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REPORT NO. 6-47

A RATE-OF-FIRE RECORDER FOR

AIRCRAFT MULTIPLE GUN INSTALLATIONS

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ON 11-10-76 M. Green 5511 dtd 31 Oct 73
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A RATE-OF-FIRE RECORDER FOR
AIRCRAFT MULTIPLE GUN INSTALLATIONS

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1. The Naval Proving Ground has found simultaneous cyclic rate-of-fire determination of importance in testing aircraft multiple gun installations. In order to determine phase relationships between the guns and the effect on rate of fire, it was desirable to refer the firing of all guns in an aircraft installation to a common time scale on the same record. The apparatus developed for this purpose, while quite usual in some respects, has features which may be of interest to other activities undertaking similar projects. The apparatus is described in sufficient detail to enable other establishments to duplicate the equipment if desired.

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C. T. Joy
C. T. JOY
REAR ADMIRAL, USN
COMMANDING OFFICER

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ON 11-10-76 M. Verum 5511 dtd 31 Oct 73
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P R E F A C E

AUTHORIZATION

The development of the rate-of-fire recorder was undertaken as a means of obtaining data for use in NPG Project No. RG 8003.10: Malfunctioning of the 20mm Gun, M3.

OBJECT

The object of this project was to develop a recorder for determining the cyclic rate-of-fire in flight of several guns firing simultaneously.

SUMMARY

A rate-of-fire recorder has been developed, employing a galvanometer oscillograph with contacts on each gun. It is used for recording individual cyclic rates-of-fire of several guns firing simultaneously, referred to a common time scale on the same record. The recorder is fully automatic in operation, quickly changed from one aircraft to another by virtue of its external stowage, and is easily accessible for service. Construction details are described.



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- Figure 2 View of Cluster Adapter, M-16 (Modified), Containing Rate-of-Fire Recording Equipment, Suspended from Bomb Rack of F4U-4 Aircraft. NPG Photo NP-9 35416.
- Figure 3 View of Cluster Adapter, M-16 (Modified), Showing Installation of Heiland Oscillograph with Access Doors for Loading and Unloading Paper. NPG Photo NP-9 35417.

A RATE OF FIRE RECORDER FOR AIRCRAFT MULTIPLE GUN INSTALLATIONS

1. The basic instrument used in the rate-of-fire recorder was a Heiland Type A-401R galvanometer oscillograph. This oscillograph employed six Type C recording elements and a vibrating reed timing system. It had its own 8-volt storage battery power supply. The instrument was modified for control from the 24-volt aircraft electrical system.

2. Automatic operation of the oscillograph eliminated the necessity for attention by the pilot and the possibility that the equipment might not be turned on. Closing the pilot's switch turned on the instrument by relay control. For this purpose, two small 24-volt relays were installed inside the oscillograph. The coil of the first relay to operate was connected across the pilot's firing switch to switch power to the recording motor, lamps, timing reed and the coil of the second relay. The starting coil of the timing relay was connected, in series with a dropping resistor, directly across the trigger switch to insure prompt starting of the reed. This circuit was broken by the contacts of the second relay. The resultant pulse across the starting coil was of sufficient duration to start the reed reliably.

3. A contact on each gun (Figure 1) was designed to close a circuit, deflecting a galvanometer element, as each round was fired. While these contacts may be made up in a number of ways depending on the type of gun and the means at hand, the contact shown has proven satisfactory for use with the 20mm gun, M-3 and is simple to construct. A flat piece of bakelite, micarta or similar insulating material was secured by means of four machine screws tapped into the anchors positioning the feed mechanism. A contact finger, of flat phosphor-bronze stock, was positioned on this insulator by two small bolts and held down against the insulator by two small coil springs. As the gun recoiled, the gas piston sleeve struck this finger and forced it upward, maintaining a sliding electrical contact between the finger and the gas piston sleeve. The finger was connected in series with a resistor, the galvanometer element, and one side of a grounded battery. The amount of deflection is determined by the constants of this circuit. As many as six different elements and the timing reed deflections may be recorded on the two-inch wide sensitized paper strip.

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4. In use, the recording equipment was contained in a modified Bomb Cluster Adapter, M16, ordinarily used for the Bomb Cluster, M29. The inside partition was removed from the cluster adapter, and two small hinged doors were installed in the side. (Figures 1 and 2). The oscillograph was secured by rubber shock mounts to a bracket which fitted the bottom contour of the cluster adapter. Four Dzus fasteners permitted easy removal of the assembly for servicing and shop check. An AN electrical connector mounted in the hinged top of the cluster adapter, connected to the gun contact leads and the electrical system of the aircraft. The entire assembly could be secured to any bomb rack and could be readily changed from one airplane to another or removed entirely when not in use. Loading and unloading of the recording paper could be done through the hinged door in the cluster adapter without removing the assembly from the airplane.

