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PHOTOGRAPHIC METHODS OF OBSERVATION
AT THE DAVID TAYLOR MODEL BASIN

PART 1

A SIMPLE SPARK TIMER FOR THE EASTMAN
HIGH-SPEED CAMERA, TYPE III

by

Lt. Comdr. D.C. Campbell, USNR



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DAVID TAYLOR MODEL BASIN

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PERSONNEL

The battery-powered timing source was developed by G.W. Cook of the Electronics Section. The timer was adapted for use with the Eastman High-Speed Camera, Type III, by members of the Photographic Development Section of the David Taylor Model Basin. The report was written by Lt. Comdr. D.C. Campbell, USNR.

FOREWORD

This is the first report of a series in preparation to make available to other experimental and research activities the results of developments at the David Taylor Model Basin in the photographic recording of technical data.

PHOTOGRAPHIC METHODS OF OBSERVATION
AT THE DAVID TAYLOR MODEL BASIN

PART 1

A SIMPLE SPARK TIMER FOR THE EASTMAN HIGH-SPEED CAMERA, TYPE III

ABSTRACT

An attachment for the Eastman High-Speed Camera, Type III, has been devised to produce timing marks on the edge of the film by means of an instantaneous high-voltage discharge. The construction of a simple battery-operated timing source is described.

INTRODUCTION

A study of objects in motion frequently requires an accurate time history that can best be obtained by photographic recording. The Eastman High-Speed Camera, Type III (1),* is one of the most reliable of the commercially available cameras for obtaining motion pictures at frame frequencies ranging from 500 to 3000 pictures per second.

The picture frequency is controlled solely by the speed of the camera drive motor, which in turn depends upon the line voltage and the setting of the rheostat in the motor circuit. Because of wide variations in the conditions under which high-speed motion pictures are taken, a table of speeds as a function of voltage or rheostat setting is unsatisfactory for accurate determination of the time between successive frames.

It is possible to place an object moving with a known velocity, such as a synchronous motor clock or an argon lamp operated on alternating current, in the field to be photographed. However, these timers cut down the field of view and often require a complicated setup.

A method of placing timing marks on the edge of the film has been developed which provides accurate timing and avoids the objectionable features found in field-of-view timers.

DESCRIPTION OF TIMER

The spark coil which was chosen for use with the Eastman High-Speed Camera, Type III, consists of a special Delco coil, with a turn ratio of 1:20,000. The coil is pressed into a brass tube having a wall thickness of 0.075 inch and an outside diameter of 1 1/2 inch. A brass mounting plate is soldered in one end of the brass tube and a Type S-308-CCT 2-prong Jones plug

* Numbers in parentheses indicate references on page 9 of this report.

is fastened to the mounting plate. The plug is used for a cable connection from the timing-pulse source to the primary of the spark coil. These parts are all shown in Figure 1.

The high-tension lead from the spark-coil secondary is insulated through the 1/2-inch hole in the camera housing, Figures 2 and 3, by a short bakelite tube. From this tube to the bakelite spark-gap block is a Number 12 solid copper wire covered with spaghetti tubing; see Figure 4. When the spark gap is properly installed, the end of the high-tension lead is flush with the end of the spark-gap block and is between 0.018 inch and 0.020 inch from the inner roller guide plate. This allows sufficient clearance for the film to pass freely between the spark-gap block and the guide plate.

After the necessary adjustments have been made, the space around the high-tension lead in the insulating tube and the spark-gap block is filled with beeswax. A schematic diagram of the camera wiring is shown in Figure 5.

A photograph showing the camera timer connected through a cable to the Strobolux output of a General Radio Strobotac is shown in Figure 6.

