "VISUAL RUN" button depressed with the thumb, try pushing the camera "STOP" button with your forefinger.

56. Projector speed can be varied, or the Stop Motion mode may be used, with the right forefinger holding in the camera start button until a specific frame appears in the viewer.

57. If the desired frame is advanced too far, use the clutch quadrant to reverse the printer and single frame it at slow speed while using procedure 56.

58. Once the specific starting frame is located in the aperture, place the clutch in the proper direction, re-connect the camera drive, remove the viewer from the optical path by pushing the lever away from you, and proceed with the scheduled printing operation.
59. Having completed the indoctrination routine, reduce the voltage control and turn "OFF" the printer lamp, "STOP" the motor, throw the three circuit breaker switches on the lower left face of the base cabinet to "OFF", place the main power switch at the left side of the printer in the "OFF" position, and, when the lamphouse is cool, replace the protective plastic dust cover if the printer is to remain idle for a prolonged period.

60. Two switches on the control panel were not used in this routine. The "TAKE-UP" toggle switch controls power to the 4-receptacle female connector at the rear of the console. This is used only with accessory torque motor take-ups. The "ACCESSORY" switch supplies power to the 2-receptacle female connector also at the rear of the console. This is a 110V AC outlet for operation of accessories such as the Piclear Liquid Gate. In many normal operations these switches are seldom used.

This indoctrination routine if followed in a step-by-step fashion provides an opportunity to see, and to experience personally the function of the various controls, and their inter-relation, to produce changes in the film being duplicated.
Section V

PROCEDURES AND FUNCTIONS

Because the Model 104 printer is capable of introducing optical effects - in contrast to a continuous contact printer which is only started and stopped - the operating routine will vary from job to job depending upon the cue sheet furnished the operator. For this reason we can only explain the function of the controls. The operator must select the functions he requires for each job, and thus sets his own printing procedure.

Before actual operation, however, a few procedures can be detailed. These include magazine loading and printer threading and these operations are described below.

LOADING THE MAGAZINE

1. Prepare for loading by unscrewing and removing both magazine doors, or covers.

2. Before each use, check the magazine interior for dirt, film shavings, or other unwanted material. Brush, or if available, use water-free and oil-free compressed air to blow out such material.

   NOTE: THE MAGAZINE MUST BE LOADED IN THE DARKROOM.

3. In the darkroom place the magazine on a clean, dust-free, table or shelf of convenient height for the loading operation.
Lay the opened magazine so that the bottom film trap openings are toward you. In this position the circular chamber or compartment to the left is the "supply" chamber and the right side the "take-up". Turn off all lights (for color film) and in total darkness open the container of unexposed film.

4. Remove the film roll from its container and position it so that the free end of the film is coming off the roll in a clockwise manner with the emulsion side in (toward roll).

5. Without allowing more film than necessary to come off the roll, thread the free end straight down (toward you) along the right side of the supply chamber and between the chamber side and the guide roller. The film emulsion will be toward the guide roller. Now using the fingers of either hand, push the film firmly against the side of the chamber with the fingertips and simultaneously move the fingers downward toward the light trap until the film end comes through the light trap.

6. As the free end exits through the trap, grasp and pull out about 20 to 26 inches of film.

7. Holding the unexposed roll firmly, center it over the supply chamber and slide the film core over the magazine.
hub. It may be necessary, depending upon the roll size, to pull slack film through the light trap to allow the full roll to seat properly. NOTE: When loading smaller rolls it is easier to place the roll of film on the hub before threading the film and through the light trap.

8. Replace the supply chamber cover securely and turn on the darkroom light.

9. Feed the film end up through the take-up chamber light trap, leaving approximately a 2-inch film loop outside the magazine. Temporarily replace, but do not fully tighten, chamber cover.

NOTE: This is a matter of preference, but most optical printer operators prefer to thread the camera before completing take-up threading.

THREADING THE CAMERA

1. Before placing the magazine on the camera, retract the take-ups (pull knurled knobs toward rear, or away from operator) and disconnect the camera drive.

2. Open camera door. Place the loaded magazine against the front stop of the camera magazine guide, and while holding the rear of the magazine up (about 25° above horizontal) push the film loop into the camera chamber.
3. Lower and secure the magazine. All 35mm magazines are locked in place with a knurled screw. All 16mm magazines are secured by a snap latch actuated by a latch lever located at the upper right corner of the camera interior.

