

SUPPLEMENT

AERODYNAMIC FLIGHT TRIALS

(XG 310)

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1. Introduction

This aircraft has been prepared, as part of the Lightning F Mk.3 development programme, for high speed flight trials with a Mk.3 fin and rudder fitted. In order to record the results of these trials a large amount of instrumentation equipment is installed. For additional safety, a modified, two-way, U.H.F. system enables a ground controller to be in constant uninterrupted communication with the pilot at all times. The aircraft is also equipped with a nose wheel steering trial installation. There is no armament system installed.

NOSE WHEEL STEERING

2. General information

Nose wheel steering is designed to improve taxiing manoeuvrability with a minimum of effort from the pilot. Steering is selected by operating a single push switch mounted on the control column handle, and control is effected by operating the rudder pedals in the normal manner. An amber light, mounted on the starboard forward coaming panel, is energized when 'IN' is selected. A nose-wheel down-lock switch prevents the selection of steering if the nose undercarriage is not in the 'locked down' position. Immediately the steering is switched 'IN' a clutch mechanism operates to isolate the differential brake valve from the rudder bar; equal braking will be available on both wheels irrespective of the rudder bar position. Selection of steering 'OUT' automatically re-engages differential braking to synchronize with the rudder bar position.

3. Rudder bar movement

A non-linearity system provides a change of steering ratio with respect to steering angle, the relative response at mid-position being half that at full rudder movement. A manual ratio-change mechanism provides ground adjustment of the overall ratio between the rudder bar and the nose wheel. Full nose wheel

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movement can be gained from a range of rudder bar movements between half and full travel.

4. Castoring

The nose wheel castoring range, with or without steering switched 'IN', is 30 deg. each side of the nose wheel central position. Ground towing of the aircraft is not affected by the installation of nose wheel steering.

5. Take-off

On take-off, as the undercarriage is retracted, a switch, operated by the nose-wheel down-lock, cancels the selection of steering if the pilot has not already done so and automatically centralizes the nose wheel. Steering can only be re-engaged if the pilot selects 'IN' when the undercarriage is fully down in the locked position.

WARNING

It is important that steering is not inadvertently selected 'IN' whilst the aircraft is on approach. Steering must only be selected 'IN' when the aircraft is on the ground at normal taxiing speeds.

U.H.F. RADIO INSTALLATION

6. General information

To maintain constant and uninterrupted two-way communication between the pilot and ground controller, the U.H.F. radio system has two distinct modes of operation. These modes, designated SIMPLEX and DUPLEX, are controlled by a two-position toggle switch, idented COMM-DUPLEX/SIMPLEX, situated on the instrumentation control switch panel in the centre of the forward coaming. DUPLEX cannot be selected unless the NORMAL/STANDBY switch on the U.H.F. switch panel is selected to NORMAL; with SIMPLEX selected the system operates in the conventional U.H.F. role.

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7. Duplex mode

In the duplex mode, the two transmitter/receivers are employed in conjunction with each other; the standby T/R acting solely as a receiver, and the normal T/R as a transmitter. Under these conditions the pilot and ground controller are in constant and uninterrupted communication, it no longer being necessary to depress the press-to-transmit button in order to speak. The duplex system blocks signals from the Rebecca and Radio compass receivers, and also makes inoperative the switches on the U.H.F. switch panel. In the event of a T/R or power failure, the duplex system will be inoperative and the DUPLEX/SIMPLEX switch must be switched to SIMPLEX.

8. Simplex mode

The following description covers the operation of the U.H.F. system in the simplex, or normal, mode.

(1) *Facilities*

The U.H.F. radio installation permits normal voice communication and azimuth homing 'ADF' on any one of 1750 channels within the frequency band 225.0—399.9 Mc/s and, providing the homing facility is not being used, simultaneous monitoring of the guard frequency (243.0 Mc/s) whilst the communications transmitter/receiver is tuned to another frequency. A fixed-frequency standby transmitter/receiver, which is normally pre-tuned to distress frequency 243.0 Mc/s, is also part of the installation. Maximum communication range of the main transmitter/receiver is greater than 200 n.m. as with all line-of-sight transmissions, the achieved range, particularly on air-to-ground operation, will be dependent upon aircraft altitude.

