REPAIR OF Fairey METAL PROPELLERS

GENERAL SPECIFICATION F.A.C. 1

ISSUE 3

AS AMENDED

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The FAIREY AVIATION Co. LTD.

REPAIR SPECIFICATION NO. F.A.C.1.

Issued by:-

The Fairey Aviation Co.Ltd., Hayes, Middlesex.

For repair of:-

Fairey Two Bladed Metal Propellers.

This folder contains information of a general character applicable to all Fairey Two Bladed Metal Propellers, and should be used in conjunction with Supplements which are issued for individual Propeller Types.

In all cases where a Supplement is referred to in the following pages, the Supplement appropriate to the Propeller Type under consideration, is inferred.

All enquiries relating to Propellers should be marked

"For the attention of the Propeller Department".

Section 1.

Identification of [illegible] Metal Propellers.

Fairey Metal Propellers are identified by (a) the Drawing No., together with (b) the Anglea Ref.No.

A Propeller cannot be identified unless both are quoted.

Example - Avro Anson [illegible] X3.
(Drawing No.) (Anglea Ref.No.)

The above details will be found marked on the periphery of the boss blocks, as shown in Appendix IV.

In all enquiries regarding propellers, it is advisable also to quote the Blade Serial Number (F.R.No.) which will be found lightly engraved on the edge of the blade at the root.

Section 2.

(1) Examination Prior to Repair.

(i) Propellers must be examined to ascertain the extent of the damage, and to decide whether the blades are repairable or not.

(ii) Remove the spinner, if fitted, taking care to mark the various parts in such a way that they can be re-assembled to an identical position, relative to the blades of the propeller. Damaged or cracked parts should be renewed rather than repaired. If, for instance, plates are riveted to the inside of a spinner body, it will probably be sufficient to upset the balance of the complete assembly.

(iii) Examine the blade surfaces carefully for evidence of cracks or indentations. The blades of a propeller which has operated over loose aerodrome surfaces, or in water spray, may have become pitted or corroded, particularly along the leading edges. This may seriously affect the efficiency of a propeller by destroying the true aerofoil section of the blades. In time it may also encourage the development of fatigue cracks, and the failure of a blade may result with serious consequences. If nicks and erosions are eliminated in the early stages, the blades will retain their efficiency, and the slight effect on propeller balance will not be noticeable in operation.

(iv) Remove the boss blocks from the blade in accordance with the instructions contained in Appendix 1. Blades which show signs of cracks originating at or near to any of the bolt holes in the blade sheet are not repairable, and must not be put back into service.

(v) Examine the radius on the bolt holes, and where this is not a smooth highly polished radius, a radius must be applied and polished in accordance with the instructions contained in Appendix 1.

Section 3.

(1) Treatment of Damaged Blades.

In general, the extent of damage repairable, may be classified as follows:-

(i) General erosion, corrosion, and abrasion over a limited area.

(ii) Nicks and dents of a minor character.

(iii) Bent Blades.

(2.) General Erosion, Corrosion and Abrasion, over a Limited Area.

Where erosion, corrosion and abrasion can be cleaned out without exceeding the normal repair tolerances for the type (see Sheet No.3. of the appropriate supplement) it shall be removed with a smooth file or scraper, and the location polished with fine emery cloth.

(3) Nicks and Dents of a Minor Character.

(i) Where a local indentation or nick is in excess of the normal repair tolerances, but is within the tolerances given for Nicks and Dents (Sheet No.4 of Supplement) it shall be removed with a smooth file or scraper, and finished off with fine emery cloth. Sharp cornered indentations should be blended out to form smooth rounded depressions, removing as little material as possible. The location shall then be polished with fine emery cloth, and metal polish, and well washed.

(ii) This treatment leaves a surface which will show up any small cracks under a magnifying glass. A good hand lens having a magnification of 5 to 8 dias: is suitable for this purpose. Unless a polished surface is obtained, minute fissures are liable to remain hidden by reason of the metal being burred over in the filing and scraping process. All marks left by the file or emery cloth must be eliminated.

(iii) The examination of the blade surfaces for cracks and fissures is most important, since the presence of any such cracks and flaws may have serious consequences, more particularly when they are parallel to the chord of the blade.

(iv) Where available, anodic treatment may be considered fully satisfactory in rendering flaws and cracks easily discernible.

