

FORESTS DEPARTMENT, WESTERN AUSTRALIA

OPERATIONS MANUAL

FOR THE

WAM '82 MANUAL LOADING INCENDIARY MACHINE

MANUAL NO. 1

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WESTERN AUSTRALIA

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This document has been prepared and assembled for:

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COMO, WESTERN AUSTRALIA, 6152

and shall be know as:

WAM '82 INCENDIARY MACHINE OPERATIONS MANUAL

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OPERATIONAL MANUAL

FOR THE WAM 1982 INCENDIARY MACHINE

These operational instructions were developed through 15 years experience gained on the 1968 CSIRO machine and subsequent trials with the '81 WAFDIM MK 1. The instructions have been formulated in consultation with the Department of Aviation and apply only to the installation and operation in the Britten Norman Islander BN 2A or in the Partenavia P68B aircraft.

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PART IOPERATIONAL STANDARDS FOR DROPPING OF INCENDIARIES FROM AIRCRAFTI - 1.0 APPROVAL FOR CARRIAGE OF INCENDIARIES

Pursuant to Air Navigation Regulation 120, permission may be granted by the Director of a Region for the carriage of incendiaries in aircraft engaged in forest fire control measures, subject to the following conditions:

- (1) The operator shall hold an aerial work licence.
- (2) The operation shall be authorized by and conducted under the supervision of the State Forestry or Bush Fires Board Authority; and
- (3) The type of incendiaries, the arming device and dropping equipment shall be approved by Regional officers having delegation to exercise the powers and functions of Air Navigation Regulation 40 (2).

I - 2.0 DROPPING APPROVAL

Pursuant to Air Navigation Regulation 126(2)(a), permission may be granted by the Director of a Region for incendiaries to be dropped from aircraft engaged in forest fire control measures subject to the provisions contained in Air Navigation Orders Section 29.5.

I - 2.1 Dropping Site

- (1) Incendiary dropping operations within Western Australia shall be authorized by the Forests Department or the Bush Fires Board of Western Australia.
- (2) The incendiary dropping site shall be specified and clearly defined by the State Forestry or Bush Fires Board authorities, using terrain features, ground signals, markers etc.
- (3) The pilot in command shall make at least one preliminary flight over the site and obtain confirmation from a Forestry or Bush Fires Board officer on the ground or in the aircraft that he/she is over the site and is aware of the boundaries of the area to be ignited.

- (4) The pilot in command is to ensure that the designated incendiary dropping area is clear of all unauthorized persons prior to commencement of dropping operations.

I - 3.0 INCENDIARY DROPPING OPERATIONS

- (1) The incendiaries shall be dropped by a person other than a flight crew member, who has no other functions during actual dropping operations; (this person shall hereafter be referred to as a bombardier).
- (2) If a Forestry or Bush Fires Board officer is near or at the dropping site, the pilot in command shall maintain two-way radio communications with the person at all times when the aircraft is in the dropping area. If the Forestry or Bush Fires Board officer is in the aircraft, the person shall have access to the pilot on the aircraft's intercommunications system.
- (3) The pilot in command shall be personally briefed by a responsible Forestry or Bush Fires Board officer on the location of the dropping site and on any other matters associated with the ignition operation prior to the start of the operations.
- (4) The pilot in command shall ensure that the movement of persons or articles during the conduct of the operation will not result in any unsafe movement of the centre of gravity.
- (5) The minimum height permitted during dropping operations is 150 feet above the highest obstruction within a horizontal radius of 600 metres from the aircraft. Normal operating heights are to be maintained at other times.

- (6) An aircraft shall not be flown at a height of less than 500 feet within 600 metres horizontally of an occupied building or vehicles except with the permission of the occupants.
- (7) Dropping operations shall be conducted in accordance with Visual Flight Rules.
- (8) The approach path to and climb away path from the dropping area shall not involve abrupt manoeuvres and the climb away shall be clear of obstacles above the dropping site.

I - 4.0 CREW QUALIFICATIONS

- (1) The pilot in command shall be the holder of a commercial or higher category licence, with a minimum of 250 hours in command, and by carrying out both low level flight (min. 500 feet A.G.L.) and actual fire burning operations for a combined minimum of 5 hours, have approval granted for incendiary dropping operations. The approval is to be carried out by the chief pilot or an approved check pilot.
- (2) The bombardier shall be trained to the satisfaction of the pilot in command, in all aspects pertaining to the dropping of incendiaries, including equipment malfunctions and emergency procedures.

I - 5.0 CARRIAGE OF ARTICLES AND PERSONS

- (1) The carriage of the incendiaries in the aircraft shall be in accordance with Section 20.16.2 of Air Navigation Orders. Incendiary capsules are only to be carried in suitable, approved rigid containers.
- (2) Ethylene glycol is to be carried in non-frangible containers in a position in the aircraft to avoid accidental contact with incendiary capsules.
- (3) No person other than those essential to the operation shall be carried in the aircraft during incendiary dropping operations.
- (4) Each crew member and person shall occupy a separate seat equipped with an approved safety belt (or harness) which shall be worn adjusted to ensure adequate restraint at the following times:

