

CONTROL, THERMOSTATIC, INCHING  
FDF/A/SERIES

REF. NO. FDF/A/885.	5C/3859
FDF/A/1224.	5C/3938
FDF/A/1510.	5C/4062
FDF/A/2390.	5C/4250

EQUIPMENT REQUIRED

REF. NO.

DESCRIPTION

TEST EQUIPMENT

795  
 220  
 152  
 10/8423  
 10610  
 6496  
 Local Manufacture  
 Local Manufacture  
 Local Manufacture  
 Local Manufacture  
 1951230

Bath, thermometer testing.  
 Thermometer, precision.  
 Tester, insulation resistance Type 'C' 250 V.  
 Balance, spring 0-5 lbs.  
 Testmeter, Type 'D'.  
 Tester, bridge megger, 250 V.  
 Torque testing arm Fig. 2 refers.  
 Quadrant Fig. 3 refers.  
 Follow-up pointer Fig. 4 refers.  
 Test rig Figs. 1 and 6 refer, comprising:-  
 Lamp, filament, 24 V. 2.8 W.

M.E.S. 5 Off.

Lamp, warning Type B. 5 Off.

Switch, tumbler, Type A, 3-way 2 Off.

Switch, tumbler, Type B.

Breeze plug, Type B.A.1, 5 x 7 amps.

Breeze plug, Type B.B.1, 7 x 7 amps.

Breeze socket, Type Z.A.2, 5 x 7 amps.

Breeze socket, Type B.B.2, 7 x 7 amps.

3 Off.

Breeze socket, Type B.C.2, 9 x 7 amps.

Breeze socket, Type B, 2 x 7 amps.

4 x 19 amps.

Cable, Quinvin 4.

Cable, Septovin 4.

Potentiometer.

MATERIALS

903  
 174  
 2296  
 N11701  
 N14845

Varnish, Seaplane.  
 Grease, X.G. 290.  
 Wire, locking, stainless steel, 20 S.W.G.  
 Carbon tetrachloride.  
 Paper, oiled.

SUPPLIES

29 volt. D.C. supply.

SPARES

NIV  
 NIV  
 NIV

Phial protector.  
 Follow-up arm tab washer.  
 Studs, instrument fixing.

SHEET NO. 1 Continued

NO. 2

ASSOCIATED PUBLICATIONS

A.P. 1275A, Vol. 1, Sect. 11, Chap. 6.  
A.P. 1275A, Vol. 1, Sect. 11, Chap. 6,  
Appx. 1.

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Fig. 1  
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CONTROL, THERMOSTATIC, INCHING

FDF/A/SERIES

SERVICING NOTES

The phial protector must at all times be fitted to the phial unless removed for installation or testing purposes.  
The breeze plug pin connections for the four types are given in Fig. 5.  
The rate of temperature change of the phial must not exceed 2 degrees C. per minute.

Item  
Dismantling.

Operation

TYPE FDF/A/2390 ONLY

- (A) Unlock tab washers and remove screws securing spring cover plate. Remove spring cover plate.
- (B) Release return spring from follow-up arm.
- (C) Unlock tab washer and withdraw screws retaining follow-up arm.
- (D) Remove follow-up arm complete with 'Teleflex' cable.
- (E) Break locking wires and remove the four screws retaining the floating bracket to back of mounting.
- (F) Remove the two nuts and bolts securing the grommet bridge of the capillary.
- (G) Break the seal and remove the nuts securing the two movement limiting brackets.
- (H) Remove bonding link, lift capillary and grommet, and remove the two movement limiting brackets.
- (J) Lift instrument, complete with floating bracket, from mounting.
- (K) Remove the nuts securing instrument cover.
- (L) Gently tap the four cover retaining bolts through the cover. This will separate the floating bracket from the instrument.

NOTE:- Do not dismantle floating bracket further unless inspection makes this desirable. If stripping is carried out, care must be taken to re-assemble metalastic bushes and their spacing shims in their original positions.

- (M) Clean outside of instrument case.
- (N) Remove the follow-up arm boss.
- (O) Remove the instrument cover.
- (P) Remove the phial protector.



SHEET NO. 2 Continued

Item

No.

Item

Operation

1. Ctd.

TYPES FDF/A/885, 1224 AND 1510

- (A) Clean outside of case.
- (B) Mark the outer face of the follow-up arm and remove.
- (C) Remove the follow-up arm boss.
- (D) Break the seal and remove the instrument cover.
- (E) Remove the phial protector.