(2) *Controls and indicator*

All controls are mounted on two panels which together form a centre panel below the main instrument panel. The upper panel is a standard U.H.F. control unit incorporating a combined ON/OFF and function switch, a 20-position

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switch for selecting one of 19 pre-tuned channels (*1-18 plus Guard*) or manual tuning, four knobs for selecting frequency on manual tuning, and an audio volume control. The four manual tuning knobs select hundreds, tens, units, and decimals of Mc/s from left to right in that order, the appropriate digits appearing in windows above the knobs. The lower panel carries a NORMAL/STANDBY U.H.F. set selector switch, a NORMAL/EMERG. POWER switch, an UPPER/LOWER AERIAL switch, a homing indication sensitivity switch (*V.P.SENS.-MAX/MIN*), a CHANNEL 'A'/GUARD switch, and a V.P./I.L.S. switch for selecting the mode of operation of the cross-pointer indicator on the main instrument panel. The vertical pointer of the latter instrument provides the left/right homing directions during homing (*ADF*) operation; the horizontal pointer is not used. The CHANNEL 'A'/GUARD switch ensures that during testing of the system when channel 'A' is used, the guard (*or emergency*) channel cannot be utilized, thus avoiding cluttering of this emergency channel.

(3) *Normal R/T operation*

For normal R/T communication the controls are selected as follows:—

U.H.F. set switch	NORMAL
POWER switch	NORMAL
AERIAL switch	As required
Function switch	T/R
CHAN. switch	To required channel (or to M if manual tuning is required)
VOL. control	As required
CHANNEL 'A'/GUARD switch	GUARD

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The equipment will become operative after a 30 second warm-up period has elapsed. The main transmitter/receiver is then in the 'receive' condition and can be switched to transmit by operation of either of the two press-to-transmit switches, one situated on the control column handle and the other on the No.2 throttle. In certain conditions of poor reception and transmission, e.g., where the attitude of the aircraft relative to the ground station is such that one aerial is 'screened' by part of the aircraft structure, changeover to the other aerial may result in some improvement.

(4) *Guard frequency monitoring and transmission*

If monitoring of the guard frequency is required in addition to normal communication on another channel, the function switch should be selected to T/R + G. To transmit on guard frequency the function switch should be selected to T/R as for normal communication, and the CHAN. switch selected to position G.

(5) *Homing (Violet Picture)*

For homing, the required frequency is first selected on the control unit with the function switch set to T/R, as for normal R/T operation, and satisfactory reception of the signal verified by checking that the voice of MCW modulation is audible in the telephones. The function switch should then be selected to ADF, the V.P./I.L.S. switch to V.P. and the V.P.SENS switch to MAX. The indicator vertical flag will move to one side, and the vertical pointer will deflect unless the aircraft is heading directly toward the homing transmitter or, in certain circumstances, unless the transmitter is astern. When the homing transmitter is astern the signal received by the azimuth aerials is considerably reduced, and the pointer may or may not deflect, zero deflection indicating either that signal strength is insufficient or that the aircraft is on a reciprocal heading. Whenever an initial 'on course' indication is given, therefore, it is necessary to verify that the indication is correct. The ambiguity can be resolved by turning the aircraft off course until deflection of the indicator pointer occurs, and

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then checking that the deflection is in the correct sense, i.e. a turn to port should cause right deflection. Correct functioning of the system should be checked at intervals during the homing by checking response of the indicator to deviations from correct heading. Indicator sensitivity should be reduced, by setting the V.P. SENS switch to MIN, when the signal strength is such that small deviations from the 'on course' heading cause large deflections of the pointer. At the end of a homing run, oscillation of the pointer indicates that the aircraft is over-flying the transmitter. Normal R/T communication between the aircraft and the homing transmitter is possible without changing the ADF setting of the function switch. When a press-to-transmit switch is operated, the azimuth aerials are isolated and the communications aerial connected, and the homing circuits are rendered inoperative for the duration of the transmission.

(6) *Standby transmitter/receiver*

The standby transmitter/receiver is switched on by selecting the U.H.F. set switch to STANDBY: thereafter the set is switched to transmit in the normal manner by operation of a press-to-transmit switch. If operation of the equipment is necessary after a generator failure, the POWER switch should be selected to EMERGENCY to compensate for the voltage drop on the aircraft d.c. busbar. The set is automatically connected to the lower communications aerial, irrespective of the setting of the AERIAL selector switch.