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NP9 35415 View of the Port Gun Compartment of an F4U-4 Aircraft Showing
Rate-of-Fire Contact Mounted on 20mm Automatic Gun, M-3 (T-21).

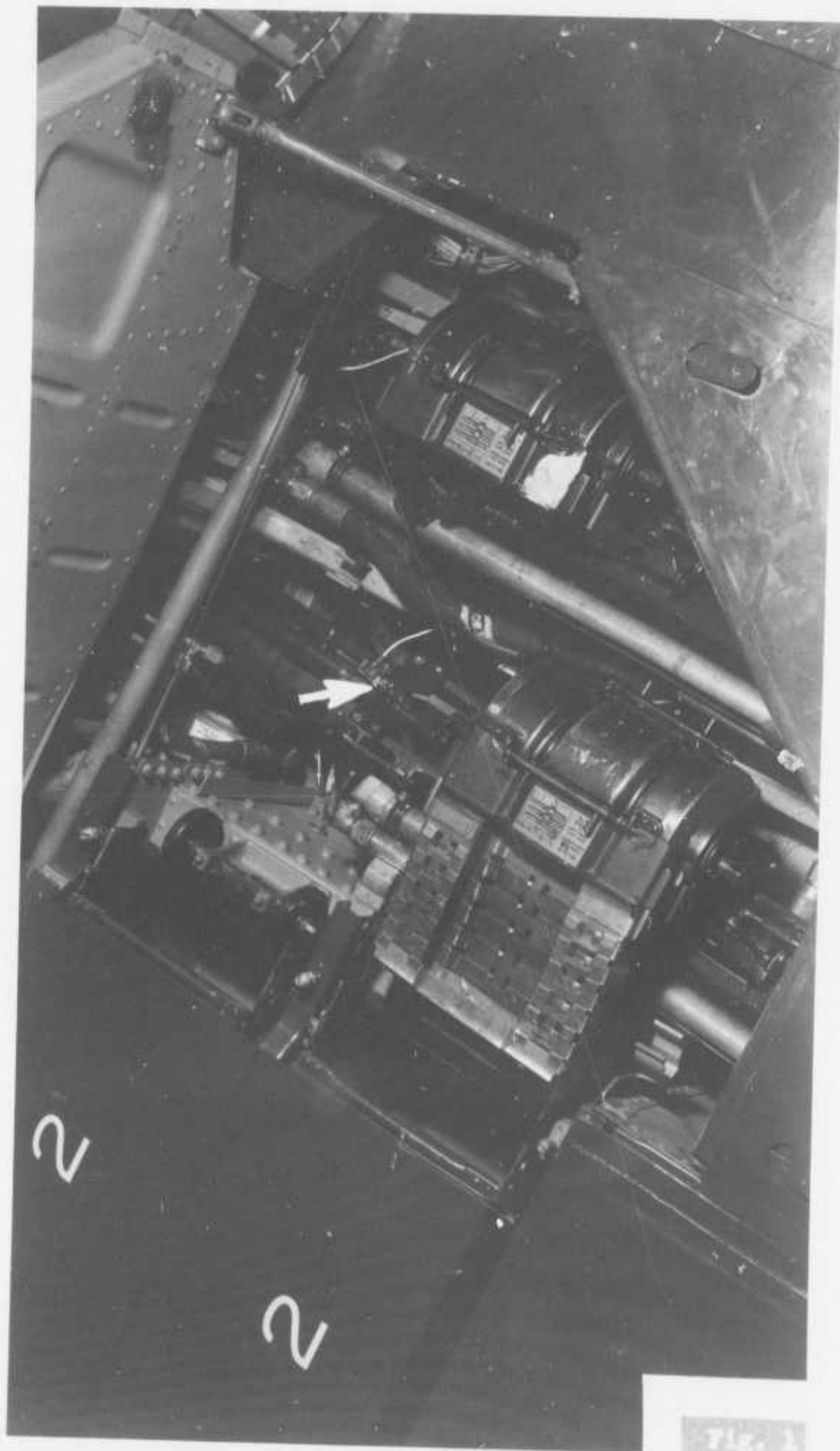


Fig. 1

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View of Cluster Adapter, M-16 (Modified), Containing Rate-of-Fire
Recording Equipment, Suspended from Bomb Rack of F4U-4 Aircraft.



Fig. 2

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Np9 35417 View of Cluster Adapter, M-16 (Modified), Showing Installation of
Heiland Oscillograph with Access Doors for Loading and Unloading
Paper.



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Fig. 3

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TITLE: A Rate-of-Fire Recorder for Aircraft Multiple Gun Installations

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ABSTRACT:

A rate-of-fire recorder has been developed, employing a galvanometer oscillograph with contacts on each gun. It is used for recording individual cyclic rates-of-fire of several guns firing simultaneously, refer red to a common time scale on the same record. The recorder is fully automatic in operation, quickly changed from one aircraft to another by virtue of its external stowage, and is easily accessible for service. Construction details are described.

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