4. Pull down sufficient film to form about an 8-inch loop. Follow threading directions on the door of the camera, or refer to Figure 5. The film path passes over the large sprocket, through the movement, under the large sprocket, and up into the take-up chamber. Hold down rollers are used on both sides of the large sprocket.

5. In threading the film into the Acme movement, the camera mechanism should be moved by hand (with the disconnect knob) until the movement pressure plate is retracted, and the pulldown arm pins are half way from top to bottom of their stroke. In this position the small knurled button on the film movement is pulled to the right, and held, to allow the film to enter the movement. Proficiency in threading this movement is gained with practice. After threading the movement, the camera should be turned over by hand (using the disconnect knob) to check film motion, and to assure proper seating on the movement pins.

6. With the film properly threaded in the movement, and the hold-down or keeper rollers positioned against the large sprocket, the camera door may be closed.
7. Remove the magazine take-up chamber cover. There should be enough film to make several wraps around the core. (If there is not sufficient film, reconnect the camera and, using a low speed setting, run enough film for this purpose.) Place a core on the take-up hub and wrap the film end around the core in a counter-clockwise direction, emulsion side out. Make several wraps around the core to make sure the film does not unroll.

8. Replace the take-up compartment cover securely.

9. Reconnect the camera drive and re-engage the take-up by pushing knurled knobs forward.

10. To avoid light fog, the camera shutter is closed and a length of film (anywhere from 3 feet to 6 feet) is run through the camera before the frame counter is reset to zero. Camera is now ready for use.

**THREADING THE PROJECTOR**

Although the projector can be operated in either direction, the normal operation is from the bottom chamber to the top chamber while the camera is running in a normal (forward) manner. The usual image placement in the projector is such that it reads correctly when viewed from the front (toward the lamp) while moving upward.
1. Refer to Figure 6 for the projector threading path.

2. Place the film core on the lower magazine hub so that the film is being pulled off the roll COUNTER-CLOCKWISE leading upward. Some operators prefer to open the keeper rollers on the lower drive sprocket, lay the film over the sprocket, and then insert the film in the Acme movement. Others prefer to thread the movement first, and then the lower sprocket. Either method is acceptable. Always re-position keeper rollers against the film.

3. To thread the movement, turn the threading knob on the drive shaft until the pulldown pins are at the bottom of their stroke, and the pressure plate is still retracted. In this position, the small knurled button on the movement is pulled to the left, and held, while inserting film in the movement. Check proper framing through the aperture. After threading, check proper seating of the film on the pins by turning the threading knob. If the frame was correctly positioned in the aperture, it will remain so.

4. Form the proper loop size between movement and upper sprocket (or both sprockets if the movement was threaded first) and close keepers.
5. Place an empty film core on the upper magazine hub, insert the film leader in the core and make several wraps around the core in a counter-clockwise position to prevent the film from unrolling.

6. When the film is properly framed in the aperture, re-connect the projector mechanism to the drive shaft and close the glass projector door.

7. If two films are to be superimposed, the following threading procedure applies.
   a. Remove the 1000' flange by pulling the hub forward. The hub and flange can easily be pulled off the keyed spindle of both top and bottom compartments.
   b. Replace the 1000' hub and flange unit with the bi-pack flanges. (These flanges allow two rolls of film, up to 200' in length, to be run simultaneously through the projector.) The bi-pack flange unit merely pushes into one of the keyed holes visible when the 1000' flange is removed.
   c. Because a specific frame of each roll must be synchronized in the aperture, the placement is a matter of personal preference. Some operators wish to place sync marks into the movement first, and then complete threading over the sprockets. Other operators prefer to complete the
threading of one strip of film before overlaying the second strip. In either case, two sync frames must be properly positioned in the aperture.

d. The inside film, the one toward the lamp, should be shorter by two 35mm perforations between the lower sprocket and the movement. The inside film should also be two perforations shorter between the movement and the upper sprocket. This prevents the two films from rubbing in the loop, and therefore reduces the possibility of abrasion damage.

e. In the normal bottom-to-top forward operation, the bipack flange hubs move in a counter-clockwise direction (same threading as for a single roll).