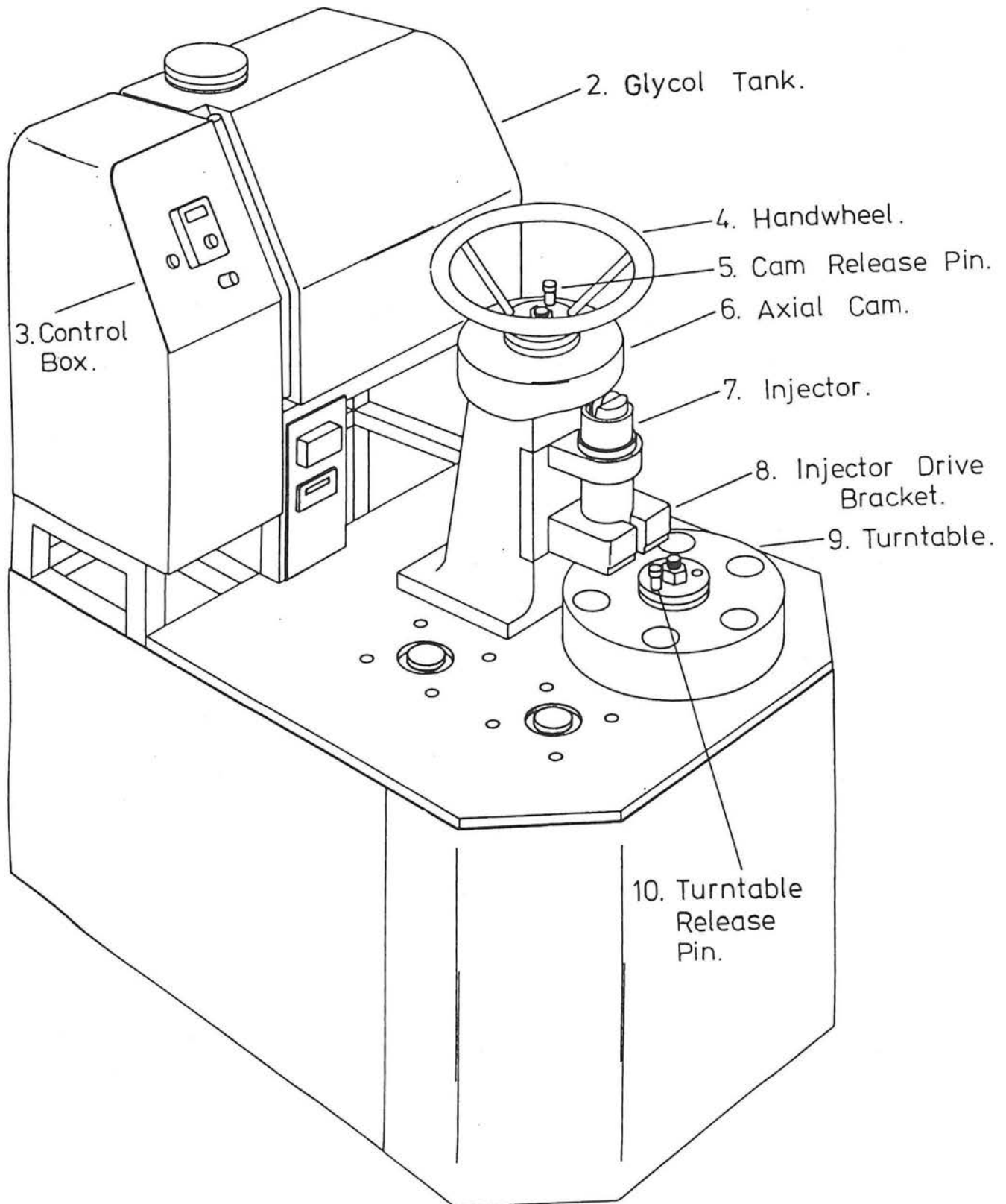
- (a) during take-off and landing
- (b) during an instrument approach
- (c) when the aircraft is flying at less than 1,000 feet above terrain
- (d) in turbulent conditions, and
- (e) during dropping operations.

I - 6.0 EQUIPMENT REQUIREMENTS

- (1) The dropping equipment and the associated incendiary device shall be subject to airworthiness approvals, obtainable by application to the Regional Headquarters of the Department of Aviation.
- (2) Installation is to be carried out by an approved organization.
- (3) Weight and balance are to be approved before flight.
- (4) Installation is to be made available to Department of Aviation for inspection.
- (5) Asbestos (or equivalent) blankets are to be carried in the aircraft (one each for cabinet and machine to cover each item).
Fire extinguishers shall be carried:
Two soda syphons (one litre capacity) and one B.C.F. extinguisher (approximately 2.5 kg capacity).
The blankets and extinguisher shall be readily available to the bombardier.
- (6) The aircraft shall be fitted with a gyroscopic horizon indicator in addition to the instruments required by Air Navigation Orders, Section 20.18 for V.F.R. operations.
- (7) At the end of each dropping operation the aircraft shall be cleaned inside to ensure that any loose articles are stowed. Any potassium permanganate or ethylene glycol that may have been spilt to be cleaned to avoid the inadvertent mixing of any spilt portions.