2. Inspection.

ALL TYPES

- (A) Inspect the phial and capillary for damage, distortion and acute kinks.
- (B) Check the thermal unit securing screws for tightness.
- (C) Inspect the breeze plugs for cleanliness, damage and security.
- (D) Ensure that the four instrument fixing studs or bolts are not damaged.
- (E) Inspect the cover and base plate for damage and corrosion.
- (F) Examine the mechanism for damage, corrosion and ingress of moisture.
- (G) Examine all accessible relay contacts and clean if necessary, using carbon tetrachloride.
- (H) Inspect the follow-up arm seal, and base plate gasket for damage and deterioration. Renew the gasket if necessary by local manufacture from oiled paper.
- (J) Clean the follow-up cam and apply a thin film of grease X.G. 290.
- (K) Rotate the follow-up shaft and check action of inching switch.
- (L) Clean inching switch contacts, if necessary, using carbon tetrachloride.
- (M) Lightly smear the teeth of the notched cam with grease X.G. 290.

TYPE FDF/A/2390 ONLY

- (N) Clean and examine 'Teleflex' cable assembly for damage and freedom of movement.
- (O) Clean and examine metalastic bushes for damage.
- (P) Clean and inspect all brackets for damage and corrosion.

3. Insulation Test.

- (A) Measure the insulation resistance between the following points:-
  - (1) Between each terminal pin of each connector and the main base.



Item	Operation
3. Ctd.	<p>(A) (2) With the relay in the released position; between pins 1 and 3, 1 and 5, and 3 and 5 of the input plug. Also for Type FDF/A/1224, between pins C and D, C and F and pins D and F of the output plug.</p> <p>(3) Manually operate either relay and test between:-  FDF/A/885 Pins D and E of the output plug.  FDF/A/1224 Pins D and E of the output plug.  FDF/A/1510 Pins B and I of the output plug.  FDF/A/2390 Pins D and E of the output plug.</p> <p>(B) In each case the reading must not be less than 2 megohms.</p>
Relay Coil Resistance Test.	<p>(A) Measure the resistance of each relay coil, using a bridge megger, between pins 1 and 8 and 1 and 9 of the input plug.</p> <p>(B) In each case the reading must be <math>125 \pm 9</math> ohms.</p>
Clutch Slipping Test.	<p>(A) Refit the follow-up arm boss.</p> <p>(B) Fit the torque testing arm. (Fig. 2 refers) to the follow-up arm boss.</p> <p>(C) Attach the spring balance to the torque testing arm.  With the arm in the position corresponding to 'Fully open' apply tension perpendicular to the arm in a clockwise direction. The clutch must not slip at less than 5 lbs./ins. torque, but must slip before the torque exceeds 10 lbs./ins. Repeat the test in the 'Fully closed' position with an anti-clockwise torque.</p> <p>(D) Remove the torque testing arm and follow-up arm boss.</p>
Follow-up Range Check.	<p>(A) Fit the quadrant and distance piece (Fig. 3 refers) to the base plate by means of a suitable nut and bolt, so that the follow-up shaft (end furthest from the clutch) aligns with the 9/16 inch diameter hole through the quadrant.</p>

SHEET NO. 3 Continued

Item  
No.  
6. Ctd.

Item

Operation

TYPES FDF/A/885, 1510 AND 2390

- (B) With the follow-up shaft rotated against the 'Fully open' stop, fit the pointer (Fig. 4 refers) to the shaft and align it to  $42\frac{1}{2}$  degrees (horizontal) and secure.
- (C) Rotate the follow-up shaft to the 'Fully closed' stop and note the scale reading. Move the pointer on the shaft to centralise the movement relative to the quadrant scale.

TYPE FDF/A/1224 ONLY

- (D) Rotate the follow-up arm 5 inching steps from one stop.
- (E) Fit the pointer, align it to zero on the quadrant scale and secure.

ALL TYPES

- (F) Check that the arc of movement of the pointer is between 41 degrees and  $42\frac{1}{2}$  degrees either side of the quadrant scale zero.

