AEROPLANE AND ARMAMENT EXPERIMENTAL ESTABLISHMENT

BOSCOMBE DOWN

Kittyhawk II F.L.220
(Merlin V1650-1)

Cabin heating tests.

A.& A.E.E. ref:- 4484/1 - A.S.76/4.
M.A.P. ref:- R.A.1871/D.A.N.A.1.
Date of tests:- 13th September, 1942.

Progress of issue of report

Report No.	Title
2nd Part of A.& A.E.E./783,a.	F.L. 220 - Flame damping trials with short stub exhaust flame dampers.
3rd do	F.L. 220 - Carbon monoxide contamination tests
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5th do	F.L. 220 - Engine cooling trials.
6th do	F.L. 220 - Radio trials - Communication sets.

SUMMARY.

Introduction.

Tests were made to determine the performance of the Cabin heating system on this aeroplane.

Scope of Tests.

Temperatures were observed every 5,000 ft during a climb to 31,000 ft. with all heat turned on. The aeroplane was then flown level at maximum power for economical cruising in weak mixture and temperatures were recorded every 2 minutes until they had stabilized.

Conclusions.

The Cabin temperatures recorded at the various positions with the exception of the pilot's hands comply with A.D.M.498 Specification, although the pilot reported that during the test he found the cabin warm and free from draughts. Nevertheless it is considered that if the hot air duct entries could be modified by extending these up to the engine radiator, temperatures would be improved.

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1. Introduction.

1.1. Tests were required to determine the performance of the cabin heating system. The aeroplane was fitted with a Packard built Rolls-Royce Merlin Engine and the tests were made on September 13th, 1942.

2. Description of heating system.

2.1. Heated air was taken from behind the engine coolant and oil radiators, which then passed into the main ducts, situated on the port and starboard side of the fuselage, just aft of the engine.

2.2. The entries to the main ducts were attached to radiator air exit duct. That on the port side was finished off flush with the top surface of the duct and at approximately right angles to the line of flow. That on the starboard side was attached in a similar fashion, with a short extension piece which protruded at about 45° into the path of the hot air flow. The point of entry of the hot air into the main ducts was 22" from the back of the radiators.

2.3. The main ducts were of 4" dia. port side and 3" dia. starboard side (See sketch Fig.I.) and were led back to the engine bulkhead where the port duct divided, one duct feeding the rudder bar heating unit, and the other of 3" dia. was led off down the leading edge to supply the heating for the guns in the port wing.

/2.4.

2.4. The rudder bar heating unit was a duct of rectangular section measuring 1¼" x 3" of U shape, each arm of which was attached to a duralumin casting, the base being bolted to the centre section aft of the leading edge, and the exit by means of a flange to the engine bulkhead, directly opposite the pads on the rudder bar.

By this means hot air was taken as near as possible on to the pilot's feet, and thereby into the cabin.

The base also had a direct outlet to the inside of the wing, and was for the purpose of admitting cold air to the cabin, cold air intakes were provided on the leading edge on both port and starboard sides, which fed cold air into the centre section.

2.5. A butterfly valve was fitted in each arm of the rudder bar heating unit, which controlled the flow of hot and cold air to the cabin.

2.6. On the starboard side, the main hot air duct was led back in the same manner as that on the port side and divided into one 3" dia. duct which fed hot air to the guns bays, and the other of 1¾" dia. which carried hot air to the pilot's wind screen defroster.

The construction of the main duct intake pieces, rudder bar heating unit and duct joints were formed from light alloy metal. The ducting to the defroster and gun bays was of flexible rubber tubing.

3. Scope of tests.

3.1. Cabin temperatures were recorded at four different positions every 5,000 ft., during a climb to 31,000 ft, with the heat turned on, and after that, flying level at every two minutes till the temperatures stabilized.

3.2. Conditions during level flight were as follows:-

I.A.S. 167 M.P.H. Boost 26" Hg.

R.P.M. 2650. Mixture weak, radiator shutters neutral.

Outside air temperature - 43°C.

4. Position of test instruments.

Thermometers were fitted in the cabin at the following positions:-

(1) At pilot's feet - on the port side at floor level.
(2) Pilot's hands - on the port side attached to longeron.
(3) Gyro instruments- on the front of instrument panel at the top.
(4) Accumulator - under the lid of the accumulator box which was positioned in the wireless compartment aft of the pilot's seat.

5. Results of tests.

5.1. The table below gives the stabilized temperatures, and these temperatures corrected to the standard sub-artic winter conditions at 31,000 and 34,000 ft. of A.D.M. 491.

The rise in temperature over the outside air temperature, are given graphically in Fig. II at the end of this report.