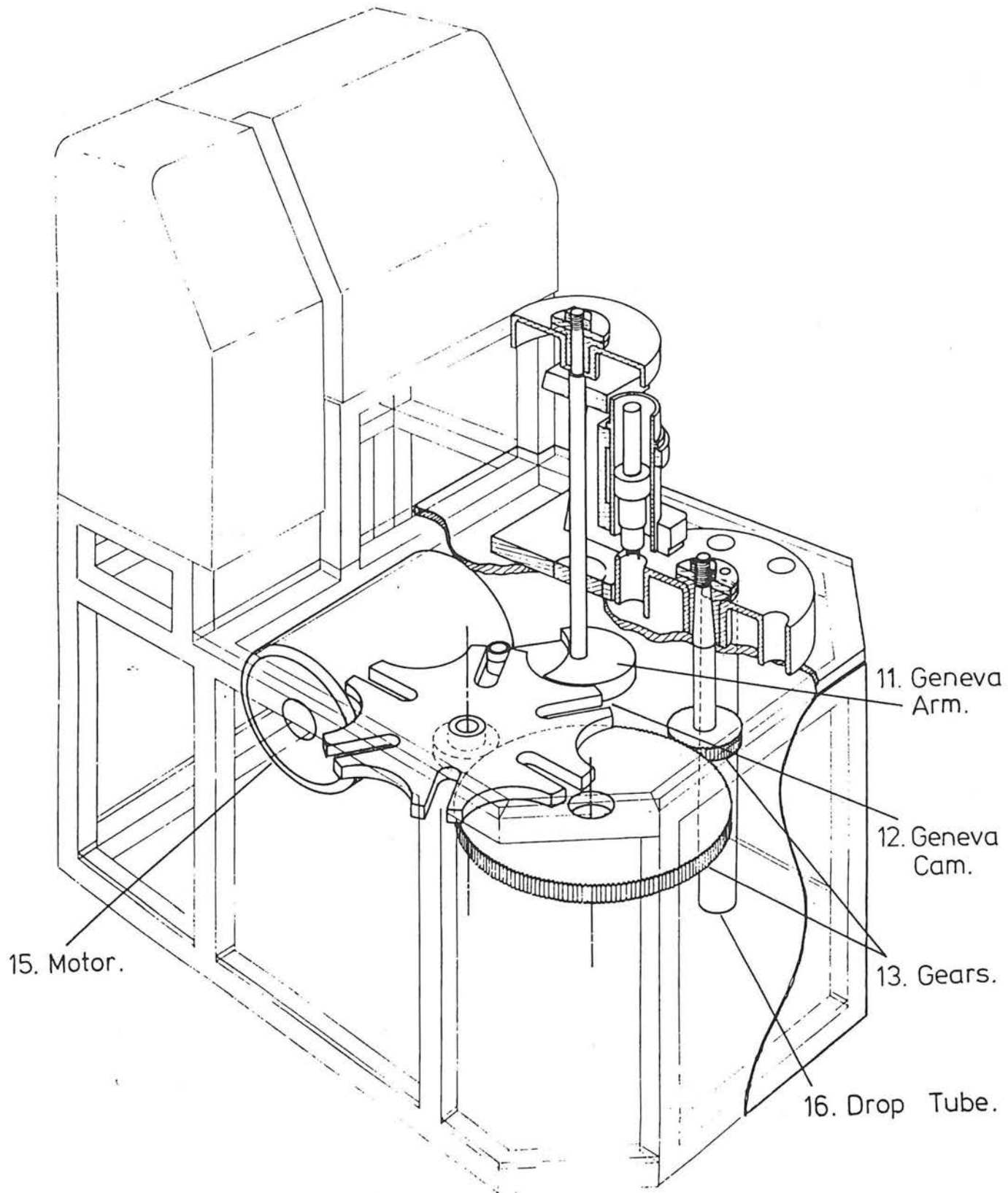
Main Components

WAM '82 Incendiary Machine - Manual Loading Type.



Working Parts

WAM '82 Incendiary Machine - Manual Loading Type.



PART IIDESCRIPTIONII - 1.0 THE WAM '82 INCENDIARY MACHINE - MANUAL LOADING TYPE

The function of the equipment is to inject small plastic capsules with a measured quantity of glycol, thereby initiating the exothermic reaction, and to eject the primed capsules from the aircraft at precisely timed intervals. The capsules are loaded into the turntable by hand. It has been designed to accomplish this with the highest degree of reliability and safety. The equipment is accepted for installation in the Britten Norman Islander BN 2A and Partanavia P68B aircraft. The main components shown in Figure 1 are:

1. Main Frame
2. Glycol Tank
3. Control Box
4. Handwheel
5. Cam Release Pin
6. Axial Cam
7. Injector
8. Injector Drive Bracket
9. Turntable
10. Turntable Release Pin
11. Geneva Arm
12. Geneva Cam
13. Gears
14. Gearbox
15. Motor
16. Drop Tube

II - 1.1 The main frame of the incendiary machine is constructed of welded 4130 Moly chrome tube designed for operator convenience. The electric motor and gearbox are installed in the main frame on the bottom plate. The geneva mechanism and gears are mounted underneath the top plate. Turntable, injector drive bracket, axial cam and injector in bracket are above the top plate. The glycol tank and operator's control box are mounted on the rear of the frame.

II - 1.2 The incendiary machine is mounted on a subframe with quick

release pitt pins. The subframe also has mounting points for a steel cabinet to store incendiaries.

In the Britten Norman Islander 3564 capsules can be carried.

In the Partenavia P68B, 3200 capsules can be carried.

II - 1.3 Mode of Operation

A 24-28 volt D.C. motor is connected by belt drive to a worm gear speed reducer to obtain a final drive speed of 10 to 55 r.p.m.

The power take-off shaft from the gearbox is directly coupled to the axial cam to continuously control the injector mechanism. The cam has five different functions to perform during each rotation, they are: dwell, pierce, inject, dwell and strip, for each cycle. During part of the dwell period at the beginning of each cycle, the geneva mechanism is activated and rotates the turntable holding the capsules in position.

While the turntable is stationary, the cam activates the injector pump to pierce the capsule top, then injects 1.3 ml of glycol, dwells for 10^0 , then strips or removes the needles from the cap. As soon as the needles return to their original "up" position, the turntable is again moved by the action of the geneva cam. The primed capsule then moves one position and is ejected from the aircraft.

The incendiary capsules are fed by hand from a storage tray into the turntable on the machine, where they are automatically injected and ejected when the machine is in operation.

II - 1.4 Specifications for the WAM '82 Manual Loading Incendiary Machine and Incendiary Capsule

Incendiary Machine

Main frame mass, glycol tank empty	47 kg
Glycol tank full, capacity 6.7 litres	55 kg
Overall dimensions, length	51 cm
height	70 cm
width	35 cm

Subframe Assembly

	Britten Norman Islander	Partenavia
Mass	3.75 kg	1.9 kg
Overall dimensions, length	84 cm	40 cm
height	21 cm	21 cm
width	30 cm	35 cm

Incendiary Storage Cabinet

	Britten Norman Islander	Partenavia
Mass, empty	37 kg	32 kg
Mass, fully loaded	73 kg	57 kg
Contents, 11 trays @ 324 each number of incendiaries	3564	3240
Overall dimensions, depth	43 cm	43 cm
height	76 cm	56 cm
width	44 cm	44 cm

Incendiary Capsule

Container:

Size: 38 mm x 21 mm diameter
Material: Styrene acrylan nitrol
Mass: (Empty) 2.52 gms

Cap:

Size: 11.5 mm x 21 mm diameter
Material: Low density virgin polythene
Mass: 1.31 gms

Contents:

Material: Potassium permanganate KMnO_4
Mass: 4.0 ± 0.5 gms

Mass Total: 7.83 ± 0.5 gms

Size Total: 45 mm x 21 mm diameter.