7. Functional Check Manual.

TYPES FDF/A/885, 1510 AND 2390

- (A) Connect the inching control to the test panel using the appropriate connectors given in table 1, column 1.
- (B) Set the follow-up pointer to the 40 degree 'Fully closed' position.
- (C) Set switches S.1 to 'ON'; S.2 to 'MANUAL'; and S.3 to 'FLAP OPEN'.
- (D) Adjust the voltage to 16 v. by means of the potentiometer.
- (E) Set the switch S.3 to 'OFF' when lamps 1, 3 and 4 must light.
- (F) Set switch S.3 to 'OPEN' when lamps 3 and 5 must light.
- (G) Set switch S.3 to 'OFF' when lamps 1, 3 and 4 must light.
- (H) Set switch S.3 to 'CLOSE' when lamps 1, 2 and 4 must light.
- (J) Set switch S.3 to 'OFF' when lamps 1, 3 and 4 must light.
- (K) Set switch S.2 to 'AUTO' with the phial at room temperature lamps 1, 2 and 4 must light.
- (L) Set switch S.2 to 'MANUAL' and repeat operations (E) to (K) above. There must be no appreciable delay in the change-over of the lamps.



## Item

## Operation

Functional Check -  
Manual - and Re-  
training Circuit  
Test.

TYPE FDF/A/1224 ONLY

- (A) Connect the inching control to the test panel using the appropriate connectors given in table 1, column 1.
- (B) Set the follow-up pointer to the 40 degree 'FULLY CLOSED' position.
- (C) Set the switches S.1 to 'ON', S.2 to 'MANUAL', and S.3 to 'FLAP OPEN'.
- (D) Adjust the voltage to 16 v. by means of the potentiometer.
- (E) Check that lamps 1, 3 and 5 are alight.
- (F) Set switch S.3 to 'OFF' when lamps 1, 3 and 5 must remain alight.
- (G) Rotate follow-up pointer one inching step when lamps 1, 3 and 4 must light.
- (H) Set switch S.3 to 'CLOSE' when lamps 1, 2 and 4 must light.
- (J) Set switch S.3 to 'OFF' when lamps 1, 2 and 4 must remain alight.
- (K) Rotate the follow-up pointer one inching step when lamps 1, 3 and 4 must light.
- (L) Set switch S.2 to 'AUTO' with the phial at room temperature. Lamps 1, 2 and 4 must light.
- (M) Set switch S.2 to 'MANUAL' and S.3 to 'OPEN', adjust the voltage to 29 v. by means of the potentiometer, and repeat operations (E) to (L). There should be no appreciable delay in the change-over of the lamps.

Functional Check -  
Thermal.

- (A) Fit the phial to the thermal test rig.
- (B) Ensure that the follow-up pointer is set to the 40 degree 'Fully closed' position.
- (C) Ensure switch S.1 is set to 'ON' and S.2 to 'AUTO' when lamps 1, 2 and 4 must light.
- (D) Raise the phial temperature slowly until the lamps change to 1, 3 and 5 (Types FDF/A/885, 1510 and 2390 will cause the lamps to change to 1, 3 and 4 when the 'CLOSE' thermal contacts break, before changing to 1, 3 and 5).
- (E) Reduce the phial temperature slowly until the lamps change to 1, 2 and 4. Note the temperature at this point. This is the 'Fully closed' temperature.
- (F) Commence to slowly raise the phial temperature.
- (G) The lamps will change to 1, 3 and 4 when the temperature has risen sufficiently to break the close thermal contacts. (This indication will not be obtained when testing Type FDF/A/1224.)



Item  
No.  
9. Ctd.

Item

Operation

- (P) The 'Fully closed' temperature as indicated when the lamps again change to 1, 2 and 4, must be within 20 degrees  $\pm$  2 degrees C. of the 'Commenced to close' temperature obtained in (N) above.

**NOTE:-** If irregular results are obtained from the above checks proceed as detailed under Rectification Item 11(C).

- (Q) Set the switch S.1 to 'OFF' and disconnect the instrument from the test panel.  
(R) Remove phial from the thermal test rig, wash it free from oil, and refit the phial protector.

## 10. Assembly.

TYPE FDF/A/2390 ONLY

- (A) Remove the pointer and quadrant.  
(B) Refit the cover gasket and cover to instrument.  
(C) Keeping the four securing bolts assembled to the floating bracket, enter the four bolts into the instrument cover and gently push home. Fit and tighten securing nuts.  
(D) Refit the follow-up arm boss with its sealing ring.  
(E) Insert the instrument complete with floating bracket into its mounting.  
(F) Refit the two movement limiting brackets.  
(G) Replace the bonding link, and re-seat the capillary grommet.  
(H) Replace the nuts and locking wire securing the movement limiting brackets.  
(J) Refit the grommet bridge.  
(K) Replace and lock the four screws retaining the floating bracket to the back of mounting.  
(L) Refit the follow-up arm complete with 'Teleflex' cable.  
(M) Refit the return spring to the follow-up arm.  
(N) Replace the spring cover plate.  
(O) Coil the capillary to a diameter not less than 4 inches and secure.