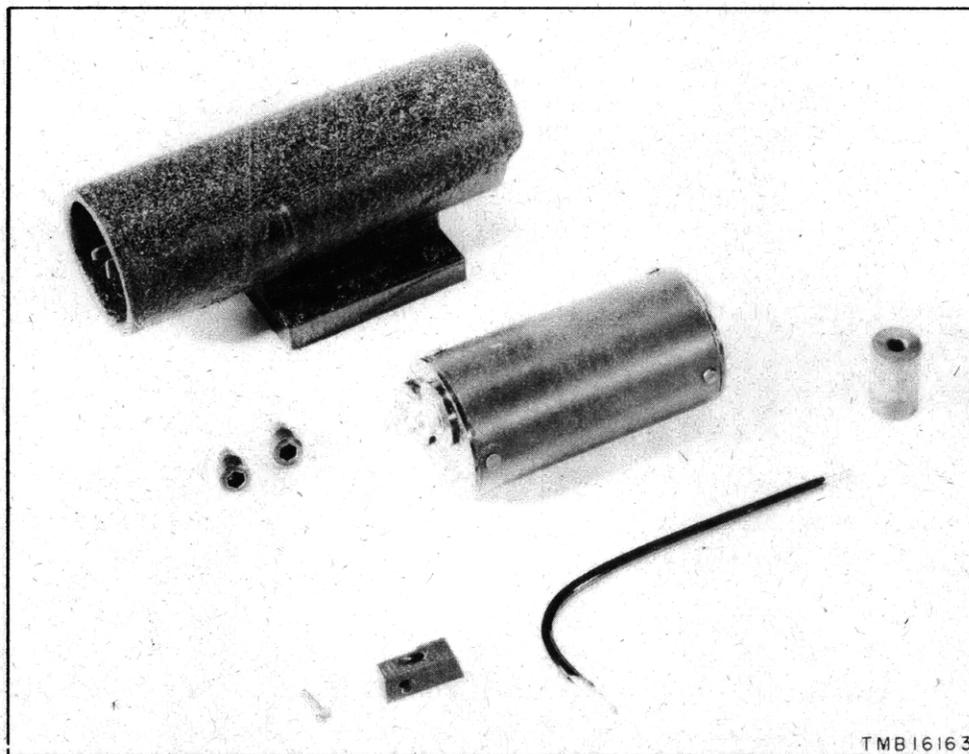


Figure 1 - Component Parts for Coil and Mounting Assembly

The Delco spark coil with a 1:20,000 turn ratio is shown in the center of the picture. The coil holder, fitted with a Jones plug, is shown in the upper left. The bakelite insulating tube is on the extreme right, and the timing lead and the spark-gap block are shown in the foreground.

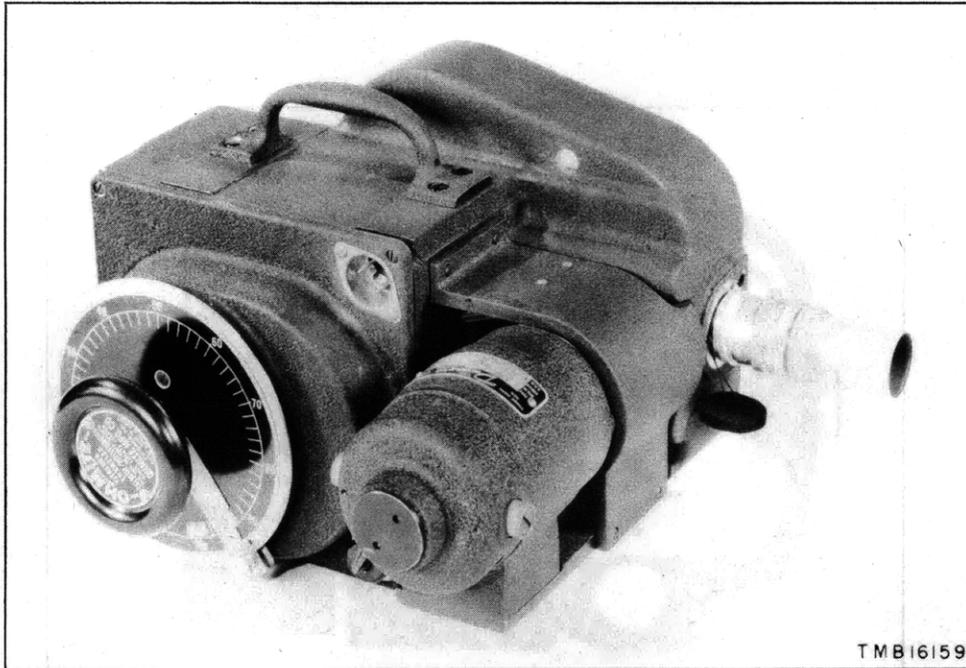


Figure 2 - Eastman High-Speed Camera, Type III

The 1/2-inch hole in the upper part of the camera housing is the aperture provided for entrance of the spark-coil lead. The two screw holes on the bracket above the drive motor are used to attach the spark-coil holder.

