NAVAL AIR TRAINING COMMAND

IGNITION SYSTEM, HEATING AND VENTILATION SYSTEM

NATIP SYSTEM UNIT

UC 09 03 03 07 ER

CNAT P-1020 (Rev.1-82) PAT

T-28 ENGINEERING PRIMARY

1982

NAVAL AIR STATION · CORPUS CHRISTI, TEXAS

CHIEF OF NAVAL AIR TRAINING
NAVAL AIR STATION
CORPUS CHRISTI, TEXAS 78419

Code 313

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1. CNAT P-1020 (Rev. 1-82) PAT, "Ignition system, Heating and Ventilation System,NATIP System Unit UC 09 03 03 07 ER, T-28 Engineering, Primary," is promulgated for information, standardization of instruction and guidance of instructors and students in the Naval Air training Command.

2. This publication will be used to implement the academic portion of the Primary curriculum.

3. Recommendations for changes shall be submitted to the Commander, Training Air Wing FOUR.

4. CNAT P-1008 (Rev. 11-76) PAT is hereby canceled and superseded.

Joe L Shaw

J. L. SHAW
Assistant Chief of Staff for
Training and Operations

Distribution:
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NAVAL AIR TRAINING COMMAND

PRIMARY PHASE

DISCIPLINE: Engineering

COURSE TITLE: Engineering, T-28 (Primary)

UNIT: Ignition System, Heating and Ventilation System, NATIP System Unit

PREREQUISITE: Units 1 through 6

FOR INSTRUCTIONAL PURPOSES ONLY

SCOPE: The purpose of this unit is to familiarize the student with the operation of the ignition system, its components and their function and to show schematically the T-28 heating and ventilation system, its operation and limitations.

SPECIFIC INSTRUCTIONAL OBJECTIVES

Affective Domain

To afford the student an opportunity to consider the ignition system and to direct his attention to the components of the system, their function, interrelationship, and construction. In addition, to provide a schematic illustration of the heating and ventilation system and direct attention to system use, operation, limits, automatic safety features (Valuing).

Cognitive Domain

Upon completion of this unit of instruction, the student will:

1. State the kind of ignition system used on the T-28 and the voltage produced (Comprehension).
2. Explain the operation of the induction vibrator (Analysis).
3. State the purpose of the insulation of the ignition harness (Comprehension).
4. State the engine r.p.m. required for the magnetos to produce ignition (Comprehension).
5. Recall power source for the heater and how it controls heater operation (Knowledge).
6. State the requisite conditions for heater operation (Comprehension).
7. Describe the purpose of: (Synthesis).
   a. High limit thermoswitch
   b. Overheat thermoswitch
8. State the operation of the cockpit air control handle (Comprehension).

Psychomotor Domain

None.

INSTRUCTIONAL MATERIALS

The instructor in charge must ensure that the following instructional materials are provided:

1. NATOPS Flight Manual

2. Engine Cutaway - R-1820 with Magnetos.

When the materials listed above have been assembled, the student will proceed in accordance with the following directions:

DIRECTIONS TO STUDENT

STEP 1 Study pages 1-32, 1-33, and 1-34, 1-35 in NATOPS Flight Manual.

STEP 2 Complete the programed text. Upon completion, review prior to commencing the criterion test.

STEP 3 Take the unit criterion test.

STEP 4 End of this unit. Remedial session prescribed if necessary.

PROGRAM PERFORMANCE VALIDATION RECORD

This instructional sequence was introduced at NAS Whiting Field on 6 May 1971. The achievements of 100 students completing the program are shown in the table below.

N	MEAN CRITERION TEST SCORE (PRE-UNIT)	PERCENT CORRECT	MEAN CRITERION TEST SCORE (POST UNIT)	PERCENT CORRECT	ESTABLISHED ERROR RATE

Percent of students obtaining 85% or better -- 93%.
This unit is designed to be completed within 25 minutes.

The learning time required for this unit was established as follows:

MINIMUM LEARNING TIME REQUIRED	LEARNING TIME REQUIRED BY 80% OF THE POPULATION	MAXIMUM LEARNING TIME REQUIRED
min.	min.	min.

Reverse Blank

THE IGNITION, HEATING AND VENTILATING SYSTEMS

IGNITION

FRAME 1

The ignition system of the T-28 consists of two magnetos, an ignition switch in the front cockpit with a mechanical linkage to the switch in the rear cockpit, an induction vibrator, shielded ignition harness, and 18 ceramic-type spark plugs. It is a high-tension system in that high voltage is used throughout. (See figure 1, page 6.)

The T-28 ignition system consists of _____ magnetos, and is considered a _____ - _____ system.