TYPES FDF/A/885, 1224 AND 1510

- (A) Remove the pointer and quadrant.  
(B) Refit the cover and reseal with locking wire.

Item

No.

10. Ctd.

Item

Operation

11. Rectification.

- (C) Refit the follow-up arm boss with its sealing ring.
- (D) Refit the follow-up arm (marked side upper-most), then the tally plate and tab washer.
- (E) Coil the capillary to a diameter not less than 4 inches and secure.

(A) 'Commence to open' temperature not within 4 degrees C. to 7 degrees C. of 'Fully closed' temperature.

(1) Set the follow-up pointer to the 40 degrees 'Fully closed' position, switch S.1 to 'ON' and S.2 to 'AUTO'.

(2) Reduce the phial temperature to below the 'Fully closed' temperature.

(3) Raise the phial temperature slowly to a point  $5\frac{1}{2}$  degrees C. above the 'Fully closed' temperature obtained in item 9(E).

(4) Slacken the locking screw and adjust the thermal contact - clockwise to decrease, anti-clockwise to increase - so that the 'open' coil is just energized at this point, i.e. when the lamps change from 1, 3 and 4 to 2 and 4 in the case of FDE/A12 to 1, 3 and 5. Tighten the locking screw.

(5) Reduce the phial temperature to below the 'Fully closed' temperature.

(6) Repeat operations 9(B) to 9(H).

(B) Incorrect 'Commence to Open' temperature.

(1) Ensure the change of temperature required to reverse the switch is correct, if not, proceed as detailed in (A) above.

(2) Set the follow-up pointer to the 40 degrees 'Fully closed' position, switch S.1 to 'ON', and S.2 to 'AUTO'.

(3) Reduce the phial temperature to below the 'Fully closed' temperature.

(4) Raise the phial temperature to the correct 'Commence to open' temperature as given in table 1 column 2.

Item

Item

Operation

No.

11. Ctd.

- (B) (5) Slacken the locking screw and rotate the adjusting nut - clockwise to decrease, anti-clockwise to increase - so that the 'Open' coil is just energised at this point, i.e. when the lamps change to 1, 3 and 5 from 1, 3 and 4, or from 1, 2 and 4 in the case of FDF/A/1224.
- (6) Reduce the phial temperature to below the 'Fully closed' temperature.
- (7) Repeat operations 9(B) to 9(H).
- (C) Irregular thermal functioning.
- (1) Remove the four screws securing the thermal contact assembly and lift off the cover.
- (2) Taking care not to disturb the setting of the adjusting nut, lift the thermal contact assembly sufficiently to permit access to the contacts.
- (3) Clean the contacts using carbon tetrachloride.
- (4) Re-assemble the contact assembly and cover plate.
- (5) Re-test as detailed in Item 9.
- (D) Further rectification must be confined to the replacement of parts listed on Sheet 1 of the schedule under 'SPARES'.

TABLE 1

	1		2
	INPUT	OUTPUT	COMMENCE TO OPEN
FDF/A/885	J	A	105 $\pm$ 1 degree C.
FDF/A/1224	J	A	69 $\pm$ 1 degree C.
FDF/A/1510	J	F	105 $\pm$ 1 degree C.
FDF/A/2390	J	A	105 $\pm$ 1 degree C.



CONTROL, THERMOSTATIC, INCHING  
FDF/A/ SERIES.