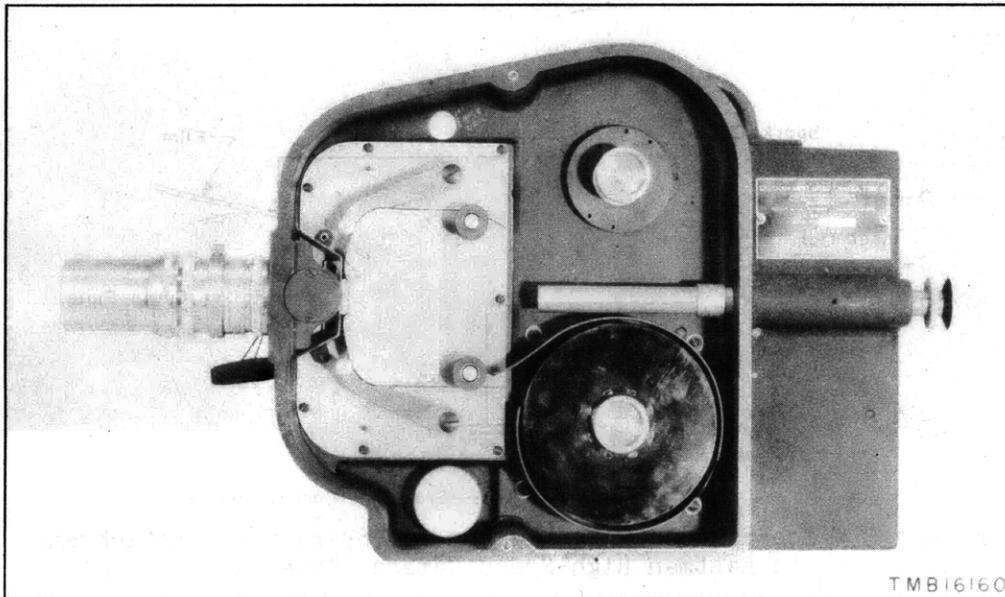


Figure 3 - Interior of the Eastman High-Speed Camera, Type III

The insulator and the timing lead will be run through the 1/2-inch hole in the upper part of the camera housing.

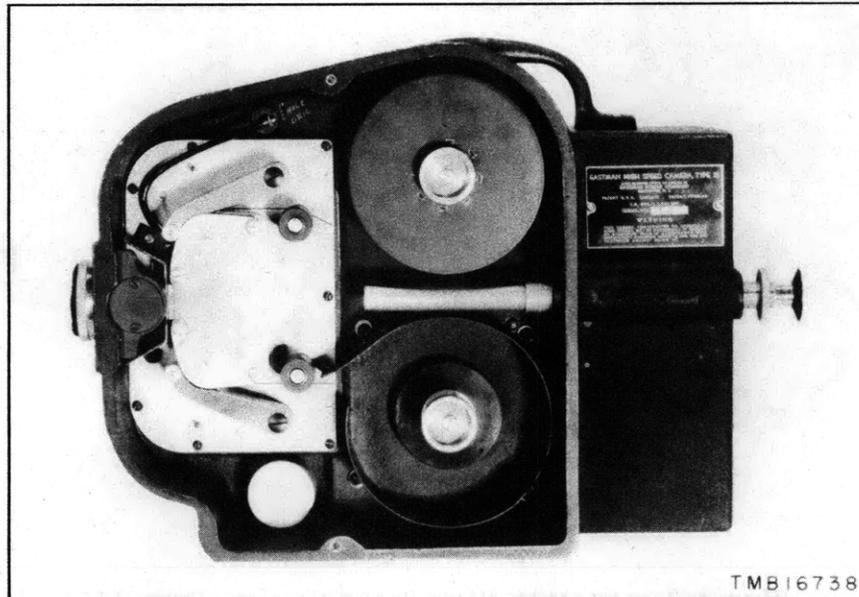


Figure 4 - Interior of Camera with High-Tension Lead Installed

The spaghetti-insulated high-tension lead is shown running from the bakelite insulator in the upper part of the camera housing to the spark-gap block mounted above the film gate.