9. Intercommunication

When in the 'receive' condition, either the normal or standby U.H.F. T/R can be used for intercommunication between the pilot and ground personnel whilst the aircraft is stationary on the ground. For this purpose an external tel/mic set is connected to a socket in the starboard wheel well. The PRESS-TO-TRANSMIT switches must be operated, otherwise unwanted radiation of the signal from the aerial will occur.

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10. Telebriefing

A ground telebriefing installation, which permits communication between the pilot and ground controller, can be connected to the aircraft at a socket in the starboard wheel bay. An indicator switch unit on the starboard console is illuminated when the connection is made. The equipment is normally in the 'receive' condition, and the indicator switch unit must be pressed to allow transmission from the aircraft.

ALTERATIONS AND ADDITIONS

11. Oxygen regulator

The oxygen regulator is situated at floor level on the wall of the starboard console.

12. Control handle (fig.1)

A later type handle, incorporating ganged two-axis trim switches and a nose-wheel steering button, is fitted to the control column.

Note...

During pre-flight checks, pilots are instructed to check that no actuator movement occurs when the trim switches are operated individually. To separate the switches on the control handle, the spring-loaded pin at the top of the ganging bar must be squeezed between the thumb and forefinger, when the bar can be lifted and pivoted to the side. The reverse procedure will tie the switches together, but check that the ganging bar is locked by attempting to lift it.

13. V.H.F. radio installation

Due to the embodiment of the U.H.F. system, V.H.F. is no longer required and has been deleted.

14. I.F.F. installation

The I.F.F. installation is inoperative.

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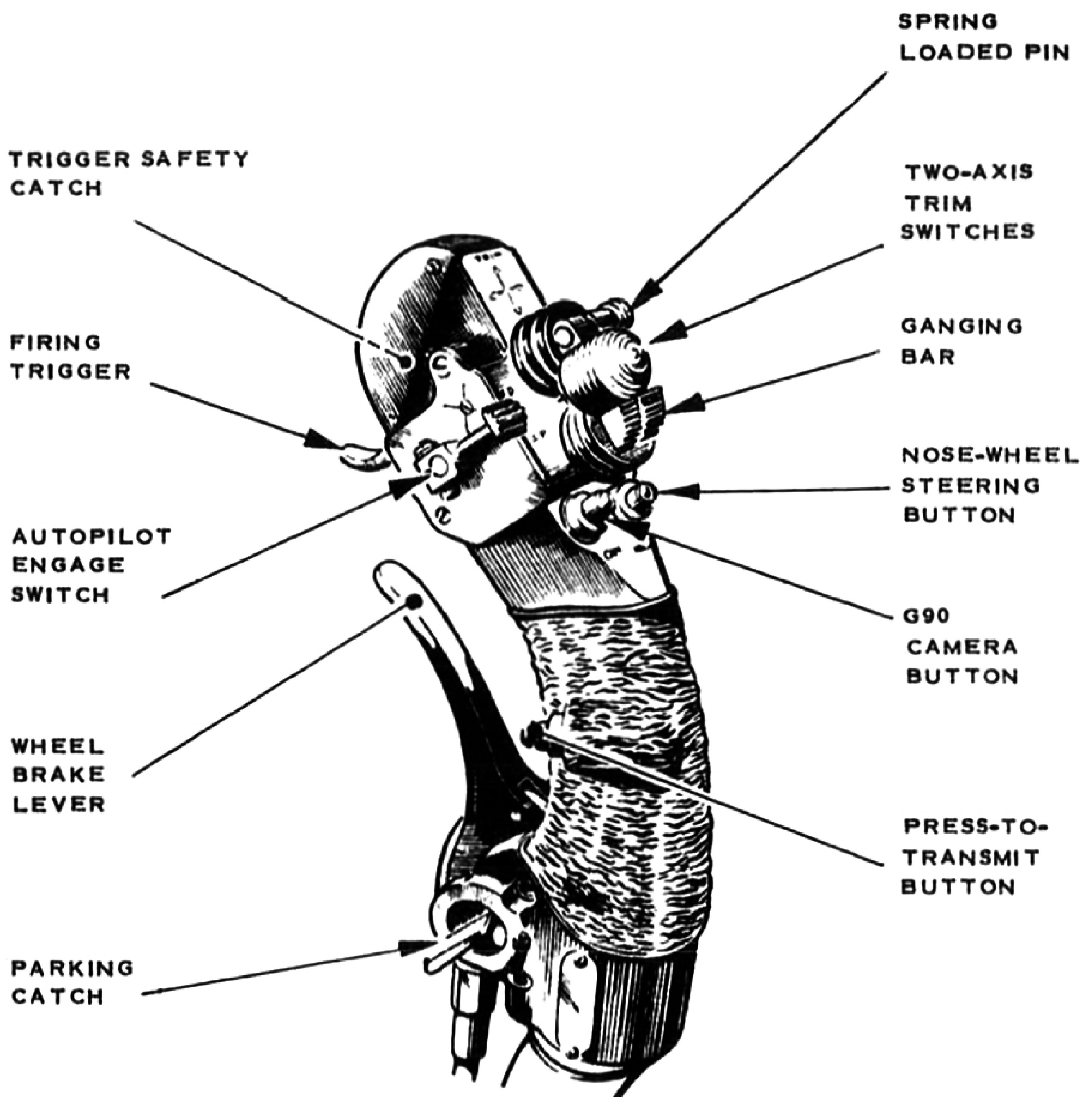