EXPOSURE CONTROL

Absolute repeatability and predictability in the control of film processing is the first requirement for establishing a standard reference exposure. Be sure the laboratory offers a high level of quality control before beginning initial exposure tests. Assuming the processing laboratory has demonstrated such diligence, and the fluctuations of your incoming electrical power are too small to cause a variation in exposure, a series of completely documented reference tests must be conducted.
A description of these various tests does not properly belong in this manual. We mention them only as background information requiring additional personal research in those installations acquiring their first optical printer.

Once a satisfactory standard exposure reference has been established, usually from Eastman Kodak or Society of Motion Picture and Television Engineers material, all incoming material relates to it.

There are a number of methods used to determine exposure ranging from the rudimentary "eyeball" viewing of a film over a light box, to the sophisticated electronic color analyzer technique. In the final analysis, an actual film test is made to provide an indisputable result.

An optical printer does provide one means of control not possible on a continuous contact printer. The projected aperture illumination can be read, by suitable meters, in either the camera aperture position or through the reflex viewer.

Having established a reference standard, it is possible to adjust the voltage while measuring this illumination through an unknown material, and arrive at a test exposure which is within satisfactory limits.

This is a very elementary exposure determining procedure as described. In actual operation the procedure would include a
value judgment of the scene, the artistic effect desired, and the specific color balance (if color) of preceding and following scenes, before a specific exposure test range could be formulated. In short, there are no hard and fast rules to determine correct or proper exposure.

The Model 104 printer has six methods, or areas, of exposure control - either deliberately or accidentally. For the beginning operator we urge the establishment of a recording or documentation routine which will preserve these variables in a reference notebook. The variables include:

- Printer speed
- Lamp voltage
- Lens aperture
- Shutter opening
- Neutral density filters
- Color compensating filters

Each of these can be inter-related to affect exposure. A chart on printer speed relationship, and shutter opening factors, will be found at the rear of this manual. One last piece of advice to a new operator - vary only one factor at a time until your control range has been firmly established. Printer speed is usually the first means of control, and shutter opening the last.
CONTROL FUNCTIONS

Details of each separate control are included below to supplement the indoctrination routine of Section IV.

MAIN POWER SWITCH. On left side of printer. Controls 220V AC to printer. Main fuses are located in this box.

220V AC MOTOR CIRCUIT. On lower left front of printer base. A resettable circuit breaker type switch protecting the motor circuit from an electrical overload.

115V AC RELAY CIRCUIT. On lower left front of printer base. Protects relay circuits from overload. Resettable type breaker switch.

115V AC LAMP CIRCUIT. On lower left front of printer base. Protects lamp and blower circuits from overload. Resettable type breaker switch.

MOTOR. A push button switch on control console for main motor start and stop.

CAMERA. A push button switch on the control console controlling a solenoid to clutch or de-clutch the camera and projector drive to the main motor drive.

STOP MOTION - CONT. A toggle switch on the control console to determine the operating mode of the printer, i.e. either a single frame exposure each time the camera start button is momentarily depressed, or the continuous running of the printer.
LAMP. A toggle switch on the control console to turn the incandescent bulb in the lamphouse either ON or OFF.

TAKE-UP. A toggle switch on the control console to start or stop the torque motors in an accessory take-up unit when used in place of the automatic take-up provided with the camera.

VISUAL RUN. A push button on the control console which, when held in, will allow the printer to run while the reflex viewer is being used. Refer to procedures 53 - 56, Section IV.

ACCESSORY. A toggle switch on the control console to supply 110V AC to an accessory outlet on the rear of the printer. Used for accessories such as the Piclear liquid gate.

DISSOLVE. A two-way lever on the control console to electrically move the dissolving shutter at a pre-determined frame rate either IN (to open) or OUT (to close), thereby causing the exposure to the camera to be modified over a specific number of frames. NOTE: The six-position selector mounted just above the DISSOLVE lever is used to select the desired operational length of the shutter movement, while the dissolve lever controls the direction. (NOTE: Dissolve nomenclature changes with printer direction.)

VARIAC. On the control console, a means of accurately controlling voltage to the printing lamp.

VOLTMETER. An expanded scale A.C. voltmeter allowing precise reading of printing lamp voltage between 60 and 120 volts.
SPEED CONTROL. A seven-position indicator on a separate panel at approximately the center of the printer console. May read in 35mm feet per minute, in frames per minute, or in both 35mm feet and frames per minute.

PROJECTOR FRAME COUNTER. On the projector, a counter to indicate the exact number of frames passing the aperture. Resettable type, adds or subtracts for forward or reverse. Optionally, 35mm projectors may be equipped with combination footage-and-frame counters.