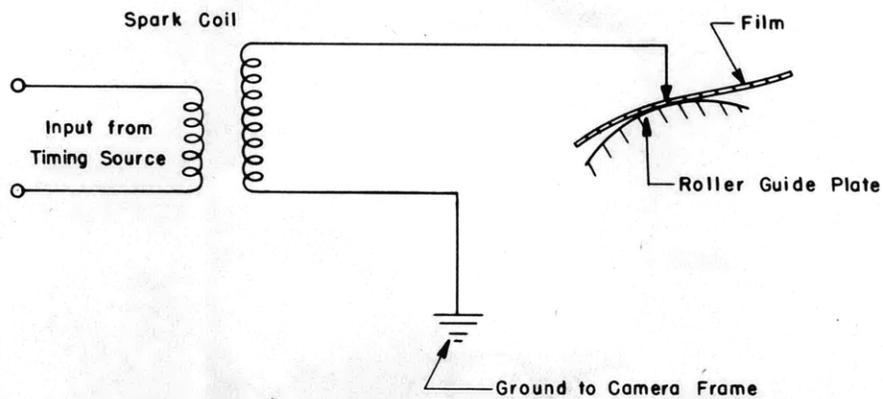


Figure 5 - Schematic Wiring Diagram for Spark-Timer Attachment to Eastman High-Speed Camera, Type III



Figure 6 - Timer for Eastman High-Speed Camera, Type III

The camera with spark-coil timer is shown on the left; the General Radio Strobotac timing source is shown on the right.

BATTERY-POWERED TIMING SOURCE

The General Radio Strobotac is usually employed as the timing source when power of 110 to 115 volts with a constant known frequency is available. Since such a power source is not always accessible at test locations, a substitute operated by a battery was constructed. The battery-operated timing source herein described has been found satisfactory. Its operating frequency is approximately 100 cycles per second.

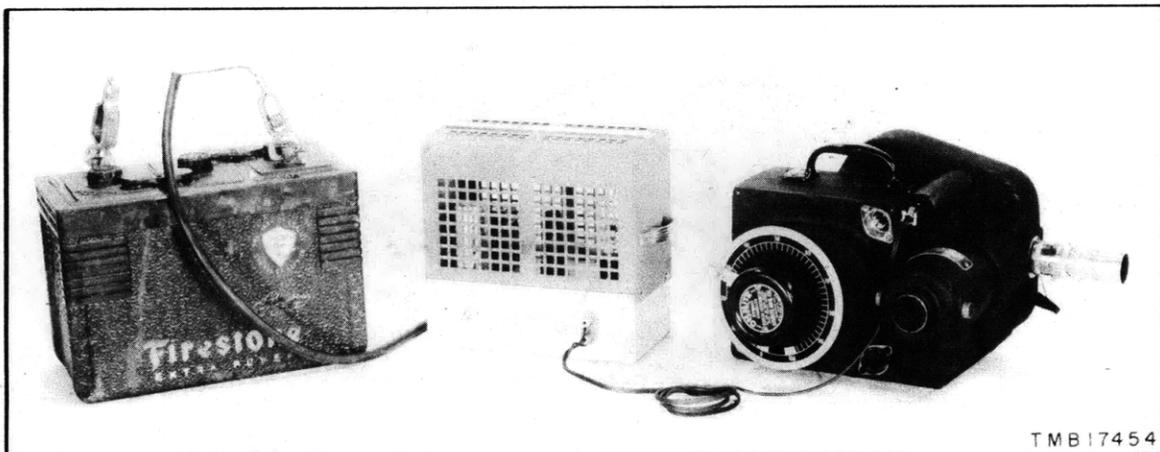


Figure 7 - Battery-Powered Timing Source and the Eastman High-Speed Camera

The timing source is built into a 5- by 7- by 10-inch Par-Metal foundation unit as shown in Figures 7, 8, and 9. Provision has been made to run clip leads to the terminals of a standard 6-volt storage battery. Terminals are provided to connect a 2-conductor cable to the receptacle on the camera coil. A schematic wiring diagram of the circuit of the timing source is given in Figure 10.