Reagent

Mass: $1.3 \text{ gms} \pm 0.2 \text{ gms}$
Material: Mono ethylene glycol $\text{C}_2\text{H}_6\text{O}_2$.

III - 1.0 PREPARATION OF AIRCRAFT FOR FITTING OF INCENDIARY MACHINE

Before installing the incendiary system in the aircraft:

- (1) A 32 mm hole must be cut in the aircraft floor to accommodate the dropping tube. Positions differ for each type of aircraft. See Appendix 1 for details of hole location.
- (2) Two power outlets and circuit breakers must be installed, to provide 28 volt D.C. power for the incendiary machine, air-to-ground radios and aircrew intercom.
- (3) Suitable radio aerial and coaxial cable must be installed for the air-to-ground radio.
- (4) Suitable approved base frames must be constructed to locate the equipment securely in the aircraft. See Appendix 2 for details of approved bases available.

Note: All installations and modifications to the aircraft must be designed by a suitably qualified aircraft engineer and approved and inspected by the Department of Aviation, Airworthiness Section, before commencement.

All work to be carried out by suitably qualified and approved personnel according to the task required.

III - 2.0 INSTALLATION OF INCENDIARY MACHINE

The injection machine is approved for operation:

- (i) behind the left-hand pilot seat in a Britten Norman Islander BN 2A aircraft
- (ii) behind the right-hand co-pilot seat in the Partenavia P68B aircraft.

2.1 Installation Procedure for Islander and Partenavia

- (1) With the exception of the front pilot and rear passenger seats, all remaining seats are removed from the aircraft.
- (2) Existing carpet is taken out and the cover plate on the incendiary dropping hole removed. Carpet for incendiary operations is installed.
- (3) The dropping tube is fitted in place to prevent accidental rotation in flight.
- (4) The incendiary base frame is installed, fastened securely and locked in position.
- (5) The incendiary machine is lifted onto the base frame and dropping tube. Secure machine to base frame with pitt pins.
- (6) The incendiary storage cabinet is positioned onto base frame and secured with pitt pins.
- (7) Electrical connections are fitted in place.
- (8) Radios, air-to-ground and aircrew intercom are fitted to suit most convenient and accessible location.

CAUTION

Check that the ejection tube is clear, properly aligned, straight and free from any protrusions or obstructions which could catch a capsule.

III - 3.0 PRE-FLIGHT CHECK

A pre-flight check and test of the installed system must be conducted to ensure system performance and pilot familiarity. Problems encountered must be remedied prior to take-off.

The pre-flight check is conducted as follows:

- (1) Glycol tank FILLED and sufficient.
- (2) Capsule load SUFFICIENT for intended operation.
- (3) Hand extinguishers FULL and CHARGED.
- (4) Ejection tube is CLEAR and CLEAN.
- (5) Turntable is FREE-RUNNING when release pin is pulled - ensure proper ALIGNMENT.
- (6) Power supply cable is CONNECTED.

Circuit breakers - IN
Switches - OFF
Remote switch, if fitted - ON.
- (7) Glycol tap TURN ON.
- (8) Injector syringe PRIMED and moves FREELY (no undue force required to rotate), place one empty capsule under injector, pull release pine on cam and use manual override to inject.
- (9) Check QUANTITY of glycol injected is sufficient (1.3 mls per injection). Repeat hand prime procedure 5 times into a single empty capsule for accurate measurement.

III - 4.0 PRE-FLIGHT TEST**CAUTION**

Ignition will be achieved during this test. A container to catch and remove the primed capsules from the vicinity of the aircraft must be provided.

Do not conduct this test during fuelling operations or where spilled fuels or other fuels or combustible materials can be ignited.

- (1) Advise pilot ready for ground "PRE-FLIGHT TEST", require aircraft master switch ON.
- (2) Load two empty capsules, followed by two filled capsules in turntable. Load turntable by lifting release pin and rotating turntable by hand until the capsule is under the injector.
- (3) Place metal container under aircraft drop tube to catch capsules.
- (4) On Control Panel:
 - Power switch - ON
 - Motor switch - ON
 - Speed control to - LOW
 - Start button - PRESS.
- (5) Machine will now operate. Switch OFF after last capsule has been injected.
 - Motor switch - OFF
 - Power switch - OFF.
- (6) Turn glycol tap - OFF.

Incendiary machine has now been checked and tested and is ready for operation.

III - 5.0 IN-FLIGHT OPERATION

CAUTION

Preparation and loading of the incendiary machine should only take place after the target area has been positively identified from ground terrain features.

III - 5.1 Starting for Continuous Operation

- (1) Reset capsule counter to ZERO.
- (2) LOAD turntable with capsules by lifting release pin, rotate by hand.
- (3) Turn glycol tap ON.
- (4) Adjust speed control to desired EJECTION rate.
- (5) Power switch - ON.
- (6) Motor switch - ON.
- (7) "Commence by pressing start button.
- (8) Continue loading turntable.
- (9) Adjust speed control as required.

III - 5.2 Stopping

- (1) Motor switch - OFF.
- (2) Power switch - ON.
- (3) Turn glycol tap - OFF.
- (4) Unload turntable by lifting release pin and remove and return unprimed capsules to storage cabinet.

III - 5.3 Starting - For Single Shot Operation

- (1) Reset capsule counter to ZERO.
- (2) LOAD turntable with capsules.

- (3) Turn glycol tap - ON.
- (4) Power switch - ON.
- (5) Depress start button as capsules are required.

When burning is completed, the following procedure applies:

III - 5.4 Stopping

- (1) Power switch - OFF.
- (2) Turn glycol tap - OFF.
- (3) Unload turntable and remove unprimed capsules, return to storage trays.

III - 6.0 SAFETY DEVICES

Safety devices are fitted so as to prevent fire in the aircraft. Whenever the machine is switch off, the machine speeds up, continues to the end of its cycle and ejects any primed capsule.