Fig. 1. Control handle

15. Mk.3 fin and rudder

A Mk.3 fin and rudder is fitted for flight trials, as part of the development of the Mk.3 aircraft.

16. Standby A.S.I.

This indicator is mounted on the starboard coaming panel,

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and it should be noted that it will give a negative or incorrect reading whilst the aircraft is being engine run or taxied. This is due to aerodynamic disturbances around the standby pitot head which is positioned in the engine intake on the upper bullet strut. A STANDBY position on the HEATER MASTER switch allows an emergency supply to the standby pitot head heater.

INSTRUMENTATION

17. General information

The instrumentation equipment in this aircraft is installed primarily for recording the handling effects of the Mk.3 fin and rudder. A brief description of the switches and indicators in the cockpit is given in the following paragraphs. For a more comprehensive description of all the instrumentation equipment refer to the Boulton Paul despatch brochure INST/LIGHTNING/310/100.

18. Switches and indicators

All the instrumentation control switches and indicators are accommodated on one panel which is mounted directly in front of the pilot on the forward coaming.

(1) *Roll-rate indicators*

Two roll-rate indicators, mounted one each side of the instrumentation switch panel, are illuminated (*red (port) or green (starboard)*), if the aircraft roll-rate exceeds 15 deg. per second.

(2) *Rotary selector switch*

This switch has five positions, the first two positions being the rotary equivalent of the instrumentation master switch. The other three positions select C.I.D. recorders SLOW, FAST, or FAST PLUS VIBRATION.

(3) *Wirek switch*

Controls the operation of the Wirek motor and wire recording system.

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- (4) *Recorder switch*
Controls supplies to all other recorders.
- (5) *Telemetry transmitter switch*
Controls supplies to the two telemetry transmitters.
- (6) *Altitude warning cancel switch*
An audible warning system, which operates at altitudes below 25000 ft, can be cancelled by the pilot selecting this switch to CANCEL.
- (7) *Roll light cancel switch*
Enables the pilot to switch-off supplies from the roll-rate gyro to the roll lights.
- (8) *Filament test button*
Applies a 28-volt supply to each of the roll light filaments.
- (9) *Pilot's test index button*
Enables the pilot to indicate, on all recorders, points in the programme of specific interest.

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ROTARY SELECTOR
SWITCH

PILOT'S TEST
INDEX BUTTON

PORT ROLL-RATE
INDICATOR

FILAMENT TEST
BUTTON

DUPLEX/SIMPLEX
SWITCH

ALTITUDE WARNING
CANCEL SWITCH

U/C SPRING FLAP
GUARD

U.H.F. CONTROL
PANEL

U.H.F. SWITCH
PANEL

RECORDER SWITCH

WIREK SWITCH

NOSE WHEEL STEERING
INDICATOR

STBD. ROLL-RATE
INDICATOR

STANDBY A.S.I.

