APPENDIX A

LIST OF SIGNS STUDIED IN THE RESEARCH

APPENDIX B

DESCRIPTION OF THE EYE-MARKER CAMERA SYSTEM

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Description of the Apparatus

The eye-marker camera system used in this research project for the collection of driver eye-movement data is an outcome of many modifications and improvements made by the Systems Research Group in a "Polymetric Products - Model V-0165-1L4" camera. The eye-marker camera system works on the principle of corneal reflection and it essentially consists of the following two major components:

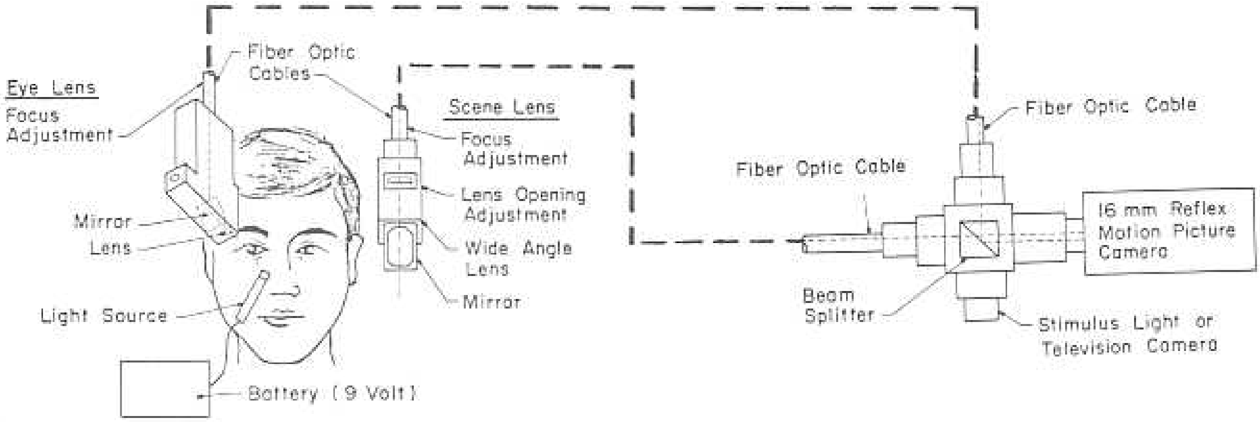
1. input system, and
2. output system.

The pictorial view of a test driver wearing the input system of the eye-marker camera is shown in Figure A-1.

The components of the input system are mounted on a stabilization headpiece which consists of a helmet and a bite bar which are molded to fit individual subjects. On the left side of the helmet a scene lens (with a 20^{o} field of view) is attached which transmits an image of the visual scene ahead of the driver into a fiber-optic cable (see Figure A-2). A small light source, powered by a nine volt battery, is attached on the lower portion of the stabilization unit. The parallel beams of the light source can be directed on the right cornea of the subject such that the corneal reflection can be picked up on the "eye" lens. A second fiber-optic cable connected to the eye lens transmits the corneal reflection to the output system.

The output system (Figure A-2) is composed of a beam splitter, which optically superimposes the images from the fiber-optic cables that come from the scene lens and the eye lens. At the other two ends of the beam splitter housing, a 16mm motion picture camera and a television camera can be connected. The recording equipment, thus, consists of a recording, the eyespot (corneal reflex) is calibrated to obtain precise superimposition on the visual scene. When the driver moves his eye, the eyespot travels accordingly across the image of the visual scene. The calibration accuracy of the system is $\pm 1/2^{o}$ in the horizontal direction and $\pm 1^{o}$ in the vertical direction.

Figure A-1.--A Pictorial View Showing a Test Subject Wearing the Input System of the Eye-marker Camera



Input System

Output System

Figure A-2.--Schematic Diagram of Eye-Marker Camera System.