If there is a power failure with a capsule already primed and with the needles jammed in a capsule, the capsule can be freed by pulling the release pin on the injector cam and turning the handwheel in an anti-clockwise direction until the syringe needles are clear. The turntable can now be moved to clear the primed capsule by lifting the release pin and rotating the turntable until the capsule falls into the dropping tube.

III - 7.0 IN EMERGENCY

Apparent power failure:

- (1) Switch motor switch - OFF.
- (2) LIFT release pin on injector cam - turn handwheel anti-clockwise until needles clear of capsule.
- (3) LIFT release pin on turntable - turn in a clockwise direction to allow capsule to fall into dropping tube.

In Case of Fire

- (1) Motor switch - OFF.
- (2) Power switch - OFF.
- (3) Direct hand extinguisher on seat of fire.

III - 8.0 MAINTENANCEIII - 8.1 Daily

Maintenance following daily operation:

After each day's burning operations, the machine should be thoroughly cleaned.

III - 8.2 Weekly

- (1) Lightly oil the following parts with Selley RP7 or similar lubricant:
 - Axial cam and following roller on injector.
 - Brass follower on the injector syringe.
 - Slideways on geneva cam and roller on the geneva arm.
 - Mating gear surfaces.
- (2) Remove injector then clean underneath the turntable to remove any residuals.
- (3) Clean ejection tube with wire brush to remove any residuals
- (4) Service and clean injector as required.

III - 8.3 Servicing the Injector

Note: Turntable release pin must be clear of injector before starting disassembly procedure.

- (1) Remove 4 socket head cap screws bolting injector mounting bracket to injector drive bracket.
- (2) Slide complete injector in mounting bracket out to the right. Note: Ensure that needles clear turntable. If the needles contact turntable, lift release pin on turntable and

shift turntable as required to clear.

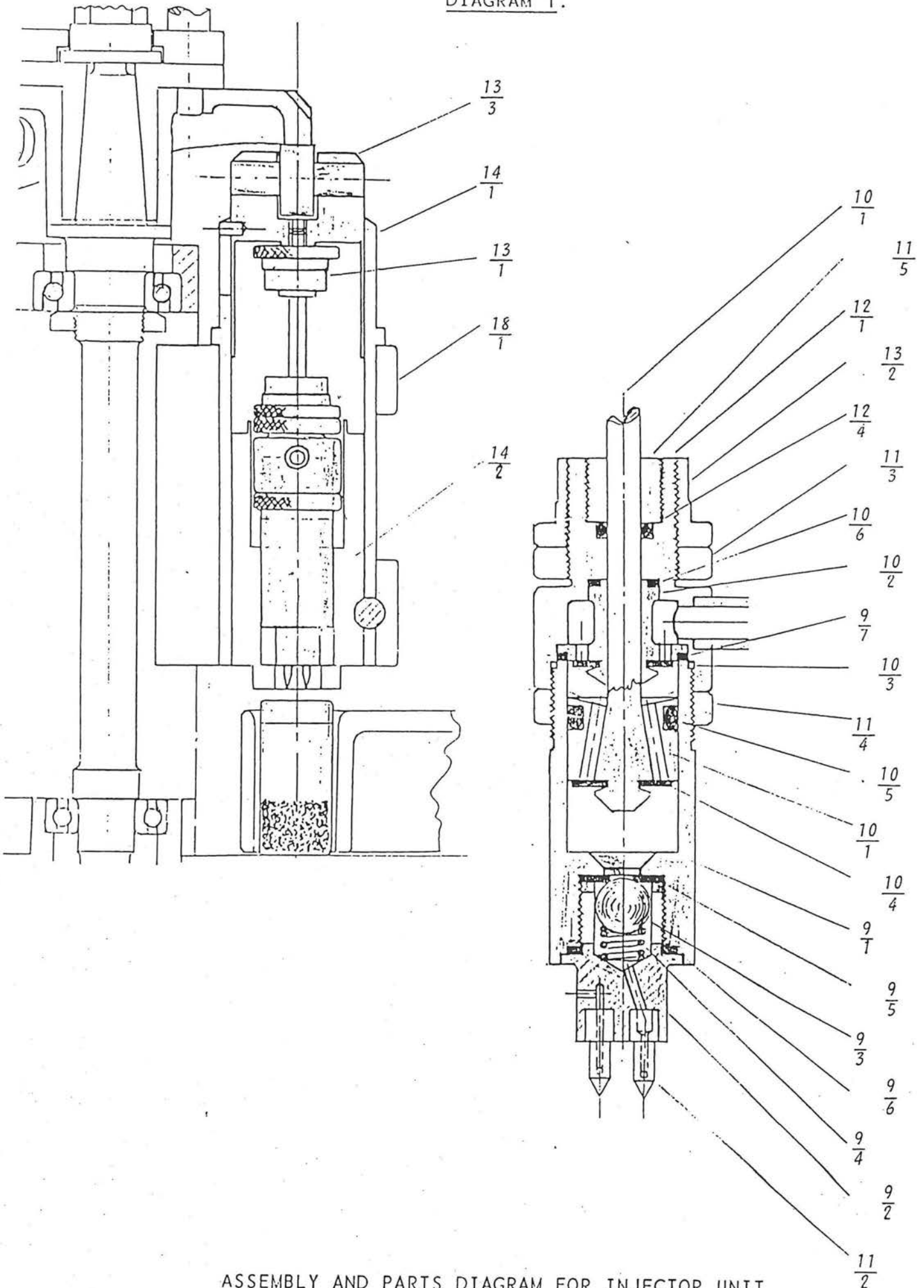
- (3) Remove socket head cap screw (8 mm), clamping injector in bracket.
- (4) Remove grub screw from brass slide follower to stop parts rotating.
- (5) Turn injector inlet pipe through 90° to the left - slide whole assembly down and out through slot in base.
- (6) Remove brass slide follower by unscrewing from piston shaft.
- (7) Remove large outer spring.
- (8) Remove top spring nut by unscrewing from piston shaft.
- (9) Remove small spring.

Inspect and replace washers and 'O' rings as necessary to maintain a perfect seal.