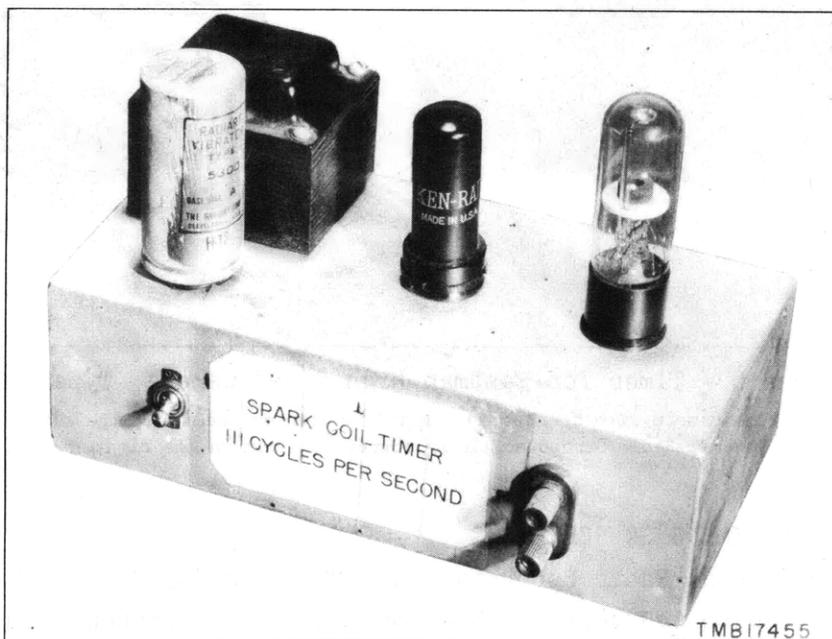


Figure 8 - Battery-Powered Timing Source with Cover Removed

View of the battery-powered timing source showing the power transformer and vibrator on the left. The 6X5 rectifier tube is in the center, and the 631-P-1 Strobotron tube is on the right. The input leads from the battery are out of sight at the center rear. The output terminals are on the right of the front panel.