CAMERA FRAME COUNTER. Mounted in the camera. Adds or subtracts in forward or reverse. Resettable type. 35mm cameras may also have combination footage-and-frame counters as an option.

SHUTTER DIAL. On the camera, an indicator visually displaying the position of the shutter at all times. Calibrated in 5° increments from 0° to 170° maximum opening, the shutter may be operated manually to produce a fade-in or a fade-out, or it may be operated electrically from the dissolve lever control. In addition, the shutter may be used to control exposure, and may be set at any opening less than 170° and manually locked in position during a printing run.

LENS POSITION INDICATORS. On the Universal lens mount. These jeweled dial indicators are used to precisely control the lens position in three planes and to allow position repeatability. One indicator is permanently mounted on each of the three adjustment ways to measure horizontal, vertical, or longitudinal movement in .001 increments. If required, indicators as precise as .0001 may be substituted.
FIGURE 7
Speed Control Pots Inside Console

FIGURE 8
Lamp Adjustment Access Holes
Section VI

ADJUSTMENTS AND MAINTENANCE

Although the Model 104 printer has been completely adjusted and tested before leaving our factory, the flexibility of the unit is such that the user can make adjustments to fit his particular needs.

On interchangeable units, a 16mm movement may be desired instead of a 35mm movement, or vice versa. All Acme movements interchange by releasing two dog-type latches and sliding the entire unit outward. When replacing units, the shuttle fork may require minor movement up or down to mate with the barrel cam.

When movements are interchanged, the drive sprocket must also be changed. In the camera, the entire sprocket and hold-down roller assembly is easily removable by releasing two catches (similar to those on the movement) and pulling outward. Replacement is the reverse.

On the projectors having interchangeable provisions, a knurled screw at the rear of the projector is loosened, allowing the sprocket assembly to be completely removed. Both sprockets are separately locked in from the rear.

The one-to-one copy ratio of the printer may require adjustment under certain circumstances. When a particular scene being copied as one-to-one requires cropping to eliminate
something objectionable near the edge, an adjustment for one-to-one may be done directly as follows.

1. Insert the film having the defect into the projector movement.
2. Move the viewer prism into viewing position. The projected frame, with defect, will appear in the eyepiece.
3. Use the longitudinal lens control knob to adjust size.
4. Insert the focus adjustment handle at the right of printer bed (Figure 4) and turn while watching the image.
5. Continue to use both the camera focus adjustment and the lens size adjustment until the unwanted defect has been cropped or eliminated from the camera viewing aperture. The two controls are related and both must be used in a size-and-focus change.

A simple one-to-one line-up adjustment procedure is as follows. A piece of resolution, or target alignment film is needed. From the roll clip two pieces, one three frames long, the other about six inches long. (Shrinkage isn't important if they're both cut, when needed, from the same roll.)

1. Correctly frame the large piece of film in the projector aperture. Be certain the pressure plate is also properly seated.
2. Place the center frame of the short strip on the pins in the viewer. Figure 3-1.
3. Looking through the viewer eyepiece, adjust the size and focus controls to superimpose both images.
It may also be necessary to adjust lateral and/or horizontal lens movement to accomplish this. The result is exact alignment for one-to-one operation.

The speed adjustment of all printers using the Ratiotrol control may be modified in the field. Exact speed may vary with age and usage and is easily reset. All printers having 60 cycle motors are set before leaving the factory. On 50 cycle units an adjustment should be made on location before the printer is placed in operation. Adjustment procedure is as follows.

1. Remove the screws from the main control panel and drop the panel to allow access to the rear of the drive motor.

2. Remove the large access cover from the rear of the control panel console. See Figure 7.

3. Load the camera magazine with film. (This can be scrap film and need not be fresh stock. It is only for purposes of putting a "load" on the motor.) Thread the camera.

4. Put a full roll of film, scrap or otherwise, in the projector. Thread it properly.

5. Proper adjustment may require two men, one at the front of the printer and one at the rear. Starting the printer in the continuous mode at 2½ feet per minute, or 40 frames, and with the printer pulling film, the front man should use a tachometer to check the speed of the motor shaft in revolutions per minute (RPM's).
6. Speeds of the motor shaft, under load, should correspond to the speed selector indicator as follows:

   40 - 2½ - 107 rpm
   80 - 5 - 214 rpm
   120 - 7½ - 320 rpm
   160 - 10 - 427 rpm
   240 - 15 - 640 rpm
   320 - 20 - 856 rpm
   640 - 40 - 1710 rpm

7. If the desired 107 rpm is not read on the tachometer it is an indication the actual speed is different than the 40 frames per minute indicated. The man at the rear should use a long screwdriver and carefully turn the adjusting screw marked 2.5 which is on a panel above the motor and attached to the back of the front wall of the console. Turn the screw until the desired number of motor revolutions is read on the tachometer.