Data Reduction Procedure

The films obtained from the eye-marker system consist of $20^{o} \times 20^{o}$ visual scene ahead of the driver with the record of the position of the optical axis of the driver's eye which appears as a white spot (eyespot) on the film. The data reduction is accomplished by lining the road geometry (the center and right lane markers) on the film with the road geometry on the data reduction grid shown in Figure A-3. By examining the film frame by frame, the location, duration and travel distances of the eye can be determined. A rear-projection system (Figure 51) has been developed to suit the Data Analyzer Projector (L.W. Photo , Inc.--Model 224A). The system permits data reduction in normal indoor lighting.

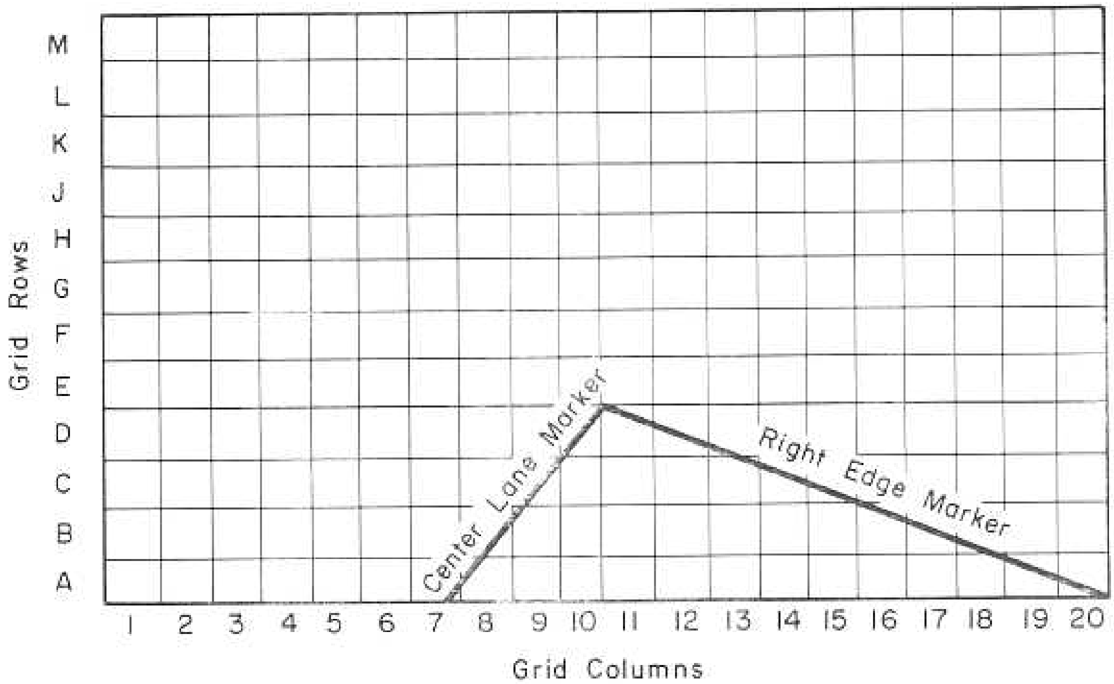


Figure A-3.--Film Data Reduction Grid of One Degree Squares

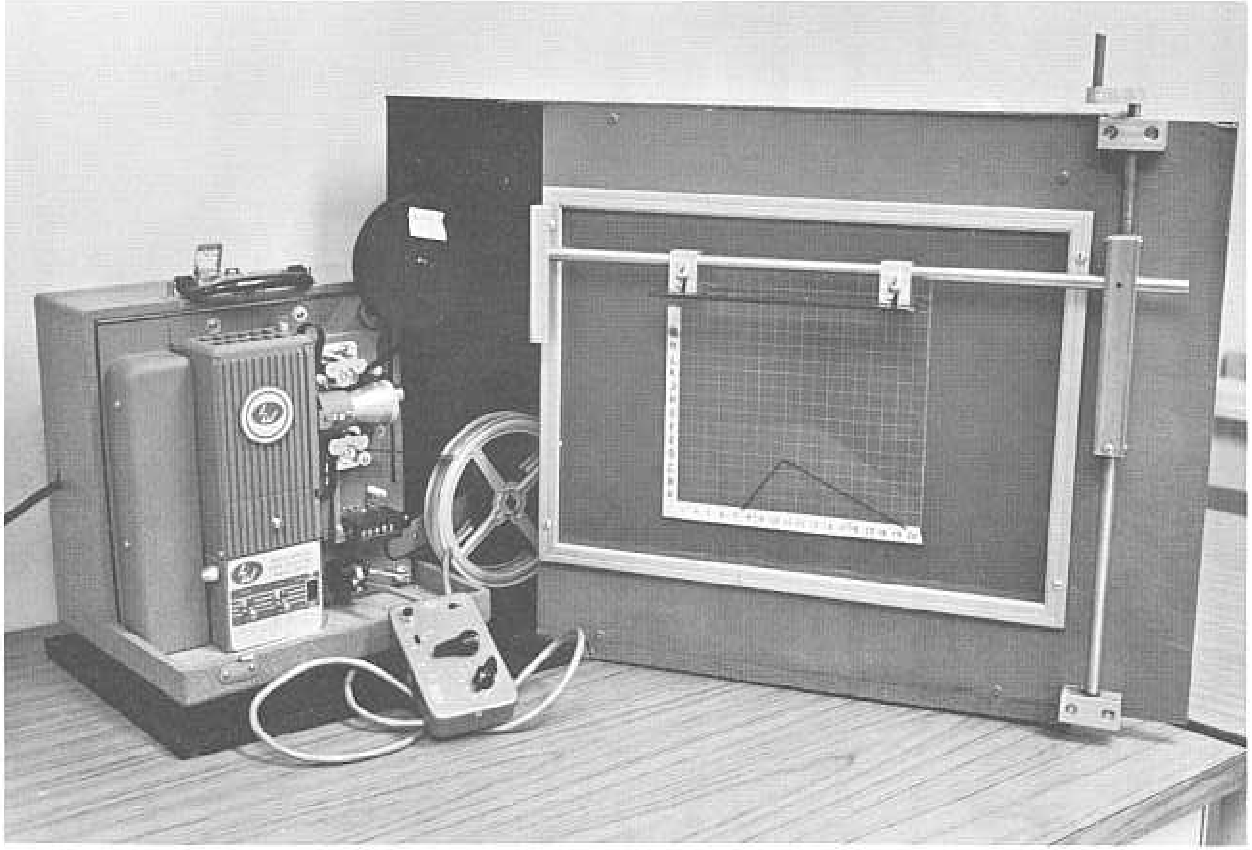


Figure A-4.--16 mm Projector with Daylight Screen.

APPENDIX C

DESCRIPTION OF THE INSTRUMENTED VEHICLES

Two instrumented vehicles were used for this research. During the Stage A; i.e., up to June 30, 1970, the data was collected by using instrumented 1963 Chevrolet, and for the Stage B, an instrumented 1969 Buick Electra 225.

The 1963 Chevrolet was equipped with 12 vdc and 24 vde alternator systems capable of supplying 100 amps of power. In addition, the vehicle was equipped with a solid state inverter for delivering 110 vac power. The basic recording requirements were handled by a 51-channel C.E.C. Oscillograph recorder.

This vehicle was equipped to measure the following driver-vehicle performance parameters:

1. velocity,
2. acceleration (longitudinal and transverse),
3. jerk (longitudinal and transverse),
4. gas pedal position,
5. steering wheel position,
6. brake pedal position and pressure,
7. events recording,
8. headway between vehicles, and
9. intervehicular voice communication.

The 1969 Buick Electra is equipped with a heavy duty 12 vdc alternator system and a solid state inverter for delivering 110 vac power. The basic recording requirements are handled by a Honeywell Visicorder Oscillograph, Model 2206 (12-channel).

This vehicle is equipped to measure the following driver-vehicle performance parameters:

1. velocity,
2. distances (by using a fifth wheel),
3. acceleration (longitudinal and transverse),
4. jerk (longitudinal and transverse),
5. headway between vehicles,
6. events recording, and
7. intervehicular voice communication.

During the data collection phases of this project, the recorder in an instrumented vehicle was used to record the necessary data describing the state of the vehicle and drivers' control actions. These data were synchronized with the eye-marker camera system and various events traces were used to identify details of the signs and their positions with respect to the driver's path.