---

two ... high-tension

FRAME 2

Two interchangeable magnetos are mounted on the engine accessory section. They provide dual ignition to the engine for safety and more efficient operation, because the fuel-air mixture is ignited at two points in the cylinder. The right magneto fires the front spark plugs, and the left magneto fires the rear spark plugs. The magnetos are timed to fire the spark plugs simultaneously in each cylinder at 20 degrees before top dead center, and at approximately 30,000 volts.

The right magneto fires the _____ set of spark plugs, and the magnetos are timed to fire _____ degrees before top dead center.

---

front ... 20

FRAME 3

A conventional ignition switch is located on the right instrument subpanel in both cockpits. It is a 4-position switch, OFF, L, R, and BOTH. Think of the switch as a selector switch. When placed in the R-position, the right magneto is selected to fire the front bank of spark plugs. When placed in the L-position, the left magneto is selected to fire the rear bank of spark plugs. With the switch in the OFF position, neither magneto is connected, and in the BOTH position, both banks of spark plugs are selected to fire. The BOTH position is utilized for starting and all normal operations.

With the magneto switch in the L-position, only the _____ magneto and the _____ set of spark plugs are selected to fire.

left ... rear

FRAME 4

A vibrator coil (induction vibrator) is incorporated into the ignition system to provide voltage for starting only. With the starter button depressed, the vibrator coil provides current to the right magneto which distributes the energy to the front set of spark plugs. When the magneto breaker points open, pulsating d.c. from the induction vibrator is applied to the primary winding of the magneto causing a retarded spark.

Voltage for starting purposes is provided by the _____ _____ and is distributed to the _____ set of spark plugs.

---

induction vibrator ... front

FRAME 5

The induction vibrator is energized when the starter button is depressed and de-energized when the starter button is released. The ignition switch is placed in the BOTH position to enable the induction vibrator to supply voltage to the spark plugs for start. The magnetos begin producing ignition voltage at approximately 350 r.p.m. to both sets of spark plugs.

The induction vibrator is actuated when the starter button is _____ and the magneto switch is _____ _____.

---

depressed ... on BOTH

FRAME 6

The ignition harness is comprised of high-tension stainless steel leads and metal conduit. This conduit is airtight to minimize voltage loss at high altitudes. The ignition leads are shielded to prevent radio interference.

The leads are shielded to prevent _____ _____, and a portion of this harness is airtight, to minimize voltage _____ at high altitudes.

---

radio interference ... loss

IGNITION SUMMARY

1. The T-28 is equipped with a dual magneto system.

2. The use of a dual ignition system serves three purposes:
   a. Increase-in-safety factor.
   b. Increase in engine output.
   c. Engine performance and economy are enhanced because the fuel-air mixture is ignited at two points in the cylinder, ensuring a rapid and complete combustion cycle. (See figure 1.)

3. To facilitate engine starts, an induction vibrator is used to provide a boosted current to the right magneto and front bank of spark plugs.

HEATING AND VENTILATION

FRAME 7

The cockpit air handle controls airflow into the cockpit and has three positions--OPEN, CLOSED, and EMERG. OFF. Air for heating, defrosting, and ventilating is obtained from an opening within the oil cooler duct. The air then passes around the heater chamber and is distributed throughout the heating and ventilating ducts. Ram-air pressure causes the circulation, forcing air into the cockpit. The same ducting is used for heating and ventilation. The combustion chamber burns fuel taken from the D-chamber of the carburetor mixed with air entering from the left wing root duct.

Ram-air pressure from an opening in the _____-_____ _____ causes circulation through the cockpit. Fuel for heater combustion is taken from the _____.

---

oil-cooler duct ... carburetor

FRAME 8

The heater in this airplane is a combustion type and has a rating at sea level of 100,000 British thermal units (B.t.u.'s). The heater is located beneath the front cockpit floor on the left side of the airplane, just aft of the firewall, and is mounted horizontally. (See figure 2, page 7.)

The _____-type heater, rated at _____ B.t.u.'s at sea level is located below the _____ cockpit floor on the left side, just aft of the firewall.

---

combustion ... 100,000 ... front

FRAME 9

The control for heating is located in the front cockpit only, just forward of the throttle quadrant. To start the heater, the COCKPIT AIR CONTROL handle must be in any position other than EMERG. OFF, and the COCKPIT HEATER CONTROL handle must be in the ON position. Heat output is increased by turning the COCKPIT HEATER CONTROL handle clockwise. The heater is automatically cut off anytime the COCKPIT AIR CONTROL handle is placed in the EMERG. OFF position.

The heater control is located only in the _____ cockpit, and the heat may be increased by rotating the COCKPIT HEATER CONTROL handle _____ to increase the cycle of fuel to the combustion chamber.

---

front ... clockwise

FRAME 10

The d.c. electrical power from the monitored bus will automatically cycle the fuel as well as ignite it within the heater to maintain a temperature as set by the COCKPIT HEATER CONTROL. Should the heater overheat, the heater electrical circuits and fuel supply will be turned off automatically.