8. Change the speed to 5 and read the motor shaft RPM's. If not 214, adjust the marked screw on the inside panel.

9. Continue for each speed setting.

10. When all adjustments have been made, the power may be cut off and the screw adjustments locked in place (with the nuts) if desired. NOTE: Printer speeds as a group may vary from above recommendations by 5%; however, the relationship between speeds on an individual printer should be as exact as possible.
11. Printer speeds are now set properly for load conditions. To prevent a difference in density, or exposure, between the beginning frame and continuing frames of the film, it is now necessary to check the reaction of the motor when load is applied. This is done in the following manner.

12. A printer speed of 20 feet, or 320 frames, is the most critical and is, therefore, usually chosen for this test. Set the indicated speed and place the printer operational mode on "Stop Motion". Now, with the drive motor running, use an adjustable stroboscope aimed at the coupling of the printer motor through the large access opening at the rear of the console.

The stroboscope should be adjusted to "freeze" the movement of the coupling, with no motion visible. Now, using the "camera start" push button, the person at the front of the printer should momentarily depress the button to put a sudden load on the motor. The man at the rear of the printer, viewing the main coupling under the stroboscope, should carefully notice any movement of the coupling when load is applied.

This test should be repeated several times to be absolutely certain the observed results are repeatable. Normally it takes a small amount of time for two people to coordinate their activities.
If the main motor coupling is "frozen," or no motion is visible under the strobe light before the stop motion button is depressed, and if, with repeated single exposures being made by the person at the front of the printer, the main coupling appears to move very slowly and smoothly backward at a rate of approximately 1/2 revolution per second, the printer is properly adjusted and the test should be concluded.

If, under the same conditions, the coupling being viewed under the stroboscope makes a sudden movement forward or backward, it is an indication of the need for IR compensation in the Ratiotrol motor control circuit. This movement indicates an RPM change in the motor large enough to produce a flash frame.

13. If compensation is required, consult the Field Adjustment Section of the Ratiotrol Instruction Manual supplied with the printer. Adjust the unit until the sudden movement is no longer present, under the strobe, and the coupling appears to move backward about 1/2 revolution per second as the sudden load of a single exposure is applied.

14. If an IR compensation must be made, it will be necessary to recheck the speed settings afterward.

15. When all speed settings have been rechecked, replace all access panels.
16. Without a tachometer it is possible to check speeds by using a stopwatch and the camera frame counter. This method is just as accurate, but requires more time than when using a tachometer on the motor shaft.

Maintenance on the Model 104 is minimal, the major items being the Acme movements. With normal daily usage, each movement should be pulled out once per week and using the oil supplied, or #10 SAE light oil, apply only one drop to both fibre shoes of the pulldown fork, one drop on each side of the pulldown arm shaft near the end bearings, and one drop on the cam roller which rides in the barrel cam. Do not over-oil and always wipe off any oil which may touch film bearing surfaces. About once a year, a single drop of oil may be applied to the rocker arm of the movement.
The main drive motor carries a maintenance label calling for minor lubrication every five years. All other grease type fittings are sealed and require no lubricant unless disassembled for major service.

Lamp replacement may require minor adjustment of the lamp position to provide an even field of illumination. Provisions have been made in the lamphouse for horizontal, vertical, longitudinal and rotational adjustments of the bulb.

The special glass dichroic reflector is also adjustable in horizontal and vertical planes as well as longitudinally toward, or away from, the lamp. All adjustments may be made without removing the lamphouse top cover. Adjustment locations and procedures are as follows.

LAMP ROTATION. A slotted, screwdriver type adjustment, the upper of two such vertical adjustment screws visible, and available, through the square opening at the rear of the lamphouse base. A worm gear under friction maintains the necessary positioning and a lock is not required. Figure 8.

