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ARROW 2

FIRE PROTECTION SYSTEM

REPORT No. 72/SYSTEMS 23/31

ENGINEERING DIVISION

AVRO AIRCRAFT LIMITED

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ARROW 2

FIRE PROTECTION SYSTEM

REPORT NO. 72/SYSTEMS 23/31

JUNE 1957

This brochure is intended to provide an accurate description of the system(s) or service(s) for purposes of the Arrow 2 Mock-up Conference, and is not to be considered binding with respect to changes which may occur subsequent to the date of publication.

COMPILED BY D. Rayston. **APPROVED BY** Alan R. Bailey

ENGINEERING DIVISION

AVRO AIRCRAFT LIMITED

MALTON — ONTARIO

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ILLUSTRATIONS

1. Introduction

1.1 The ARROW 2 aircraft is to be equipped with a high rate discharge fire protection system, by which extinguishing agent is to be discharged into a fire area within a time of 0.45 to 0.90 seconds. The system is designed to detect fires in, and give protection to, the potential fire areas of both engines and the equipment bay.

2. Extinguishing Agent

2.1 The extinguishing agent will be CF_2Br_2 (Freon).

3. Definition of Fire Areas

3.1 The potential fire areas are the left hand engine compartment, the right hand engine compartment, and that portion of the fuselage lying between the two engine compartments containing fuel, electrical and hydraulic equipment. In addition, the engine fire areas are further divided into three zones each, namely zone 1 forward of the restrictor ring, zone 2 aft of the restrictor ring and zone 3 contains all the engine accessories and is encased in a separate shroud.

4. Description of Fire Protection System

4.1 For descriptive purposes, the fire protection system will be divided into two sub-systems; the fire detection sub-system, and the fire extinguishing sub-system.

4.2 Fire Detection Sub-System

4.2.1 Fire Detectors: The Fire detectors are of the continuous wire type and are located in the potential fire areas. The detectors operate either when the average temperature reaches a pre-determined level above normal or when the rate of temperature rise at any point exceeds a given value. They are thus capable of detecting general fires covering a large area, and small jets of flame such as may occur with a punctured engine casing.

4.2.2 Pilot Warning: A warning light for each fire area is located on the fire and fuel panel on the left hand console just aft of the throttle box. A fire in any of the three fire areas causes the detection system to give a visible warning signal to the appropriate light, at the same time illuminating the master red warning light on the main instrument panel.

4.2.3 Re-setting of Detection System: The detection system has automatic re-setting, i.e. after normal conditions have been re-established, the warning lights will go out, and within 10 seconds, the detectors are again ready to signal the out-break of further fires.

4.3 Fire Extinguishing Sub System

4.3.1 Discharge of Extinguishing Agent: The system provides for the discharge of extinguishing agent to any two of the three areas selectively, or two shots of agent to any one area, i.e. single shots to one engine and the equipment area, or two shots to either.

4.3.2 Activation of System: The system is activated electrically, through a switch which is incorporated in the appropriate push button type warning light. It energizes the selected circuit, to direct extinguishing agent to the desired area. These individual push button switches are utilized for the first shot to any one particular fire zone. The second shot to any fire zone is accomplished by means of a second shot toggle switch, located on the same panel. The first operation of the push button switch sets the circuit up in preparation for the second shot.

4.3.3 Provision for Crash Case: A crash switch is fitted so that in the event of a crash, all potential fire areas receive a discharge of extinguishing agent automatically. One bottle is discharged to the equipment bay, the discharge from the second bottle is split between the two engine areas.

4.3.4 Fire Extinishing Containers: Two containers are located immediately forward of Sta. 742.0. Each container is non-shatterable and has a capacity of 378.0 cu. ins. The charge

is 12.0 lbs. of CF_2Br_2 (Freon) pressurized with nitrogen gas at 400 p.s.i.g. Each container is equipped with a pressure gauge, a safety disc, and three solenoid operated discharge valves.

4.3.5 Solenoid Operated Discharge Valves: Each valve may be independently operated. They are connected as shown in Fig. 1. By means of this connection, it is possible to give each potential fire area a second shot of agent should the first prove ineffective, or should the fire recur (Ref. para. 3.2).

The valves are of the type shown diagrammatically in Fig. 2. Pressure within the container, acting upon the full area of the main valve, keeps the valve shut tightly on its seat, maintaining a leak proof seal between the extinguishing agent and the outlet port. Upon the solenoid being energized (either by the pilot or the crash switch, Ref. paras. 4.3.1 and 4.3.2) the pilot valve is withdrawn from its seat, admitting pressure to the lower side of the piston attached to the main valve stem. Since this piston is of larger area than the main valve seat, and pressures above and below the main valve are now equal, the main valve is pushed open, allowing the extinguishant to be forced through the outlet port by the gaseous nitrogen pressure.