See Diagram on following page for location of washers and 'O' rings.

- (10) To reassemble, reverse procedure.

DIAGRAM 1.



ASSEMBLY AND PARTS DIAGRAM FOR INJECTOR UNIT

III - 8.4 Servicing the Turntable

- (1) First remove injector, leave attached to glycol supply hose.
- (2) Remove turntable by holding firmly, use an open end spanner, turn centre nut anti-clockwise. Considerable force is required initially to break the seal. This action frees the driving sleeve from the drive spindle.
- (3) Lift off the turntable and thoroughly clean both turntable and the platform underneath. Glycol has an extremely corrosive effect on aluminium.
- (4) Clean centre core and grease lightly before reassembly.

To Reassemble

- (1) Place the turntable over the shaft and slide the driving sleeve into the turntable and over the spindle.
- (2) Load an empty capsule in one of the stations in the turntable and rotate clockwise until it is directly underneath and aligned with the centre of the injection position.

Note: As the stations in the turntable are of greater diameter than the capsules, the capsules will be dragged back to the trailing side of the stations by the rotation of the turntable. Therefore, it is the capsule, not the station, which must be aligned with the syringe.

- (3) When the turntable is correctly positioned, replace the centre locknut and tighten securely.
- (4) Slide syringe assembly back into position and replace four socket head cap screws.
- (5) Prime syringe to expel all air, until only glycol is ejected.

III - 8.5 Retiming Injection Syringe Operation

Axial cam position and geneva arm position to be aligned as shown. Cam position 0° - geneva arm just leaving slideways.

- (1) Turn drive belt by hand in the direction shown on gearbox pulley until the pawl on the geneva arm is just leaving the slideways of the geneva cam.
- (2) Release the nut holding the driving sleeve from the drive spindle on the axial cam, moving the cam until the timing mark on the cam lines up with the mark on the injector bracket. Check pawl position and retighten nut.
- (3) Check position of microswitch cam under turntable until properly aligned. Make minute adjustments and retighten until the required stopping position is reached.
- (4) Release the nut holding driving sleeve on the turntable and reposition until injector and turntable position line up.

PART IVINCENDIARY MACHINE ELECTRONICSELECTRICAL CONTROLSIV - 1.0 GENERAL

All the electrical controls and equipment for operating the machine are contained in a detachable aluminium box. The unit operates from an aircraft's supply of 24 volts (nominal) D.C. supply, negative earth only.

(1) Mechanical Design

The aluminium box has a removable rear panel and a hinged front panel for access to components for ease of field repairs.

The main control board is a plug-in unit, and the front panel has been designed with operator convenience and safety in mind.

(2) Circuit Design

The control board controls motor speed by feeding the field winding with pulses of constant voltage but variable width. Motor stop/start function utilizes a silicon controlled rectifier, which ensures the machine stops in the safe 'rest' position.

IV - 1.1 Control Plugs

The control box has power and remote connection plugs located at the rear, whilst the power output to the motor and accessories is located underneath

(1) Local Controls

The Front Panel

Controls and Indicators are:

- a. Fire ext. switch
(optional)
- b. Fire ext. circuit fuse
(optional)
- c. Glycol pump circuit fuse
(optional)
- d. Glycol pump switch
(optional)
- e. Power light (red) on
- f. Motor light (green) on
- g. Motor speed control
(with drop rate indicator)
- h. Motor on switch
- i. Motor start button
- j. Power on switch.

Diagram.

(2) Connections

Socket connection for accessories and power are provided at the rear:

- a. Locking 6 pin cannon for a motor control and start button
- b. Locking 3 pin cannon for motor on/off control
- c. Locking 3 pin cannon for power input

Socket connection for power out to motor and accessories provided underneath:

- a. Locking 4 pin cannon for motor power
- b. Locking 7 pin cannon for cam switch, fire and glycol pump.

(3) Remote Control

- a. A remote safety switch is provided which stops the machine at its correct rest position.
This switch must be on for the machine to operate from its local controls.
- b. Stop/start and motor speed controls where necessary, can be fitted into a remote control box.

IV - 2.0 GENERAL TECHNICAL DATA

Operating voltage	_____	20 to 30 volts DC
Current consumption		
Start	_____	25 Amps
Run	_____	6 Amps
Polarity	_____	Negative Earth only
Dimensions		
Control box	_____	150 mm Deep
		340 mm High
		110 mm Wide
Remote Control Box	_____	60 mm Deep
		110 mm High
		32 mm Wide

IV - 3.0 CIRCUIT DESCRIPTIONIV - 3.1 Motor Speed Control Board

IC1 together with IC2 form a triangular wave generator, the output of which is fed into the non-inverting input of voltage comparator IC3. The inverting input of IC3 is connected to a voltage divider consisting of RV1, R6, RV3, RV2 and R7. By means of RV3 (speed control) the voltage can be adjusted between the upper and lower levels set by RV1 and RV2. The output of IC3 is a square wave with constant amplitude but a mark space ratio which varies with the setting of RV3.

The output of IC3 is buffered by emitter follower TR1, which drives driver transistor TR2, which drives output darlington device. Resistors RA limit current on turn on and heavy load.

IV - 4.0 OPERATION

Power switch SW1, motor switch SW3 and motor aux. control switch SW6 are placed in the on position. PB1 is then pressed, which triggers SCR1 on energizing RL1 and as long as current flows, SC1 will remain on. When RL1 energized, contacts CN1, CN2 are closed, CN3 are opened. Voltage is then supplied to the motor via MJ10100 and RA.