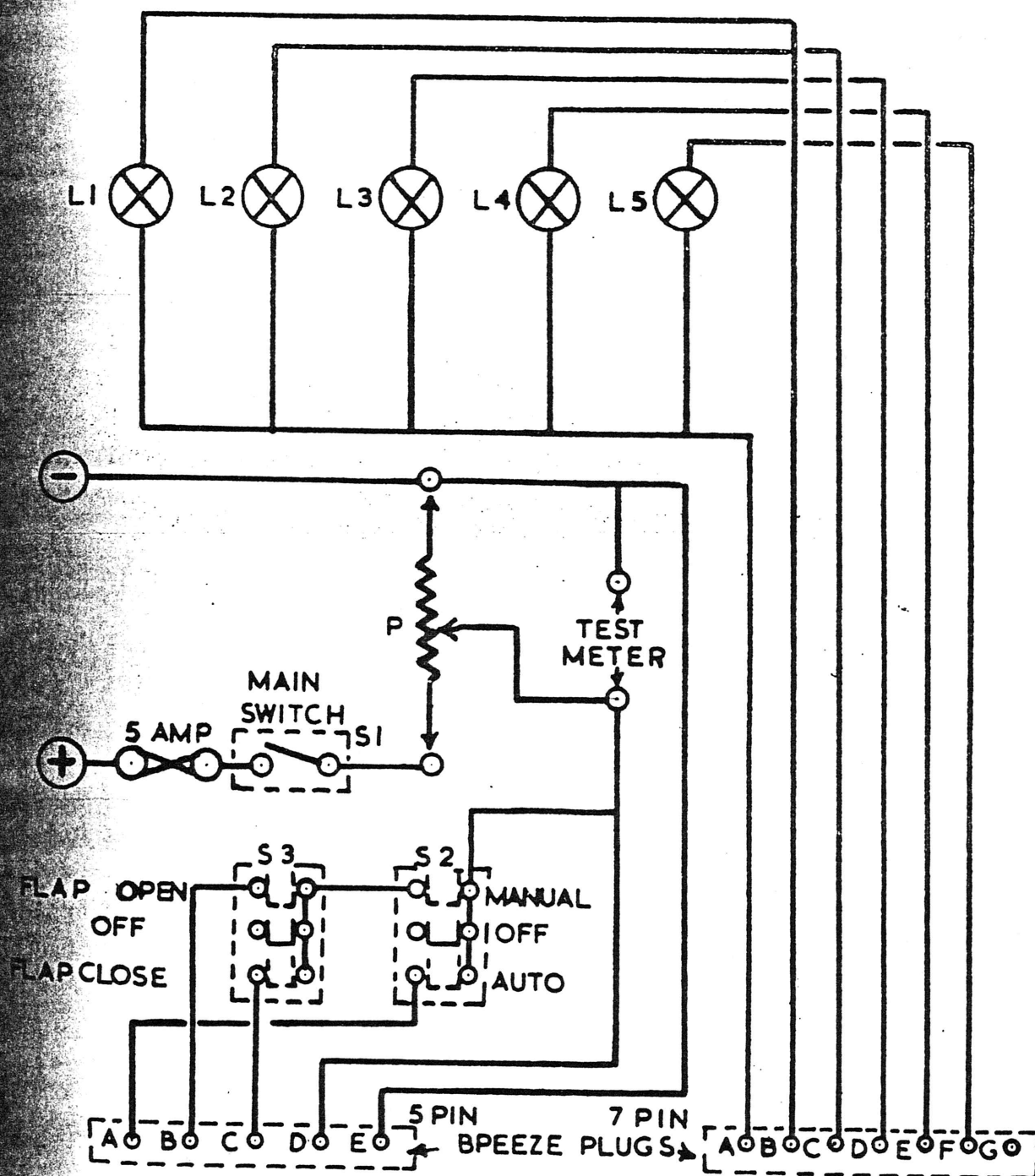


FIG.1.

WIRING DIAGRAM OF INCHING  
CONTROL TEST RIG

Sheet No.7 Contd.