LAMP VERTICAL. The lower of the two vertical slotted adjustment screws visible through the square access hole mentioned above. This is a locking adjustment. Back off the Allen head set screw located to the right of the two slotted screws before attempting vertical adjustment. Be sure to tighten the set screw after the vertical position has been determined. Figure 8.
LAMP HORIZONTAL. A non-locking screwdriver type adjustment reached through the small round access hole at the rear of the lamphouse base. Figure 8.

LAMP LONGITUDINAL. A non-locking screwdriver type adjustment reached through the oval access hole at the end of the lamphouse under the reflector adjusting knob. Figure 8.

REFLECTOR VERTICAL. Controlled by two Allen set screws located at the 12:00 and 6:00 o'clock positions in the circular centering housing at the left end of the lamphouse casting, the lower set screw, requiring a smaller Allen wrench, is spring loaded. If upward movement is required, loosen the upper set screw and tighten the lower screw until the desired movement distance has been attained, then tighten the upper screw.

REFLECTOR HORIZONTAL. Controlled by the two Allen set screws located at 3:00 and 9:00 o'clock in the same circular fitting. Again, depending upon direction, loosen one set screw and tighten the other to achieve desired movement. Always tighten both after adjusting.

REFLECTOR LONGITUDINAL. Loosen the small set screw in the shaft hub. Use the large knurled knob to position the reflector closer to, or further away, from the lamp. Re-tighten set screw after the reflector position has been determined.
UNIFORMITY OF ILLUMINATION. Any adjustments made in the lamphouse are for the purpose of improving the uniformity of the illumination field. The filament image of the lamp should be in focus at the nodal point of the lens. On a printer set for one-to-one, when the lens is removed and a piece of white paper stretched over the left side of the lens holder, the nodal point is simulated.

A piece of dark metal should be placed between the lamp and the reflector when the lamphouse cover is removed. The filament image should be evenly centered on the paper representing the center of the lens. When this has been done, remove the metal piece blocking the reflector and position the reflector so that the reflected filament image is used to fill in the spaces between the projected lamp filament image on the paper target. When this has been accomplished, the uniformity will usually be excellent. A photographic test is the final determining test, and exposure is critical. Any excess of exposure will tend to hide any minor uniformity differences.
### SPEEDS

<table>
<thead>
<tr>
<th>Frames Per Minute</th>
<th>35mm Feet Per Minute</th>
<th>16mm Feet Per Minute</th>
<th>Motor RPM</th>
<th>Frames Per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>2½</td>
<td>1</td>
<td>107</td>
<td>-</td>
</tr>
<tr>
<td>80</td>
<td>5</td>
<td>2</td>
<td>214</td>
<td>1-1/3</td>
</tr>
<tr>
<td>120</td>
<td>7½</td>
<td>3</td>
<td>320</td>
<td>2</td>
</tr>
<tr>
<td>160</td>
<td>10</td>
<td>4</td>
<td>427</td>
<td>2-2/3</td>
</tr>
<tr>
<td>240</td>
<td>15</td>
<td>6</td>
<td>640</td>
<td>4</td>
</tr>
<tr>
<td>320</td>
<td>20</td>
<td>8</td>
<td>856</td>
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<tr>
<td>640</td>
<td>40</td>
<td>16</td>
<td>1710</td>
<td>10-2/3</td>
</tr>
</tbody>
</table>

### EXPOSURE TIME

*(In Seconds)*

<table>
<thead>
<tr>
<th>Shutter Opening</th>
<th>2 Frames Per Second</th>
<th>4 Frames Per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>170°</td>
<td>2/9 sec.</td>
<td>1/9 sec.</td>
</tr>
<tr>
<td>150°</td>
<td>1/5 &quot;</td>
<td>1/10 &quot;</td>
</tr>
<tr>
<td>120°</td>
<td>1/6 &quot;</td>
<td>1/12 &quot;</td>
</tr>
<tr>
<td>90°</td>
<td>1/8 &quot;</td>
<td>1/16 &quot;</td>
</tr>
<tr>
<td>60°</td>
<td>1/12 &quot;</td>
<td>1/24 &quot;</td>
</tr>
<tr>
<td>45°</td>
<td>1/16 &quot;</td>
<td>1/32 &quot;</td>
</tr>
<tr>
<td>10°</td>
<td>1/72 &quot;</td>
<td>1/144 &quot;</td>
</tr>
<tr>
<td>5°</td>
<td>1/144 &quot;</td>
<td>1/288 &quot;</td>
</tr>
</tbody>
</table>
1) Vertical adjustment has almost 180° play
2) Very small amount of Kent (appr. .001 shine)
3) Hitting the base will still produce a small schimmer.