The electrical power for heater operation comes from the _____ bus.

---

monitored

FRAME 11

Fuel for combustion in the heater comes from the D-chamber of the carburetor. At least 19 p.s.i. of fuel pressure is required for operation.

With a generator failure in flight, what is the status of further heater operation?

It will not function, because the monitored bus is lost with a generator failure.

FRAME 12

As an additional safety feature, a ram-air pressure switch is installed to prevent combustion before adequate airflow can enter the combustion chamber. Approximately 1300 r.p.m. are needed to close the ram-air pressure switch for combustion. If the blast air pressure falls below that produced by 1000 r.p.m., the circuit is opened and ignition ceases, causing the heater to shutoff. The inlet for the ram-air pressure switch is located in the left wing root.

The _____ - _____ _____ switch closes at 1300 r.p.m., permitting heater operation. The ram-air pressure inlet is located in the _____ _____ _____.

---

ram-air pressure ... left wing root

FRAME 13

The heater cycling is controlled by the cockpit heater cycling thermoswitch, which turns the heater off at 110° F. The heater high-limit thermoswitch is provided as a backup for the cycling thermoswitch, and is set to turn the heater off at 300° F. Then as a final safety feature, the overheat thermoswitch will turn the heater off at 375° F. Once the overheat thermoswitch opens in flight, heater operation is lost.

The cockpit heater cycling thermoswitch turns the heater off at _____° F. The _____ - _____ _____ backs up the cycling thermoswitch, and turns the heater off at _____° F.

110° F. ... high-limit thermoswitch ... 300° F.

HEATING AND VENTILATING SUMMARY

1. The d.c. electrical power required for heater operation is taken from the monitored bus.

2. Fuel for combustion in the heater is taken from the carburetor.

3. To start the heater, the following steps must be followed:
   a. The COCKPIT AIR CONTROL must be in any position other than EMERG. OFF.
   b. Turn the COCKPIT HEATER CONTROL to the ON position.
   c. The ram-air pressure switch must be closed.
   d. The monitored bus must be energized.

4. If the heater overheat thermoswitch is actuated, heater operation in flight is lost.

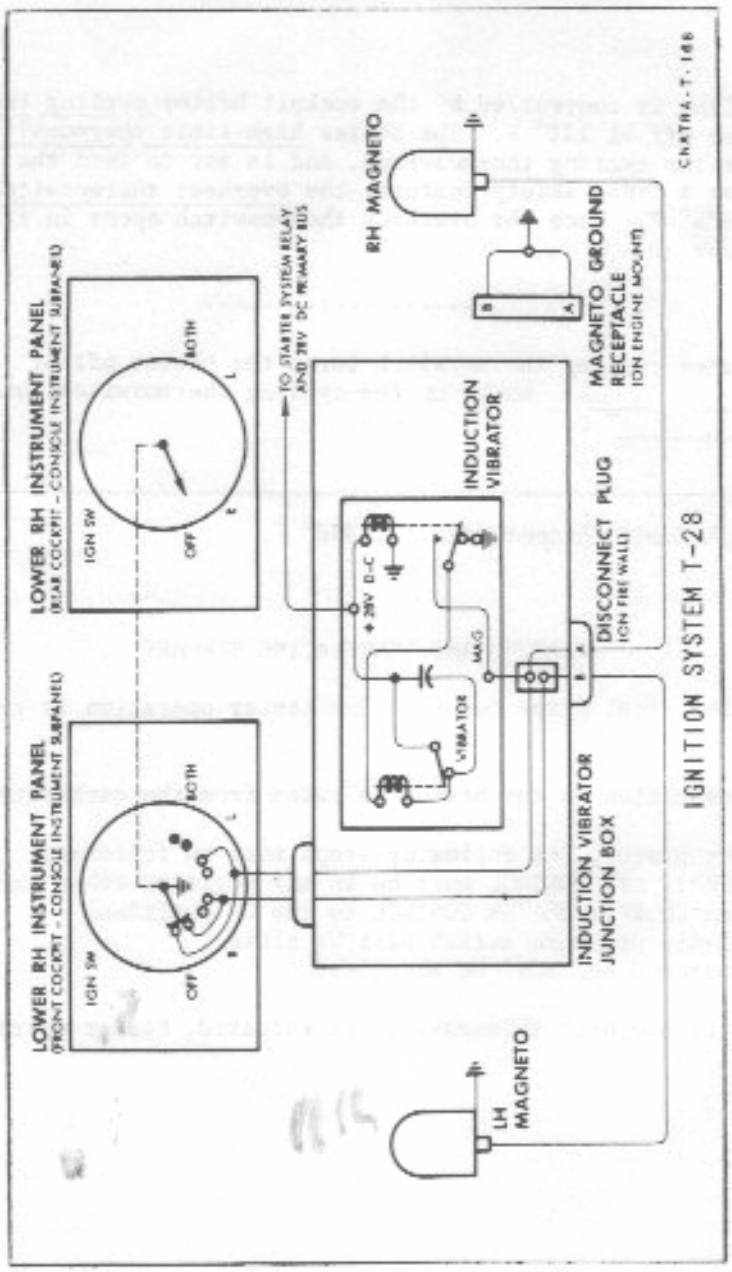
IGNITION SYSTEM T-28
LOWER RH INSTRUMENT PANEL
(REAR COCKPIT - CONSOLE INSTRUMENT SUBPANEL)
LOWER RH INSTRUMENT PANEL
(FRONT COCKPIT - CONSOLE INSTRUMENT SUBPANEL)
IGN SW
OFF
BOTH
TO STARTER SYSTEM RELAY AND 28V DC PRIMARY BUS
INDUCTION VIBRATOR
+28V D-C
MAG
VIBRATOR
INDUCTION VIBRATOR JUNCTION BOX
DISCONNECT PLUG
(ON FIRE WALL)
RH MAGNETO
LH MAGNETO
MAGNETO GROUND RECEPTACLE
(ON ENGINE MOUNT)
CHATRA-T-166