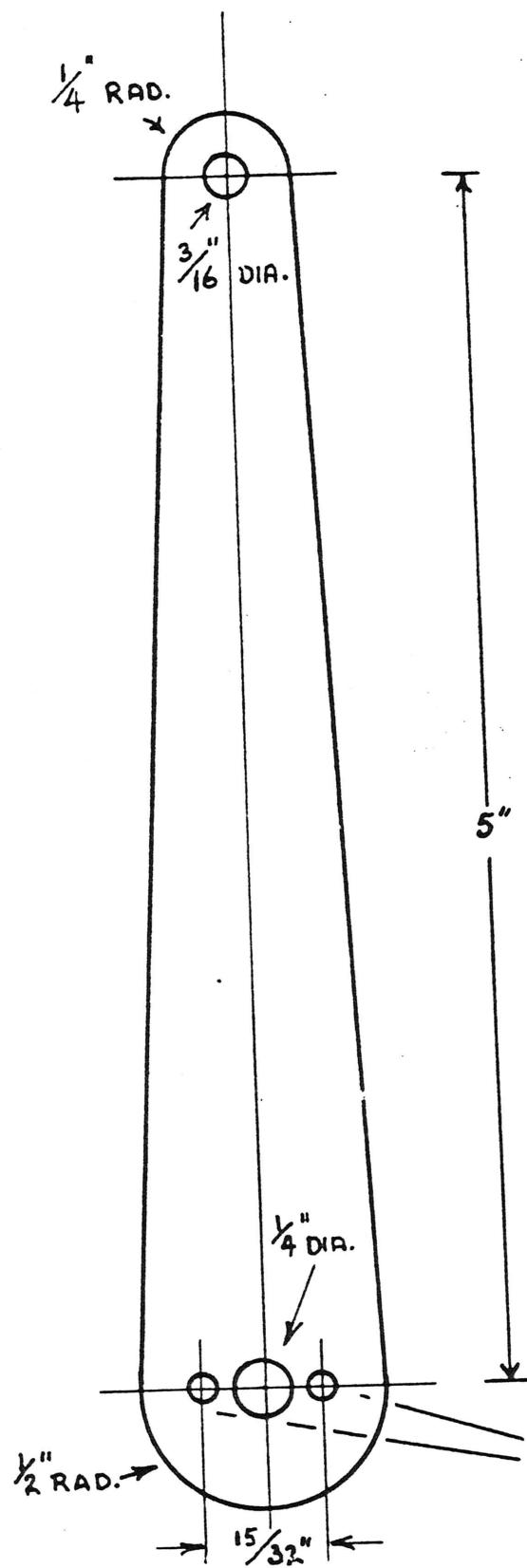


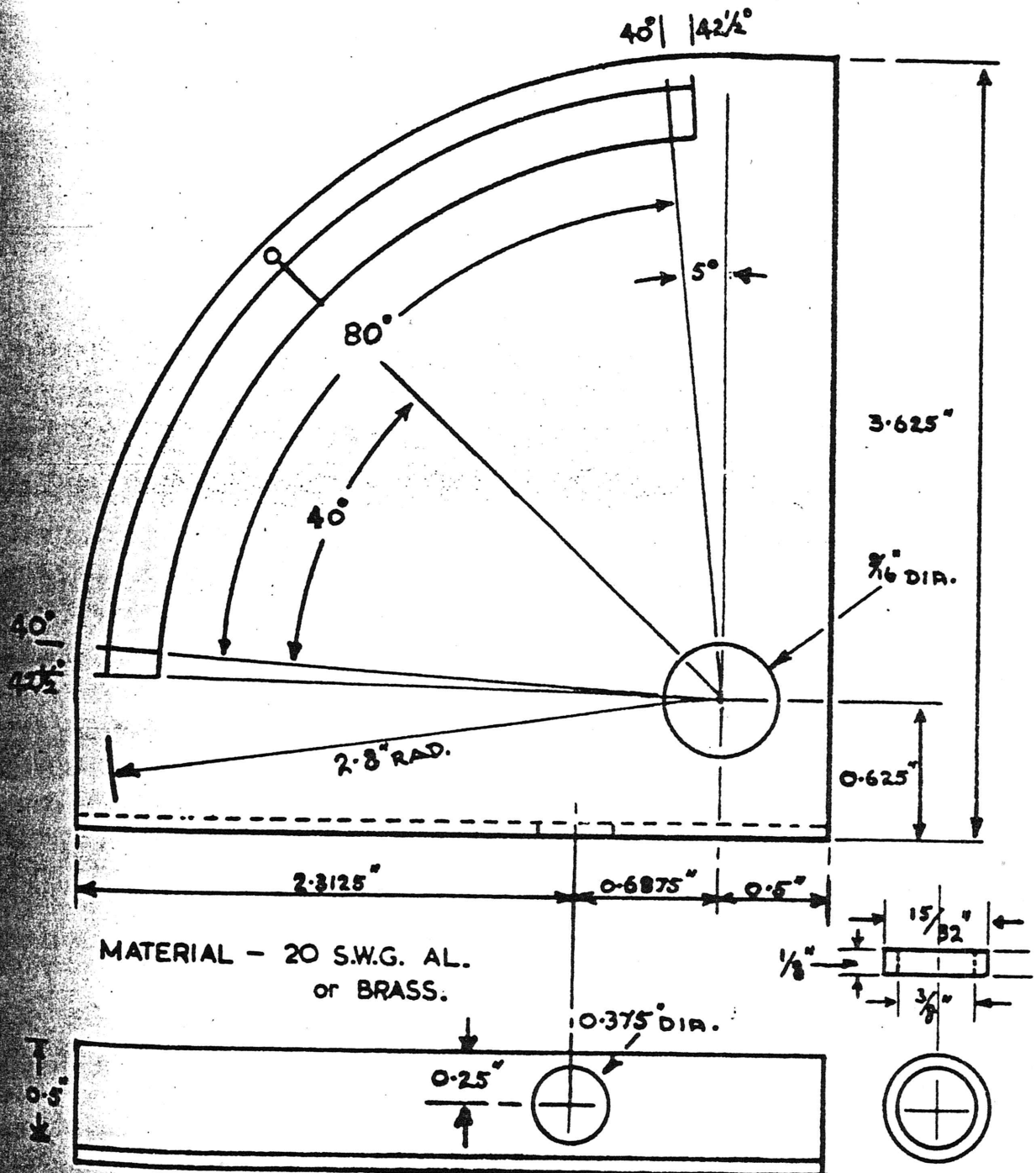
FIG. 2.