4.3.6 Shuttle Valve: As shown in Fig. 1, each outlet port is

connected to an opposing port on the adjacent container. To prevent extinguishing agent from a second shot entering a container previously emptied on the first shot, a flap type shuttle valve is fitted between the discharge valves. Thus, the agent from either container is positively directed to the common line leading to each of the three fire areas.

4.3.7 Safety Disc: The safety disc on the container is designed to melt at a predetermined temperature, to allow the gas to escape, and thus protect the container from rupturing. The escaping gas is restricted to minimize blast effects on adjacent structure.

4.3.8 System Piping: All piping in the fire extinguishing system is of thin-walled stainless steel. Since this is a high rate discharge system, spray rings are not required, the agent being discharged through discharge nozzles.

5. Design Considerations

5.1 Rate of Discharge

It is considered that the high rate discharge system gives better fire protection, and shows considerable weight saving over the standard system.

5.2 Type of Discharge Valve

Due to the high ambient temperature (250°F) in the region of the containers, it has been found impossible to use the standard pyrotechnic type discharge valve. A survey of available explosives has shown that few are stable above 180°F, and not considered safe above 210°F. In consequence, the solenoid operated valve (Ref. para. 4.3.5) has been developed to meet this condition.

5.3 Choice of Agent

Temperature considerations have also affected the choice of agent. The vapour pressure of Freon is considerably lower than that of Methyl Bromide, or Bromochloromethane at high temperature, thus internal container pressures are reduced by using the former. Freon is equal to methyl bromide in fire extinguishing properties and also has the virtue of being less toxic and less corrosive.

APPENDIX 1

EQUIPMENT LIST

FIRE PROTECTION SYSTEM

Description	Qty.	Part No.	Spec.	Manufacturer and Part No. Where Applicable
Bottle - Extinguisher	2	7-2358-15	AVROCAN E379	Kidde
Valve - Discharge	6	7-2358-13	E379	Kidde
Valve - Shuttle	3	7-2358-18	E405	Kidde

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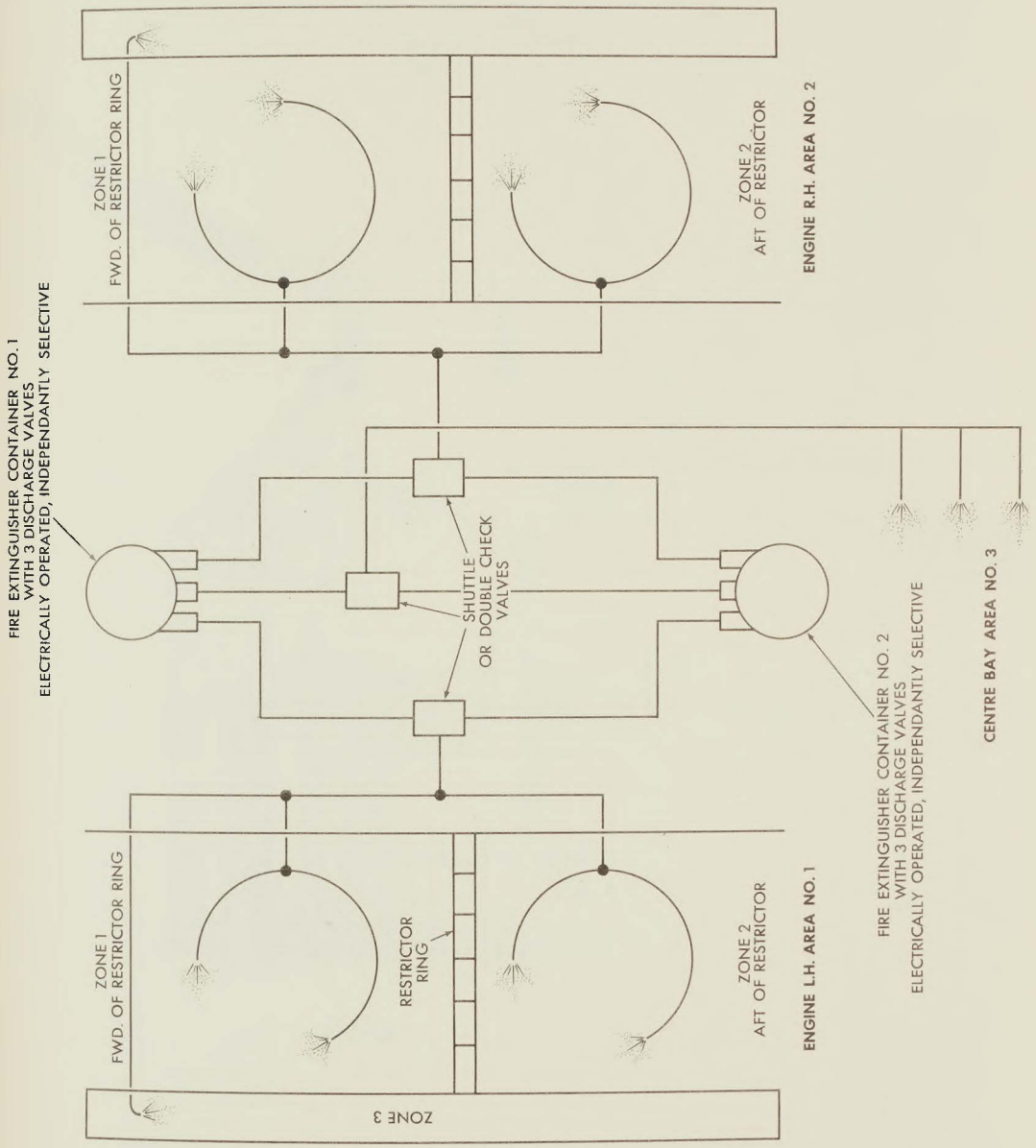