TELEMETRY
TRANSMITTER SWITCH

ROLL LIGHT
CANCEL SWITCH

OXYGEN
REGULATOR

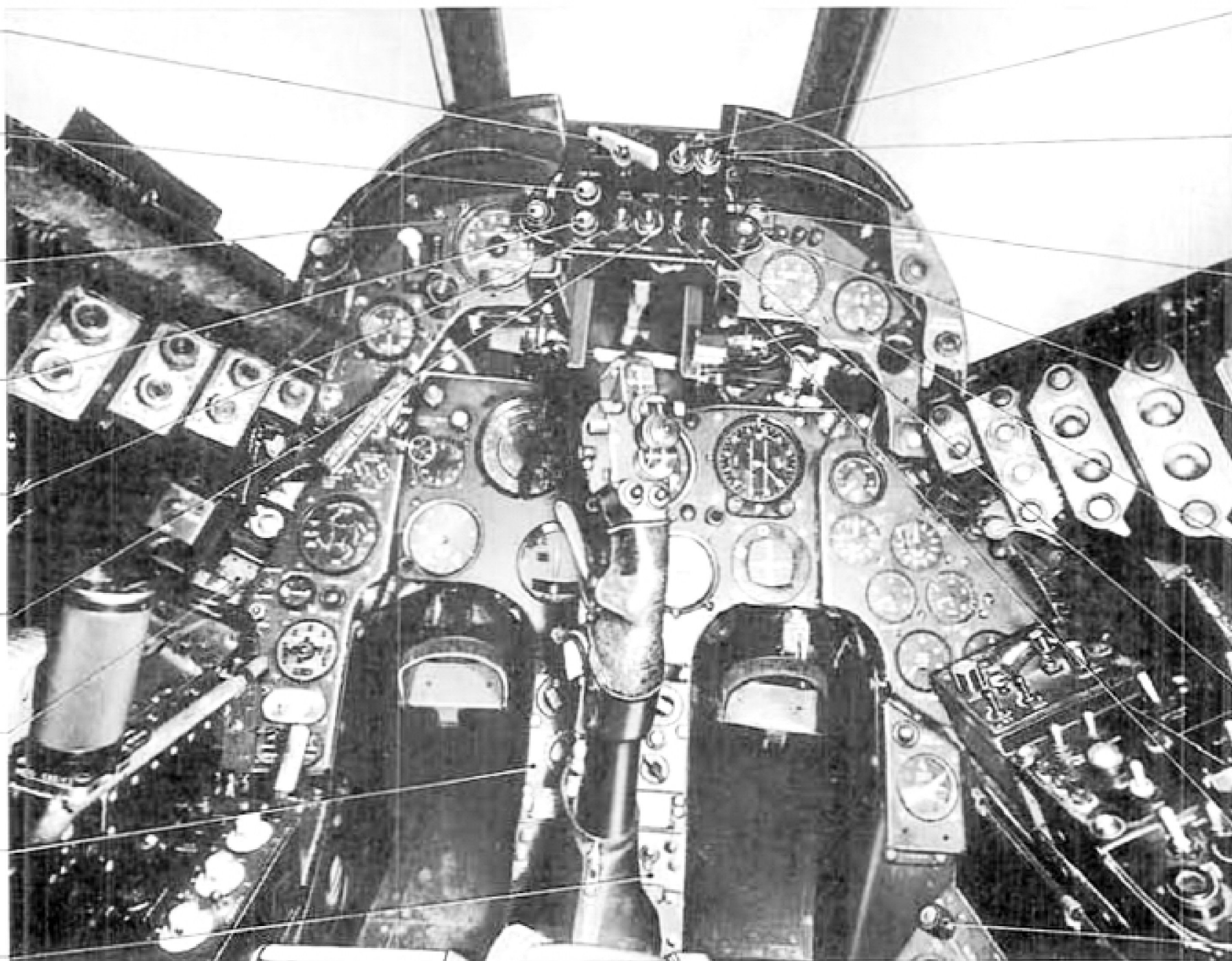


Fig. 2. Cockpit