Position	Obsvd Temp °C	Temps. Corr^{d} to Std. sub-artic winter conds. at 31,000 ft.	Temps. Corr^{d} to Std. sub-artic winter conds. at 34,000 ft.
Pilot's feet	13	+ 3½	+ 1
Pilot's hands	- 3½	-15½	-18
Gyro Instruments	13½	+ 4	- 2
Accumulator	3½	- 7	-10
Outside air temp.	-43	-60	-64

5.2. It will be seen from the table, that only the temperatures recorded at the pilot's hands did not comply with A.D.M.498 specification.

During the test the pilot reported that he experienced a distinctly lower temperature in the region of the thermometer recording th pilot's hands, than in the vicinity of the control column.

This is understandable, when the observed temperatures of the Gyro Instruments, and pilot's feet, which were appreciably higher, are taken into consideration. Further, the pilot who was only wearing overalls reported that he found the cabin of the aeroplane warm, comfortable, and free from draughts.

6. Conclusions and recommendations.

6.1. The temperatures recorded at the various positions in the cabin with the exception of the pilot's hands, comply with the A.D.M.498 specification, although the pilot at the time of the test reported favourably on the cabin heating and absence of draughts. Nevertheless it was considered that the heating would be improved by carrying the duct entry forward by extension pieces up to the engine radiator.

6.2. This alteration is too difficult for a local modification due to engine fittings in that region.

6.3. It is therefore considered that if the position of the engine fittings could be modified so as to enable the ducting to be extended on the lines suggested, the cabin heating would be improved, and as the gun heating is connected to the system this would also benefit.