(4) Bent Blades.

(i) A blade bent under the boss seating, and evidenced by cracking of the boss blocks is not repairable.

(ii) Blades bent to angles not exceeding those given by curve "A" Appendix II may be straightened cold (without annealing) twice only in succession; for the third repair they must be annealed before straightening and finally heat treated.

(iii) Thereafter, two more cold straightenings (without annealing) are permissible before annealing again becomes necessary. This procedure may be carried on indefinitely.

(iv) Blades bent to angles more than those given by curve "A", but not exceeding those given by curve "B" Appendix II, may be straightened provided that blades so bent have been annealed prior to each straightening.

(5) Annealing and Normalising.

Important Note:-

Annealing and the necessary re-heat treatment (Normalising), must only be given at the Works of The Fairey Aviation Co.Ltd.

(6) Blade Straightening.

(i) A visual examination of the blades will indicate the position of maximum bend.

(ii) Measure the angle of bend at this position, using the special protractor shown on Appendix III. Care must be taken when using this protractor, that the straight edges are truly tangential to the blade surface at the one inch scribed lines.

(iii) Measure the blade thickness at the location of maximum bend, with suitable calipers.

(iv) The angle of greatest bend, and the thickness of the blade having been ascertained, consult the curves on Appendix II, and check whether the blade is

(a) Beyond repair.

(b) Suitable for straightening after annealing.

(c) Suitable for cold straightening.

(v) Having decided that a propeller can be cold straightened, proceed to straighten with the aid of a suitable press. For this purpose, the blade should be supported on blocks of duralumin, or hard wood, from which all sharp edges have been removed. If, however, it is considered that the propeller is suitable for straightening only after annealing, it should be returned to The Fairey Aviation Co.Ltd., for repair.

(vi) When the blades have been straightened as near as possible checking with a straight-edge on the flat face, re-mount the bosses. Refer to markings to ensure correct assembly. Check seating of bosses on the blade, and re-bed where necessary, takin great care that the boss faces are parallel on final assembly.

(vii) <u>To check the Blade Angles.</u>

Place the propeller on a surface table, marked off to correspond with the stations of the propeller, and having a centrally mounted spindle, bushed to suit the bore of the propeller.

(viii) Check the blade angles at the respective stations, and where necessary correct in a twisting machine. The twisting machine should clamp the blade at two stations about six inches apart. Blades may be twisted in the normalised condition up to 0° 30' per six inches length of the blade. For greater twists than this, the propeller must be returned to The Fairey Aviation Co.Ltd., for heat treatment and twisting.

(ix) <u>To check Projected Plan Form.</u>

Check the projected plan form, one blade with the other, in the following manner:-

Rotate the blade on the surface table until at any given station the leading edge of No.1 blade is vertically above the centre line of the table; check with a square. Now check the position of the leading edge of the same station on No.2.blade. Repeat this for all stations, and check the discrepancies against the limits set out on Sheet No.3. of the appropriate Supplement.

(x) <u>To check the Track.</u>

Measure the height of the leading edge at each station, and compare with the height of the leading edge on the other blade at the same station. Allowance must be made for nicks when carrying out this operation.

(xi) Correction to projected plan form and track can be made by pressing the blade up or down within the limits allowed by the dihedral. As correction to projected plan form may upset the blade track, it should be remembered that, bending the blade at a station where the angle is high, will give the largest correction to projected plan form with the least alteration to track. Bending the blade where the angle is low, will have the effect of altering the track without appreciably affecting the projected plan form.

(7) <u>Damaged Blade Tips.</u>

(i) Slight corrugations along the edges close to the blade tips may be hammered out on a flat surface

(ii) Extensive damage to blade tips may be removed by cropping within the limits shown on Sheet No.5. of the Supplement appropriate to the particular propeller, and retwisting where necessary.

(iii) When carrying out repairs of this character, the blade tip shall be dressed down to a smooth radius blending with the surrounding surfaces. No more metal shall be removed than is necessary to eliminate all the defects.

(iv) The two blades of one propeller must be matched within the tolerances of similarity given on Sheet No.3. of the appropriate Supplement.

(v) All blades to have a smooth continuous contour.

(8) Buffing & Polishing.