FIGURE 1

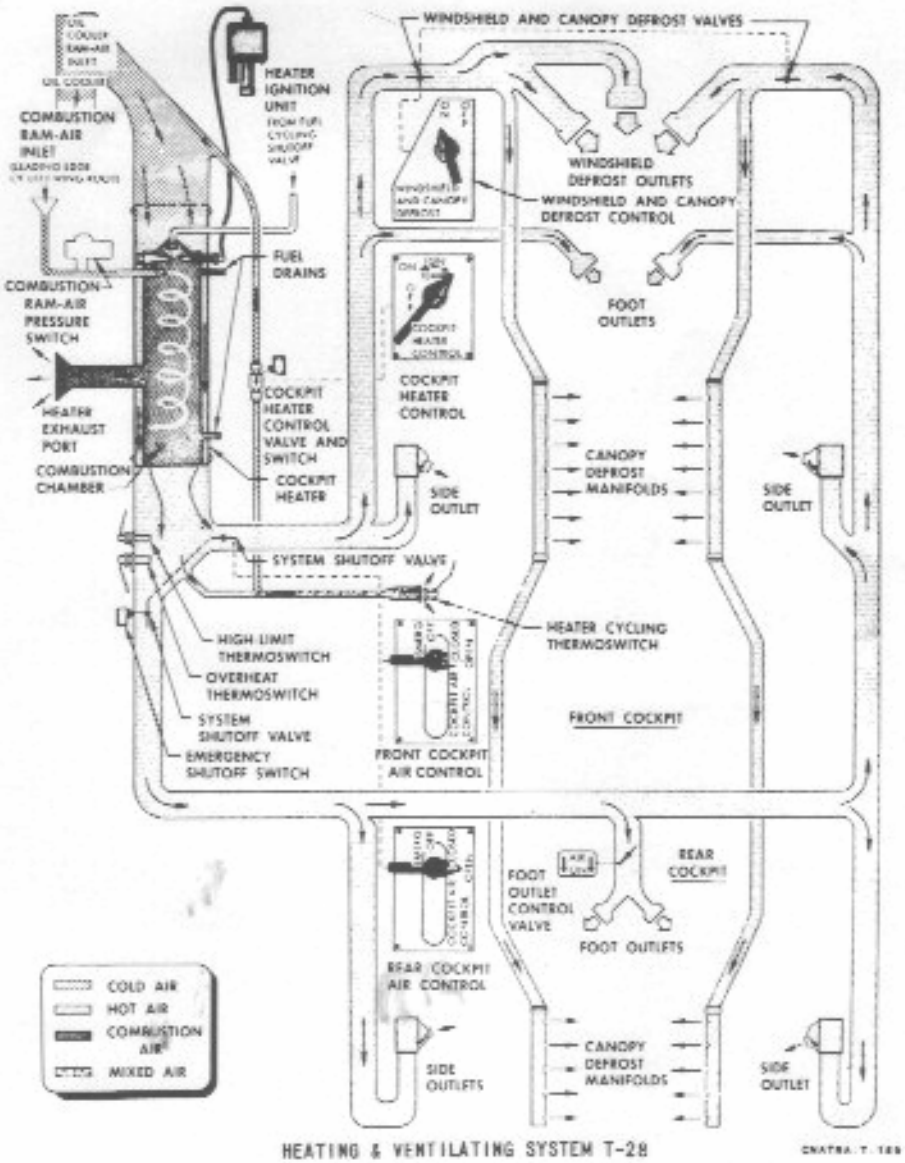

FIGURE 2

Reverse blank