1 $6.75 elite 99PS-40 speed allen wrench set

Hardware store

We need:
1 Stroboscope
1/27/71
1 Stop watch
1 Tachometer
DISASSEMBLY AND REASSEMBLY OF ACME MOVEMENT

This movement is a precision device and at the time of disassembly and reassembly the service personnel should not force any of the parts as they can be damaged.

The scope of this maintenance manual is for cleaning of the movement only. If the movement is nicking or punching perforations or continues to scratch after cleaning it should be returned to the manufacturer for adjustments and measurements which must be made by P.S.C.

I. Figure 1 shows the movement completely disassembled and each part numbered with an explanation of each part below:

1. Movement Base
2. Support Post and Screws
3. Rocker Arm Post and Screws
4. Rocker Arm
5. Cam Roller Assembly
6. Pressure Plate Bearing
7. Screws for Cam Roller Assembly and Pressure Plate Bearing
8. Pressure Plate
9. Stripper Plate and Portion of Lower Rocker Arm
10. Screws, Nuts and Spacers for Stripper and Pressure Plates
11. Pulldown Arm Assembly and Screws
12. Lower Rocker Arm Clamp and Socket Head Screw
13. Film Release Assembly and Screws

These parts should be studied by the service personnel prior to attempting to disassemble the movement.

II. Figure 2 shows the movement completely assembled and arrows pointing to the screws to be removed to allow the Film Release Assembly to be removed. This part must be removed with care and noting the following two things. The first being how the Pulldown Arm is connected to the Film Release Assembly. The second, that between the Post and Film Release Assembly, in some movements, there may be spacers.

III. Figure 3 shows the Film Release Assembly removed and arrows pointing at three screws to be removed to disassemble the Support Post. Of the three screws there is one short one and this must be replaced in the same place it is removed.

IV. Figure 4 shows the Support Post and three screws removed. The next parts to be removed are the Rocker Arm and Cam Roller Assembly and Pressure Plate Bearing. The arrows point to one screw that is visible and one directly opposite that cannot be seen. As the service personnel is removing the screws, apply slight pressure to the screw heads to allow each of the mating parts to be pushed out. After both parts are removed the Rocker Arm will now pivot. Move the Rocker Arm into position so it clears the Pressure Plate and pull towards the front of the movement.
V. Figure 5 shows the Rocker Arm, Cam Roller Assembly, Screws and Pressure Plate Bearing. Remove the Rocker Arm Post as explained in III for the Support Post, also noting the small screw. To remove the Pulldown Arm Assembly, an arrow points to one of two screws, the other being to the left on the upright portion of the movement base. With the two screws removed the Pulldown Arm now may be removed by carefully maneuvering the Pulldown Arm to the back of the movement.

VI. Figure 6 shows the Pulldown Arm Removed.

VII. Figure 7 shows the Lower Rocker Arm Clamp and Socket Head screw, Stripper and Pressure Plates, and Lower Rocker Arm disassembled. To remove the Lower Rocker Arm turn the movement over, this will expose the Socket Head screw and removing it will allow the Bracket to be disassembled. The Stripper and Pressure Plates and Lower Rocker Arm Assembly may now be removed by moving the Assembly towards the front of the movement.

VIII. Figure 8 shows the Stripper and Pressure Plates disassembled. Prior to disassembling these two pieces, carefully look at them assembled first. One side will expose the two nuts, these are on the Lower Rocker Arm or Stripper Plate side. Remove the two screws on Pressure Plate side being careful when the two pieces separate that the spacers are not lost.

IX. The movement now completely disassembled, cleaning may begin. Note all the parts that are oiled. Only a few drops of oil must be replaced if oil is completely removed. Oil the Rocker Arm Post, Film Release Assembly where Pulldown Arm rests, Pulldown Arm where shaft slides through mounting studs and where Lower Rocker Arm pivots on movement base. The following items may be used to clean the parts of the movement.

1. Cotton Balls
2. Cue Tips (Wooden if 5 is used)
3. Soft Cloth
4. Alcohol (To remove sticky or gummy substances)
5. Small ultrasonic cleaner
6. Small magnifying glass

X. To reassemble the movement, reverse procedures II thru VIII.

Prepared By

Approved By