(i) Use a rough emery bobbin, and 140 grade emery powder to remove all scratches from the blade surfaces.

(ii) Use a smooth grease bobbin, grade 220 emery powder, and "Albo" grease for polishing, to eliminate all the marks left by the previous process.

(iii) Use a cloth mop (G quality, 8 inch stitched cloth 90 fold), Lustra buffing soap, and emery brushing compound, and finally polish the blade to a high gloss.

(9) Balancing.

The propeller shall be assembled on an engine hub, or special fixture, with a ground spindle at right angles to the longitudinal axis of the propeller. This shall be mounted on accurately levelled and parallel, hardened steel knife-edges, and balanced to within five inch ounces.

(10) Re-Anodising.

When the anodic surface of the blade has been extensively disturbed, or when surface cracks have been worked out, the blade sheet must be completely cleaned of old paint, or dye finish, and re-anodised in accordance with Specificatio . DTD.910.A. When the repair is of a local nature, re-anodising is not necessary, but the area, or areas affected, must be treated with protective varnish, Specification B.E.S.A.2 X 17.
Note:- After re-anodising, and before painting or dyeing the blades, a careful search is to be made for flaws or cracks in the suffface of the blades. These are evidenced by a brown stain, caused by the chromic acid of the Anodic Bath, working out of small fissures which have escaped detection in the polished state. All such cracks or flaws revealed by this process must be removed in the manner described in Section 3, Clause 3.

(11) Painting.

(i) Before painting the blades, re-assemble the bosses.

(ii) Clean the surface down with cellulose thinners.

(iii) Polish with a clean dry rag.

(iv) Lightly spray or brush paint with grey undercoat primer DTD. 314. (Stores Ref. 33B/210) thinned in the proportion of seven parts of paint to three parts of turpentine by volume.

(v) Allow to dry in a warm atmosphere for 8 hours.

(vi) Spray or brush paint with Matt Black Paint DTD. 314. (Stores Ref. 33B/204)

(vii) Screen the blade, leaving four inches of the tip exposed.

(viii) Spray or brush paint the tip on both faces with Identification Yellow, DTD. 314 (Stores Ref. 33B/178).

(ix) Leave to dry for three hours in a warm atmosphere.

(x) As an alternative to painting, blades may be dyed black in accordance with R.D.E. Specification D.[illegible], prior to assembly of bosses; yellow tips being subsequently applied in accordance with paragraphs (vii), (viii) and (ix).

(12) Check Balance.

Check the balance after painting, and correct for uneven painting by the application of more paint on the light blade. Avoid local concentration of paint in carrying out this operation.

(13) Marking of Repaired Propellers.

(i) With the exception of the Blade Serial No. (F.R.No.), which is lightly engraved on the edge of the blade, all marking will be found on the side of the boss blocks, or as in the case of some small propellers, around the periphery of the bore in the front boss.

(ii) All additional marking is to be applied on the side of the bosses. On no account must stamping be carried out on the Propeller Blade sheet.

(iii) After any repair, if the blade is not within drawing tolerances, it shall have the letter "R", plus the Code letter of the Repair Depot, stamped on the side of the boss adjacent to the existing stamping.

(iv) Straightened blades shall also have the following additional markings:-

C. for blades straightened without annealing.

H. for blades straightened after annealing.

C. and H. shall be followed by the number of the straightening.

These markings are additional to, and must follow the Repair Depot Code letter.

(v) In order not to lose the record of straightening operations, markings applicable to subsequent straightening of a blade shall be recorded as suffix additions, e.g. a propeller already marked Repaired F.C.1 (Repaired by the Fairey Aviation Co.Ltd., cold straightened once), which has again been straightened after annealing by The Fairey Aviation Co. Ltd., will have H2 added to its present markings, which will then read Repaired F.C.1. H2.

(vi) The letters C and H must not be used as Code letters by a Repair Depot.

(vii) Cropped Blades.

Propellers which have been cropped must have the word "Cropped" stamped on the side of the boss, followed by the amount by which the diameter has been reduced, e.g., a propeller which has had 1½" removed from each blade tip, will be marked "Cropped" 3"

(viii) Where, due to cropping, it is necessary to increase the blade angles to maintain the performance, this increase must also be recorded on the side of the boss, e.g., an "Anson" Propeller, Drg.No.612714, Angles X3, retwisted +0°-30', would be marked Angles + 30'.