TORQUE TESTING  
ARM.

MATERIAL  $\frac{1}{8}"$  AL.

CONTROL, THERMOSTATIC, INCHING.

FDF/A/ SERIES.



QUADRANT ENGRAVED 40°-0-40°  
2 1/2° OVER-RIDE MARK EACH END.

FIG.3.

QUADRANT AND DISTANCE PIECE



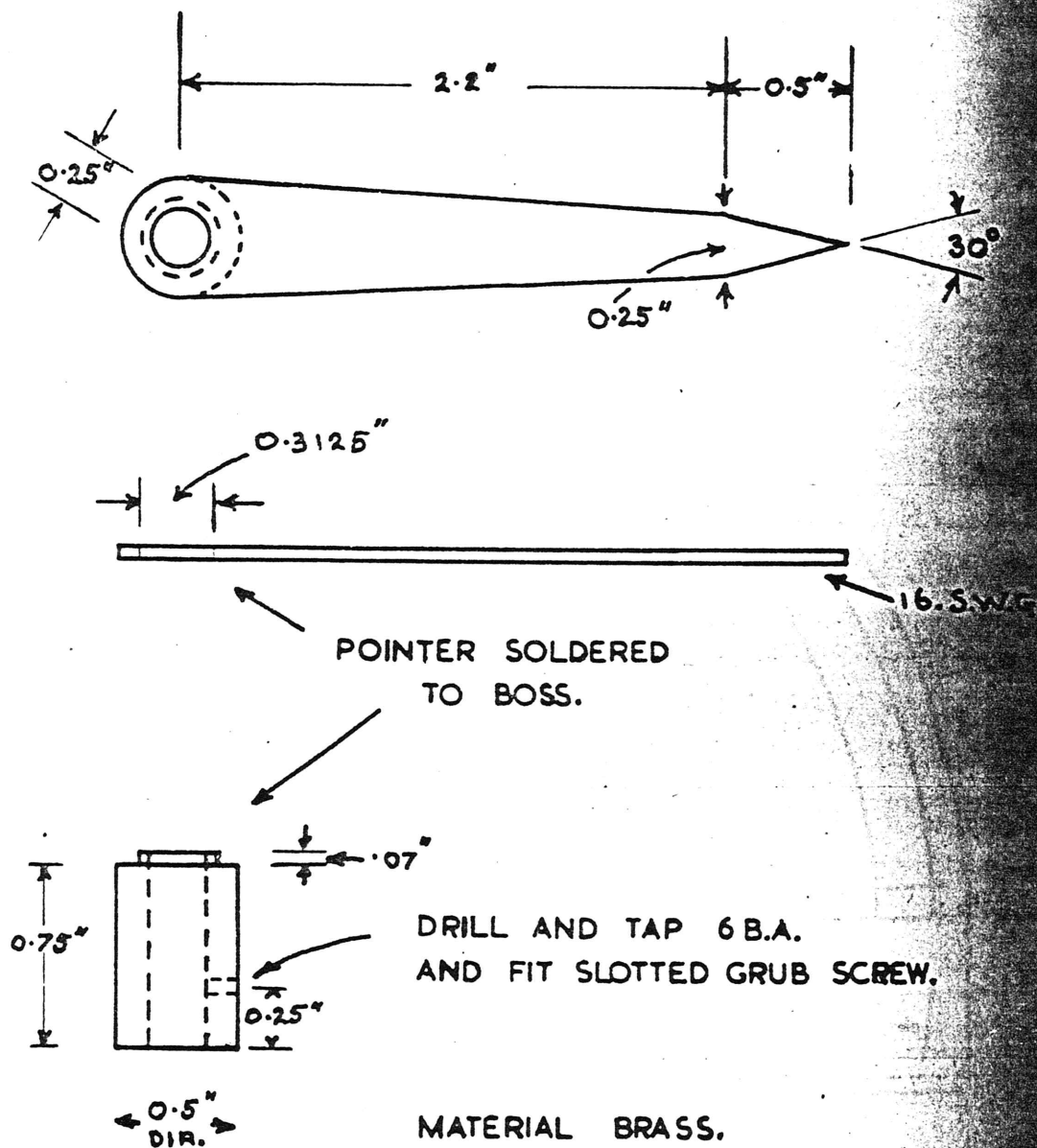
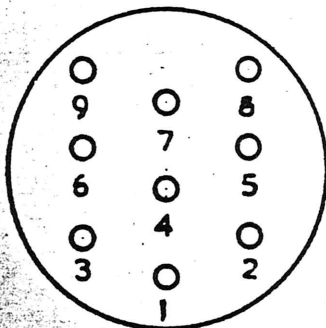