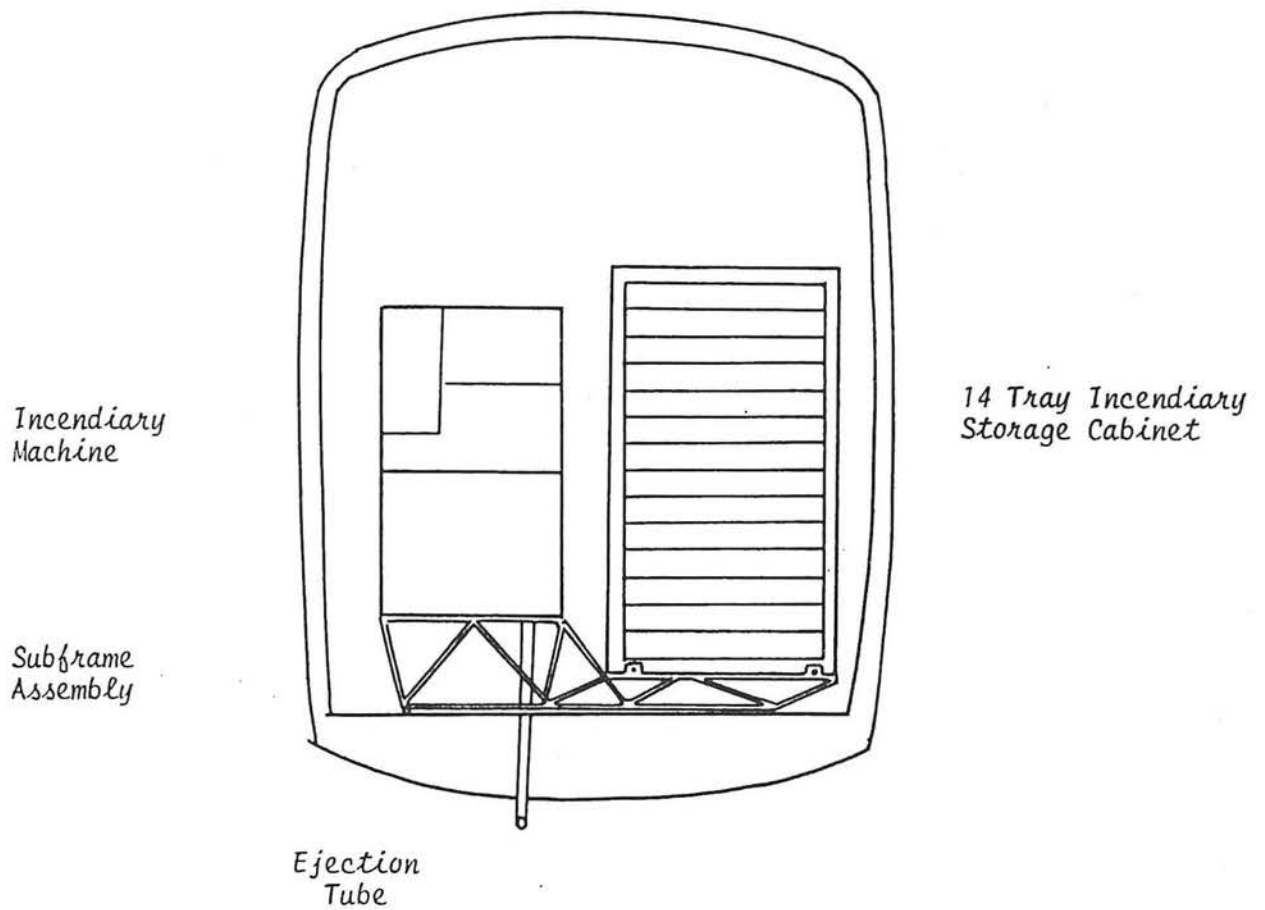
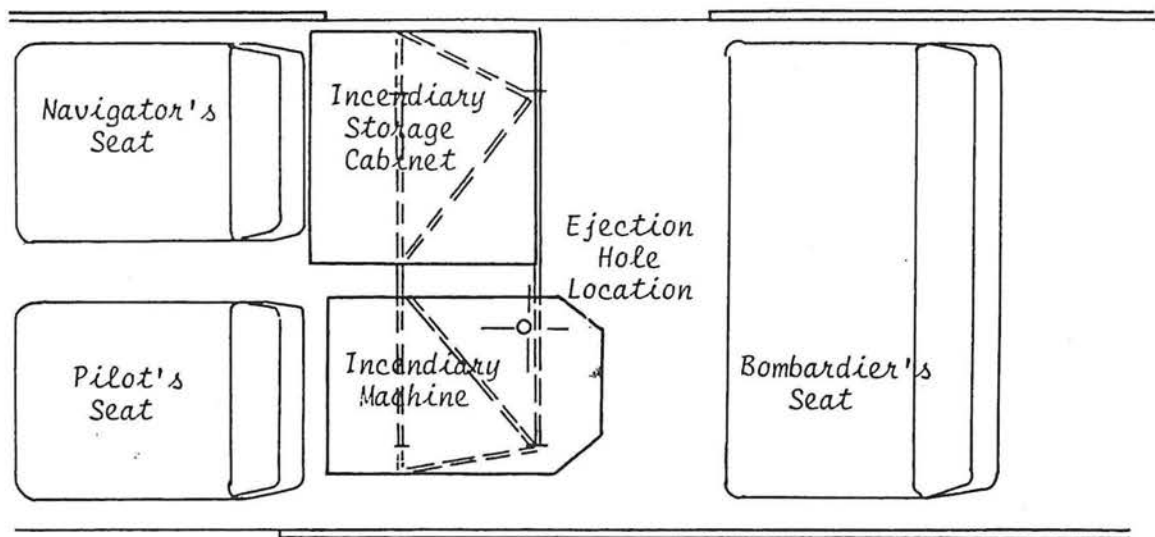
Switch Off

This is done by placing SW3 (or SW6) in the off position, which places SW2 in circuit and on reaching the null point on the cam, SW2 switches the motor off. When this happens, the last capsule that has been injected is dropped out of the machine. The main power switch SW1, can now be turned off.