(ix) Subsequent repairs necessitating a further reduction in blade length, and consequently a greater increase in angle, must be marked in the same manner after first cancelling the previous marking.

(x) Typical example of marking a repaired blade is shown on Appendix IV.

(14) Assembly of Propeller with Engine Hub.

(i) In order to ensure smooth running of a propeller on the aircraft, it is essential to see that it is correctly assembled on the Engine Hub.

(ii) Before fitting, the surfaces of the propeller bosses, and the engine hub flanges, should be carefully cleaned in order to ensure that the surface contact is in no way impaired by the presence of foreign matter.

(iii) The following torques have been found satisfactory.

10 m/m dia. Bolts (e.g. Cirrus Minor Propeller Hub) 350 inch lbs.

1/2" dia. Bolts. (e.g. Cheetah 9 and 10 Propeller Hub) 560 inch lbs.

REPAIR SPECIFICATION. Nº F.A.C. 4

TWO BLADED METAL PROPELLERS - ALL TYPES

EXAMINATION & APPLICATION WHERE NECESSARY OF RADII TO HOLES IN THE PROPELLER BLADE SHEET.

(1) IT IS IMPORTANT THAT THE BOSS BLOCKS REMOVED FROM THESE PROPELLERS ARE RE-ASSEMBLED IN THE SAME RELATIVE POSITION. TO THIS END AN UN-BROKEN WHITE LINE APPROX. 3/8" WIDE IS PAINTED FORE & AFT ACROSS THE SIDE OF THE FRONT BOSS, ACROSS THE EDGE OF THE CENTRE PORTION OF THE BLADE & ACROSS THE SIDE OF THE REAR BOSS. THIS LINE MUST BE CONTINUOUS ON RE-ASSY.

NOTE. BEFORE THE INTRODUCTION OF THIS WHITE LINE, ASSEMBLY MARKS IN THE FORM OF A LETTER "O" FOR EXAMPLE WERE STAMPED IN LINE ON THE SIDE OF THE FRONT BOSS, THE EDGE OF THE BLADE, & THE SIDE OF THE REAR BOSS. ALL PROPELLERS IN THIS CONDITION MUST BE BROUGHT INTO LINE WITH THE LATEST PRACTICE BEFORE DISMANTLING THE BOSSES BY PAINTING A WHITE LINE AS DESCRIBED ABOVE ON THE SIDE OF THE PROP: REMOTE FROM THAT ON WHICH THE F.R. Nº APPEARS. SEE FIG. 1.