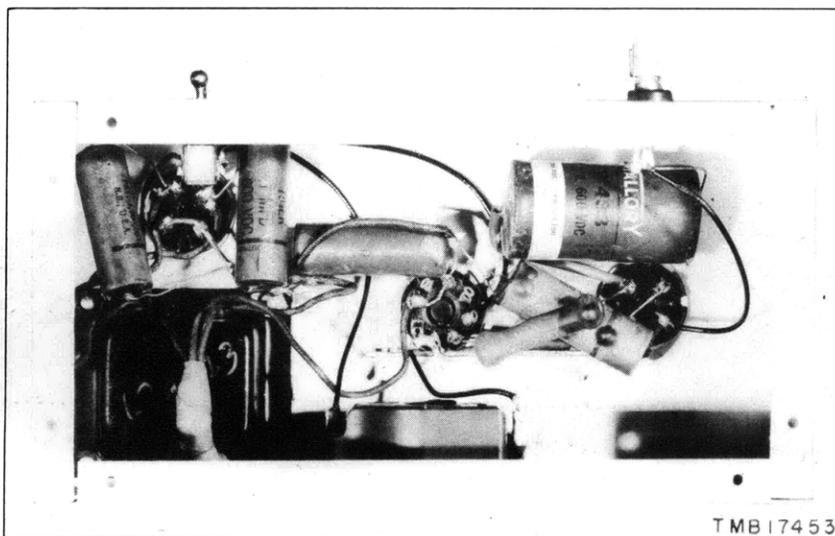


Figure 9 - Bottom View of Interior of Battery-Powered Timing Source

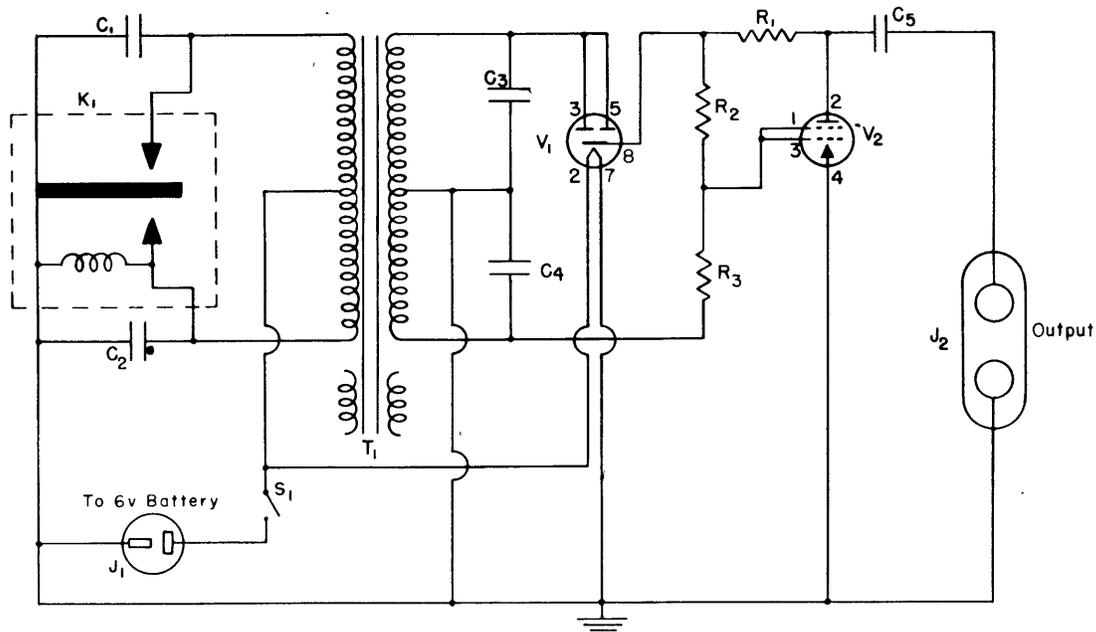


Figure 10 - Schematic Diagram of the Circuit of the Spark-Timing Source

Parts List

- | | |
|--|--|
| R_1 - 1 K, 10 w, wire-wound | V_1 - 6X5 double rectifier |
| R_2 - 200 K, 1 w, carbon | V_2 - 631-P-1 Strobotron (Sylvania) |
| R_3 - 250 K, 1 w, carbon | |
| C_1 - 0.1 μ f, 600 v, tubular | X_1 - Octal socket |
| C_2 - 0.1 μ f, 600 v, tubular | X_2 - Four-point standard socket |
| C_3 - 0.02 μ f, 1600 v, tubular | J_1 - Polarized convenience receptacle, Bryant 556 |
| C_4 - 0.02 μ f, 1600 v, tubular | J_2 - General Radio two-terminal strip |
| C_5 - 1.0 μ f, 600 v, tubular | K_1 - Radiart vibrator, Type 5300 |
| S_1 - SPST toggle switch | |
| B_1 - Battery power required, 7 amp at '6 v d-c | |
| T_1 - Thordarson power transformer 13R12. The 6-volt winding is used as a primary; the regular high-voltage winding is used as a secondary. The 5-volt and 120-volt windings are not used. | |

Note: All resistances are in ohms; K is a multiplying factor equal to 10^3 .