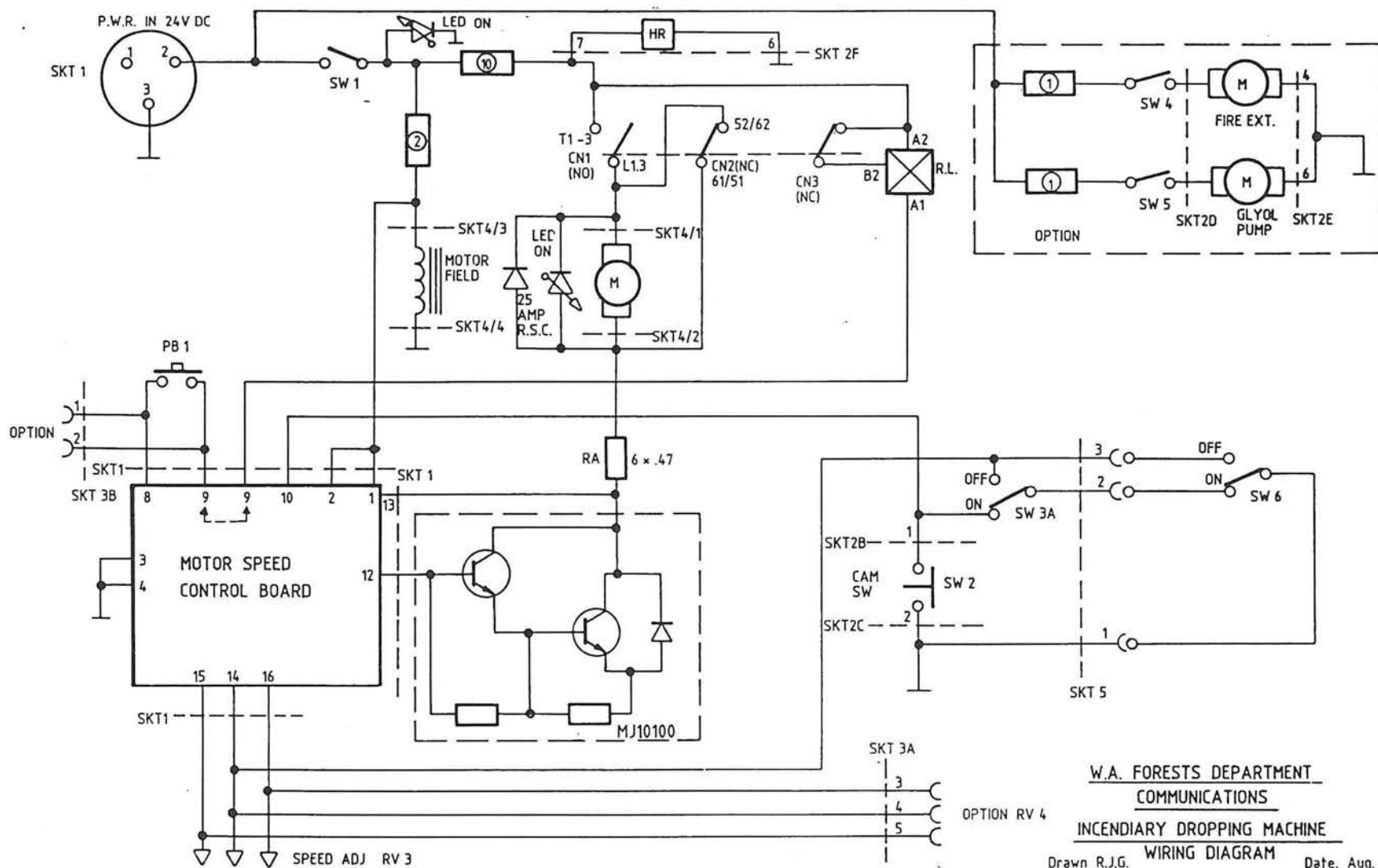
When SW3 or SW6 is switched off, the motor runs at full speed to eject the last capsule quickly.

Single shot operation can be achieved by this machine by switching on SW1 only and pressing PB1. This will activate the machine for one cycle of operation and switch off, due to cam SW2.

APPENDIX 1A



BRITTEN NORMAN ISLANDER BN2A AIRCRAFT INSTALLATION



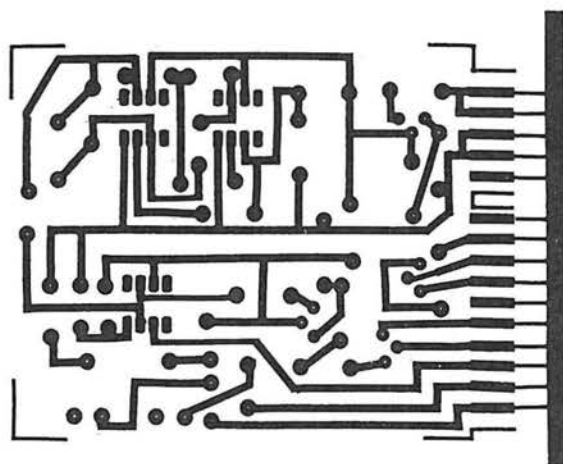
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 INCENDIARY DROPPING MACHINE
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W.A. FORESTS DEPARTMENT
COMMUNICATIONS
INCENDIARY DROPPING MACHINE
MOTOR SPEED CONTROL -BOARD DIAGRAM

Drawn R.J.G.

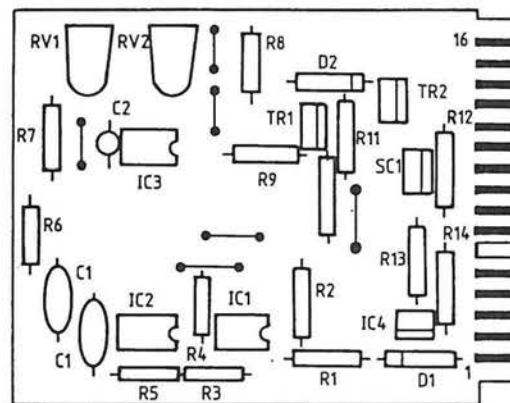
Date. Aug. 1982



MOTOR SPEED CONTROL BOARD
PRINTED CIRCUIT DIAGRAM

SOLDER SIDE

Drawn R.J.G. Date: Aug. 1982



MOTOR SPEED CONTROL BOARD

COMPONENT LAYOUT

Drawn R.J.G.

Date Aug. 1982