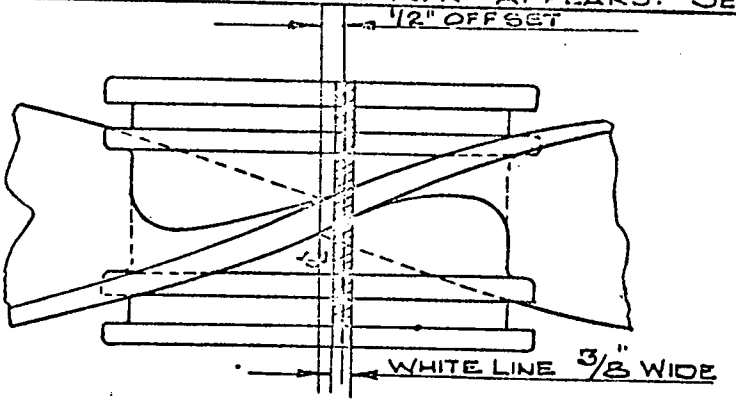


FIG. 1

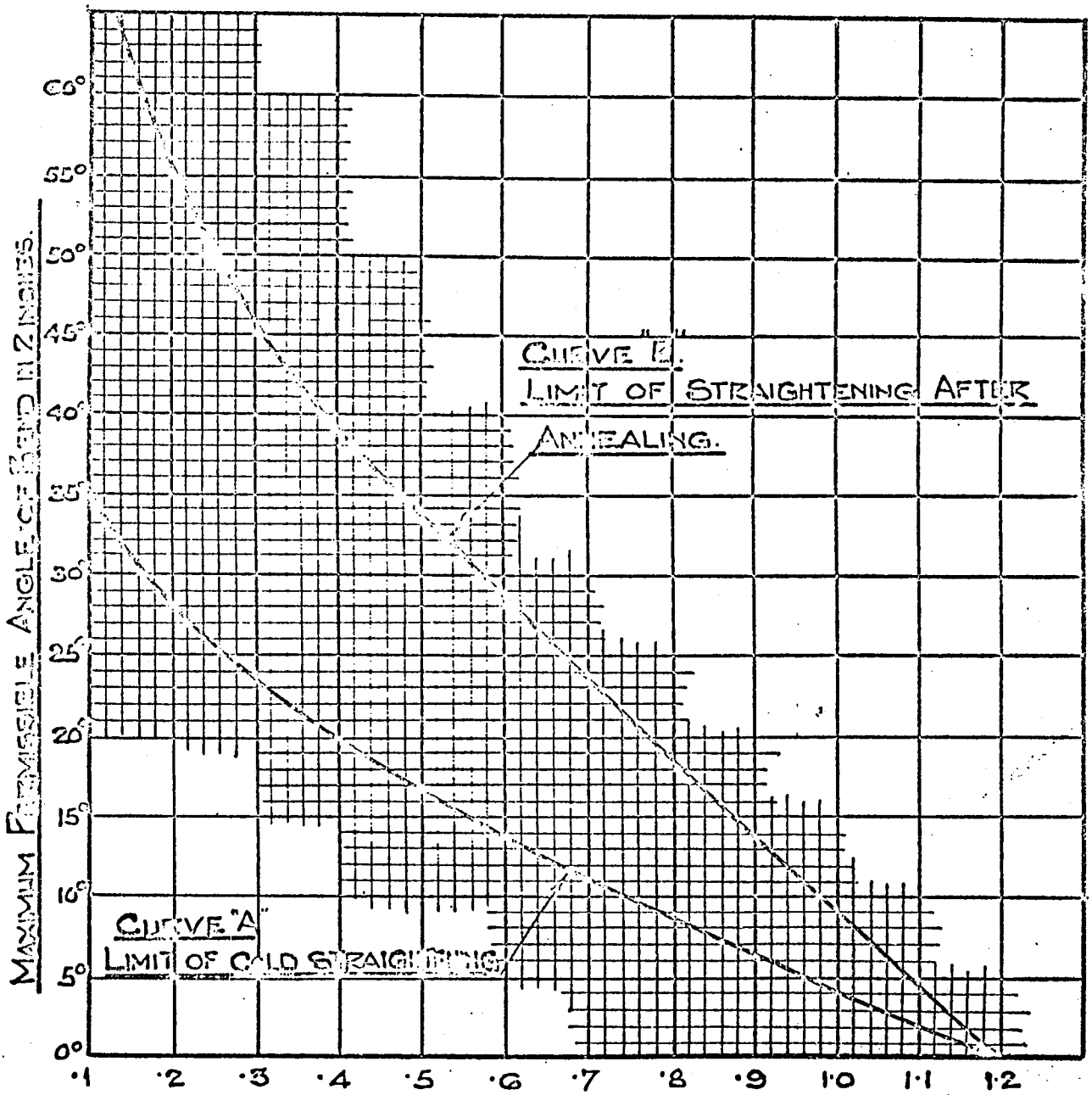
(2) REMOVE STIFF-NUTS FROM THE FOUR 3/8 DIA. LOCATION BOLTS, KNOCK OUT THE BOLTS, & REMOVE THE BOSS BLOCKS FROM THE BLADE SHEET.

(3) EXAMINE THE BLADE SHEET FOR FLAWS OR CRACKS, ESPECIALLY AT THE EDGES OF THE BOLT HOLES. BLADES SHOWING SIGNS OF CRACKING MUST NOT BE PUT BACK INTO SERVICE, BUT MUST BE RETURNED TO THE MAKERS OR AN APPROVED MAJOR REPAIR DEPOT FOR FURTHER EXAMINATION.

(4) EXAMINE THE RADIUS ON THE EDGES OF EACH BOLT HOLE ON BOTH FACES OF THE BLADE, & WHERE THIS IS NOT A SMOOTH HIGHLY POLISHED RADIUS. A RADIUS MUST BE APPLIED WITH A CUTTING TOOL & POLISHED WITH A ROTATING FELT BOB, FIRST USING EMERY COMPO, & FINISHING OFF WITH LUSTRA. COMPOUND.