FIG. 4.

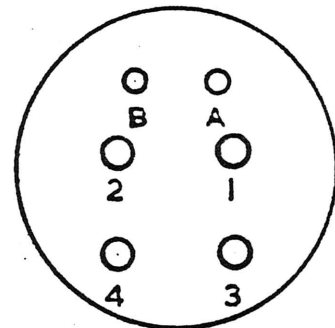
FOLLOW-UP POINTER.

CONTROL, THERMOSTATIC, INCHING.  
FDF/A/ SERIES.

INPUT

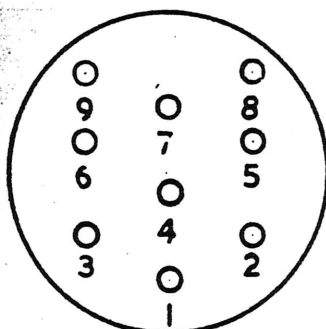


OUTPUT

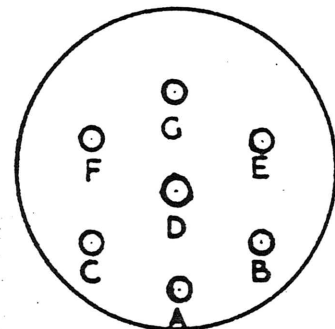


TYPE FDF/A/1510

INPUT



OUTPUT



TYPE FDF/A/1224

TYPE FDF/A/885

TYPE FDF/A/2390

BREEZE PLUG PIN CONNECTIONS  
PLAN VIEW



(A.P.113, Sect. 3D)

**RESTRICTED**

AIR PUBLICATION

**1275A**

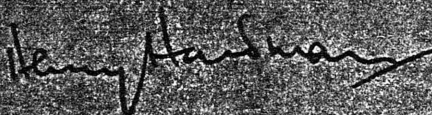
**VOLUME 1**

**SECTION 24**

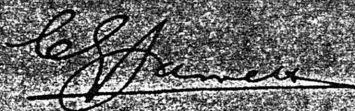
# **GENERAL INSTRUMENTS**

## **AUTOMATIC SWITCHES**

Prepared by direction of  
the Minister of Aviation



Promulgated by  
Command of Their  
Lordships



**ADMIRALTY**

Promulgated by  
Command of the  
Air Council



**AIR MINISTRY**


(A.L.94, Apr. 63)



## SUB-SECTION B

## LIST OF CHAPTERS

Note - A list of contents appears at the beginning of each chapter

- 2 Switches, thermostatic, FAP/A Series
- 3 Controls, thermostatic inching, FDF/A Series (Cancelled: now issued as A.P.112G-1129-1)
- 4 Thermostatic switches (Flamestats), Type FH0, spring-operated types (Cancelled: now issued as A.P.112G-1122-1)
- 5 
- 6 Thermostatic switches (Flamestats), Type FH0, lever-operated types (Cancelled: now issued as A.P.112G-1122-1)
- 7 Overheat switches, Type FET (Cancelled: now issued as A.P.112G-1127-1)
- 8 Temperature sensing elements (Ductstats), Type FHG/A Series (Cancelled: now issued as A.P.112G-0216-1)