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KITTYHAWK II FL-220

DIAGRAM OF HEATING SYSTEM

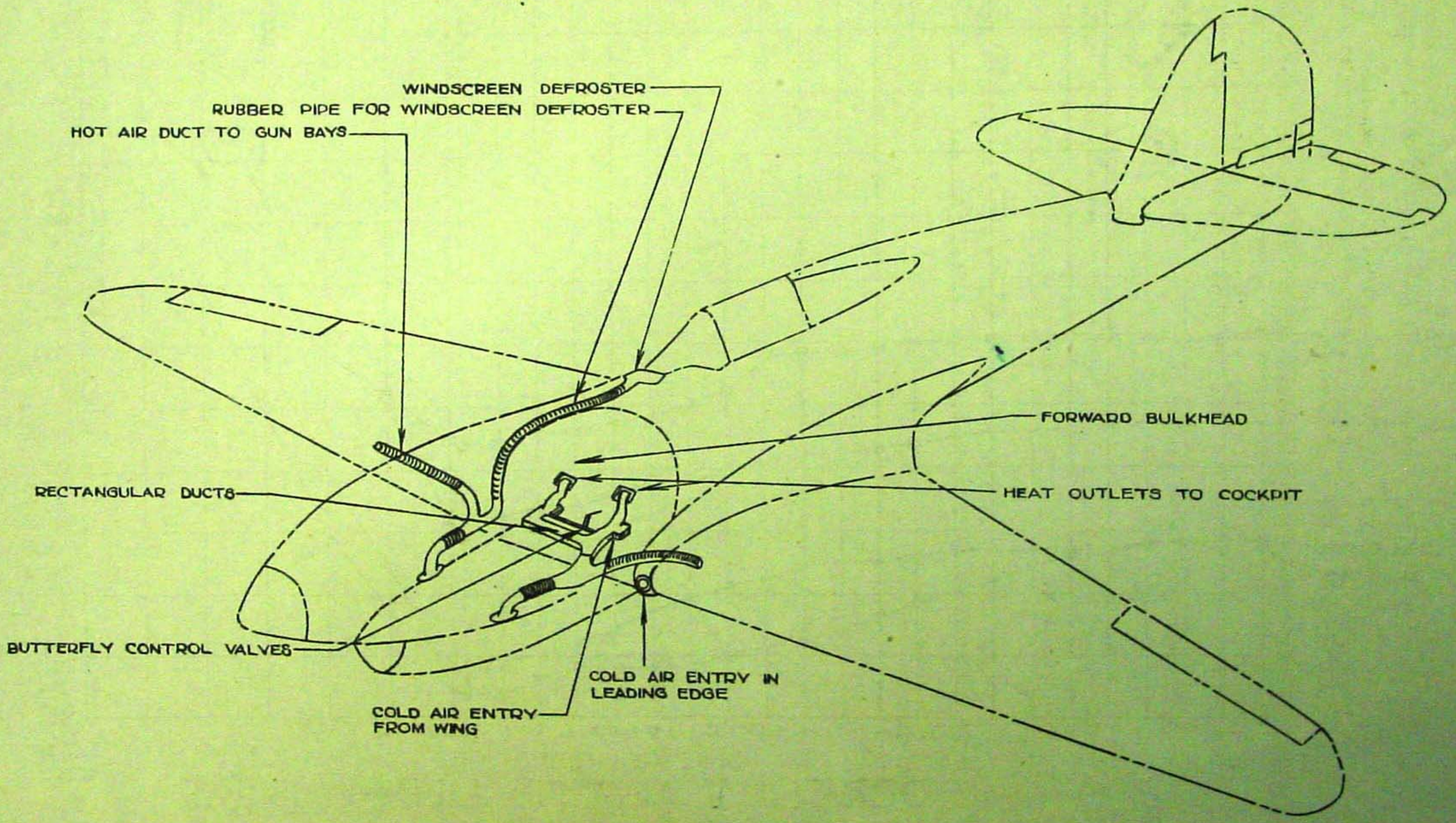

Fig. 1

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h pilot's hands,

KITTYHAWK II FL-220

CABIN HEATING

OUTSIDE AIR TEMP. AT 31,000 FT. ~ -43°C

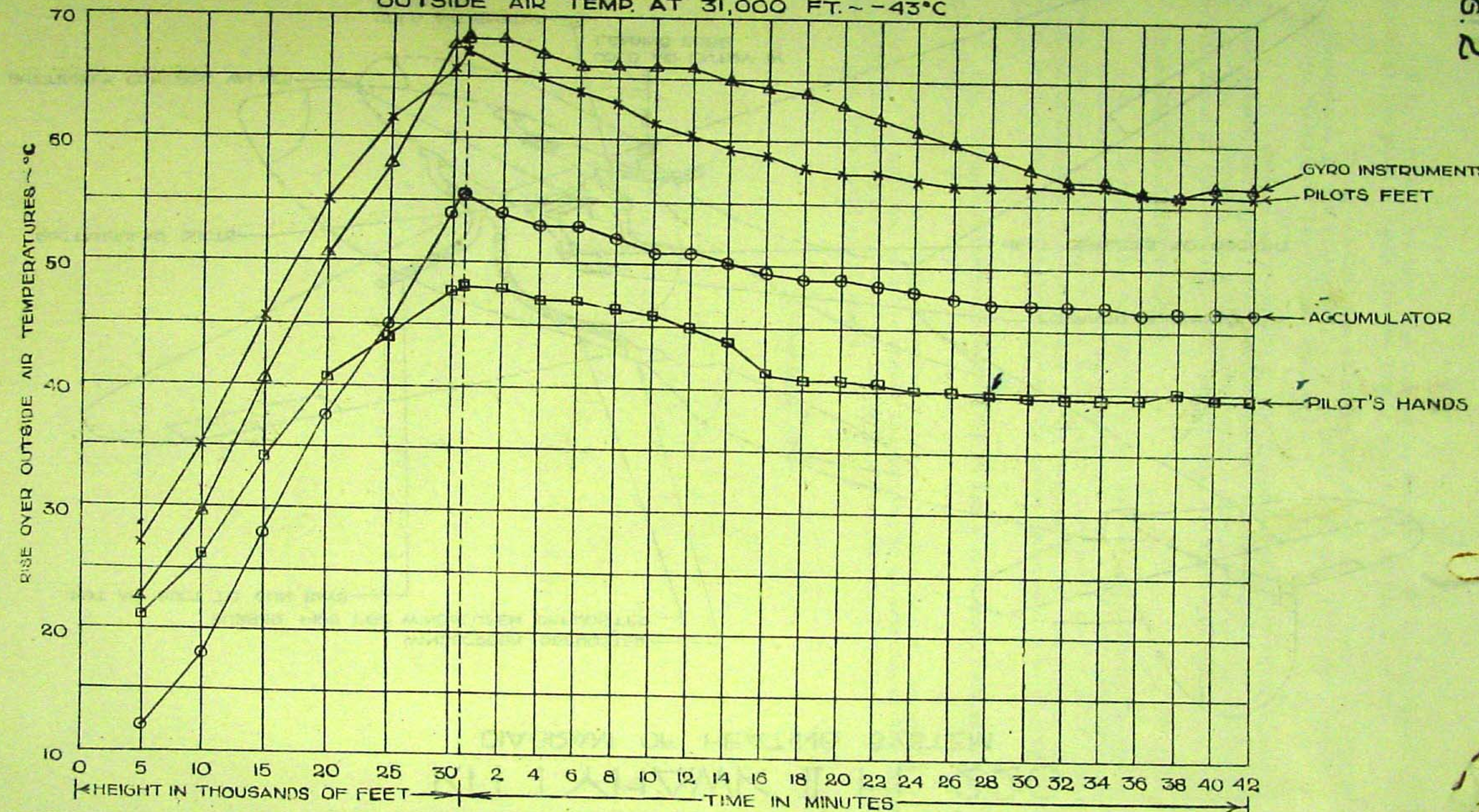

FIG. 2

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