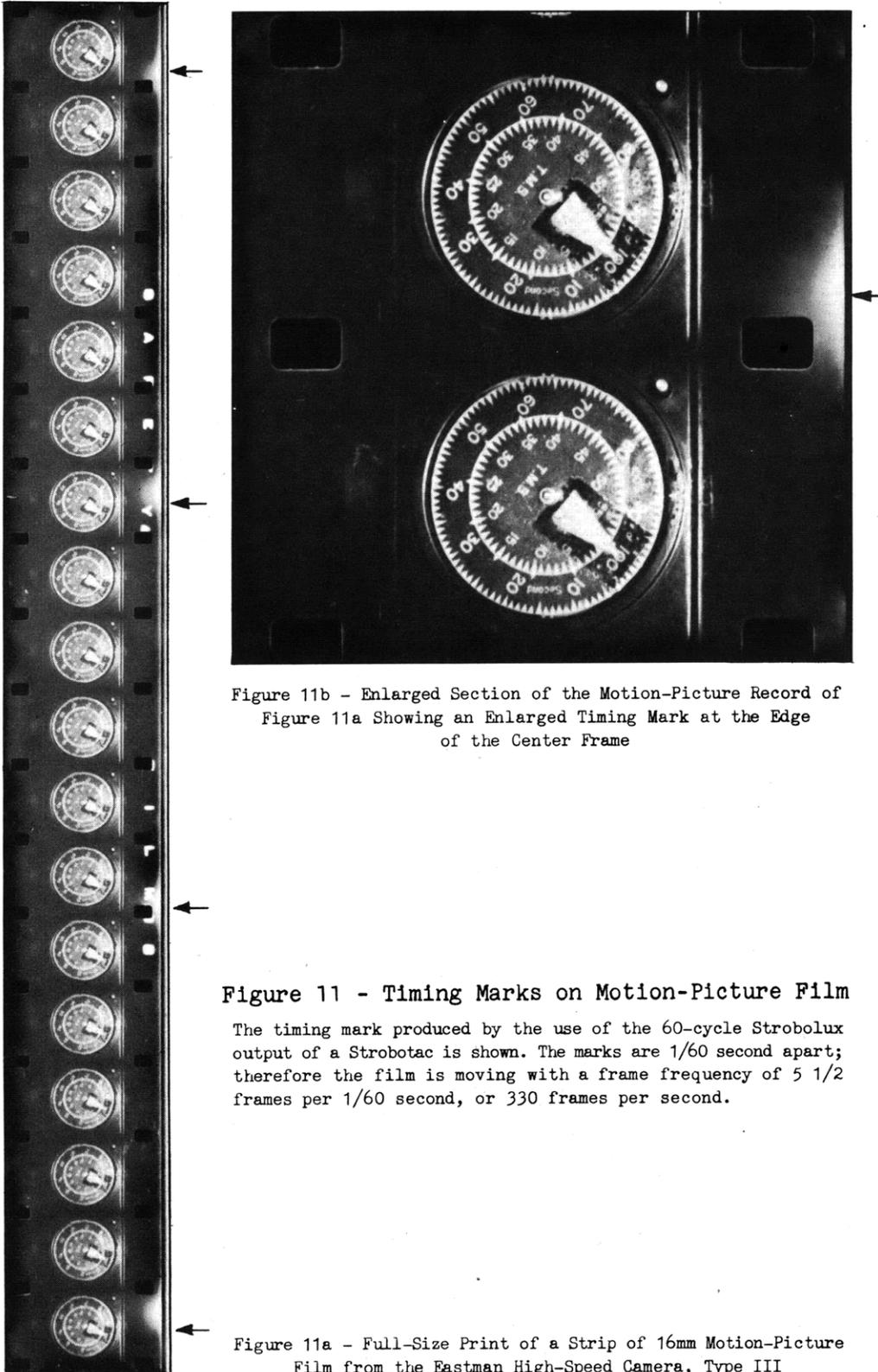


Figure 11b - Enlarged Section of the Motion-Picture Record of Figure 11a Showing an Enlarged Timing Mark at the Edge of the Center Frame

Figure 11 - Timing Marks on Motion-Picture Film

The timing mark produced by the use of the 60-cycle Strobolux output of a Strobotac is shown. The marks are $1/60$ second apart; therefore the film is moving with a frame frequency of $5 \frac{1}{2}$ frames per $1/60$ second, or 330 frames per second.

Figure 11a - Full-Size Print of a Strip of 16mm Motion-Picture Film from the Eastman High-Speed Camera, Type III

THE TIMER IN USE

The instantaneous pulse of approximately 100-volt magnitude produced by either the Strobotac or the battery-operated timing source is transformed by the camera spark coil to a high-voltage discharge across the gap between the end of the high-tension lead and the inner roller guide plate. The light produced by this spark discharge produces a small fogged area on the edge of the film. This is shown in Figure 11.

REFERENCES

(1) Instruction Manual for the Eastman High-Speed Camera, Type III, Eastman Kodak Company, Rochester, New York, January 1943.