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FIG. 1 SCHEMATIC - H.R.D. FIRE EXTINGUISHING SYSTEM

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NOTE:
THIS IS A DIAGRAMMATIC
REPRESENTATION ONLY

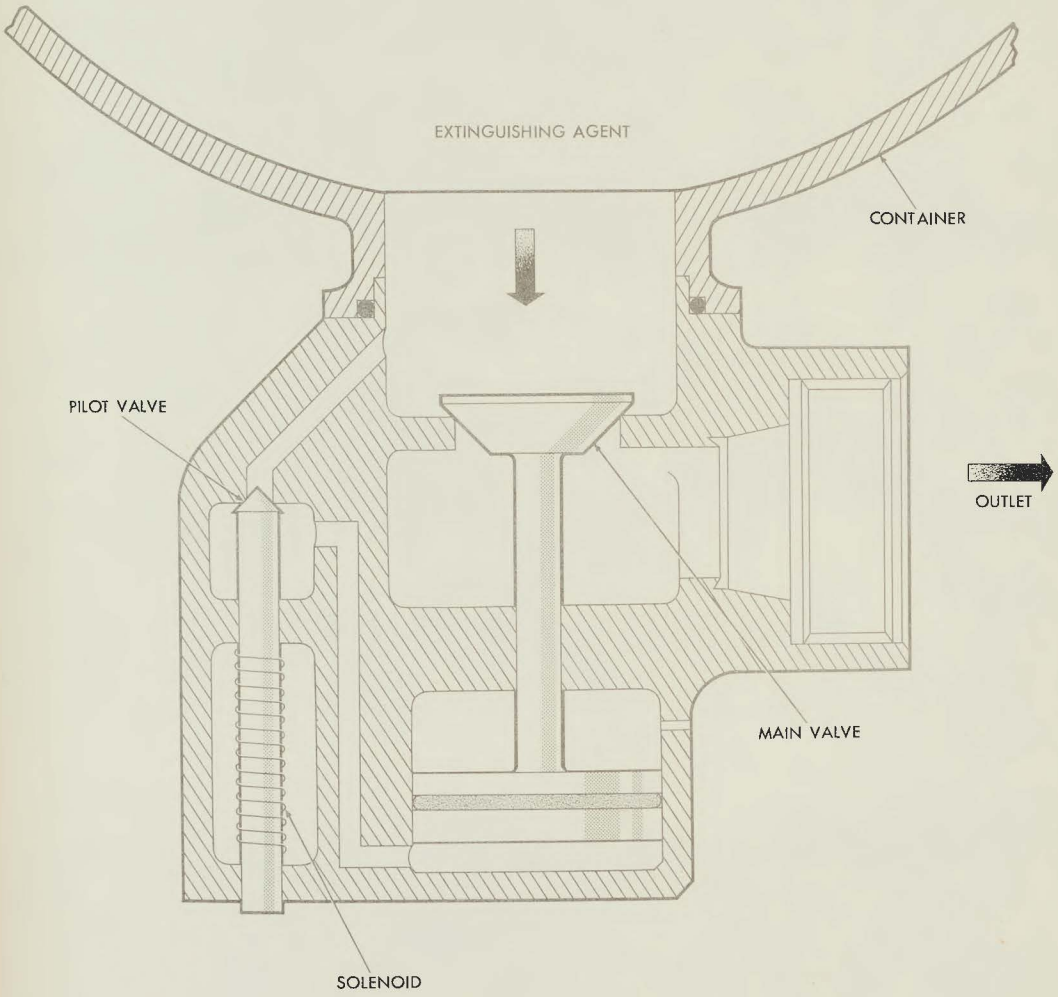

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FIG. 2 DISCHARGE VALVE SOLENOID OPERATED