SEE FIG 2 SHEET 2.

MAXIMUM PERMISSIBLE FOR COLD AND HOT STRAIGHTENING - PROPELLERS MANUFACTURED IN D.T.D. 147.



TWO BLADED METAL PROPELLERS - ALL TYPES

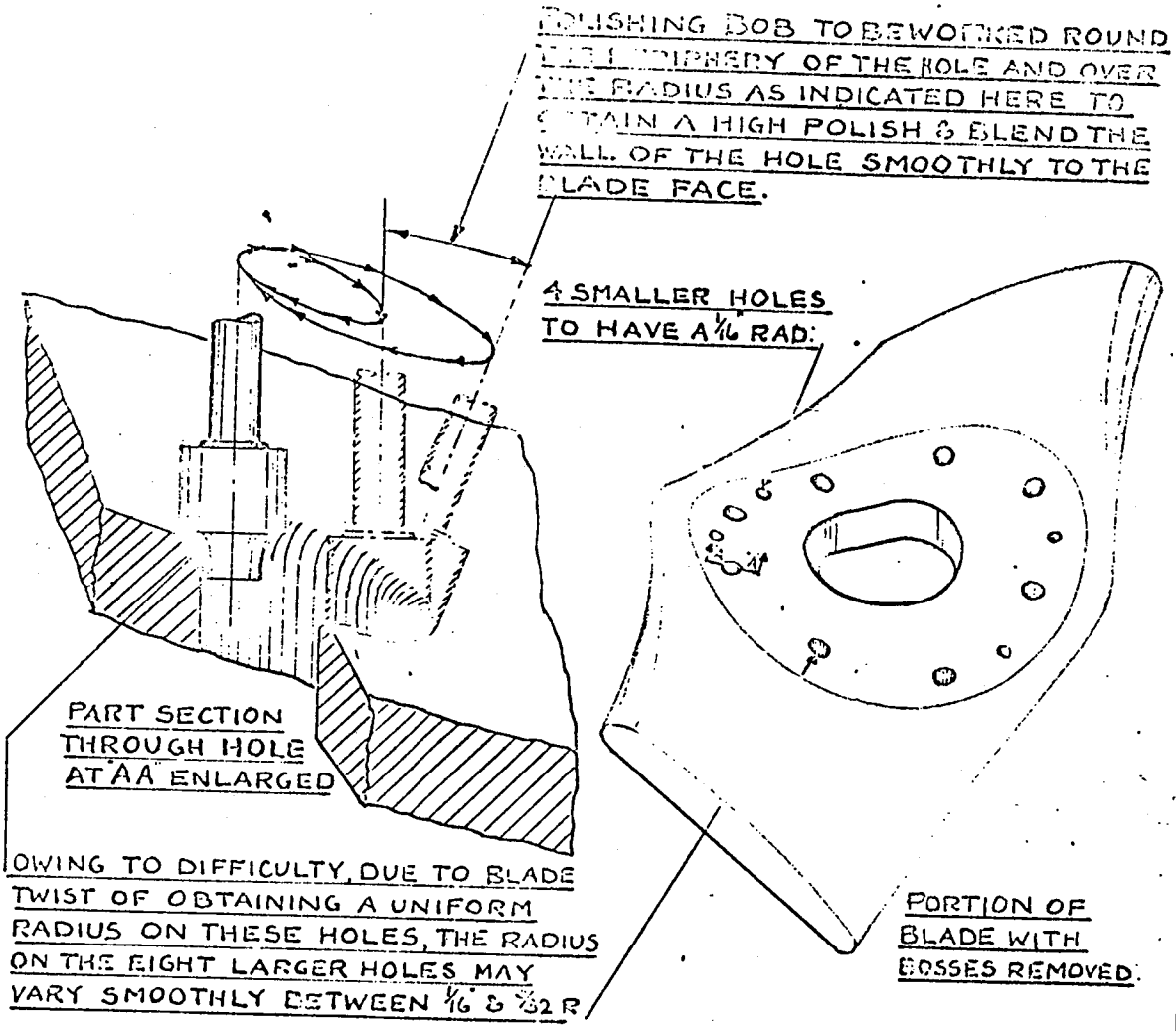


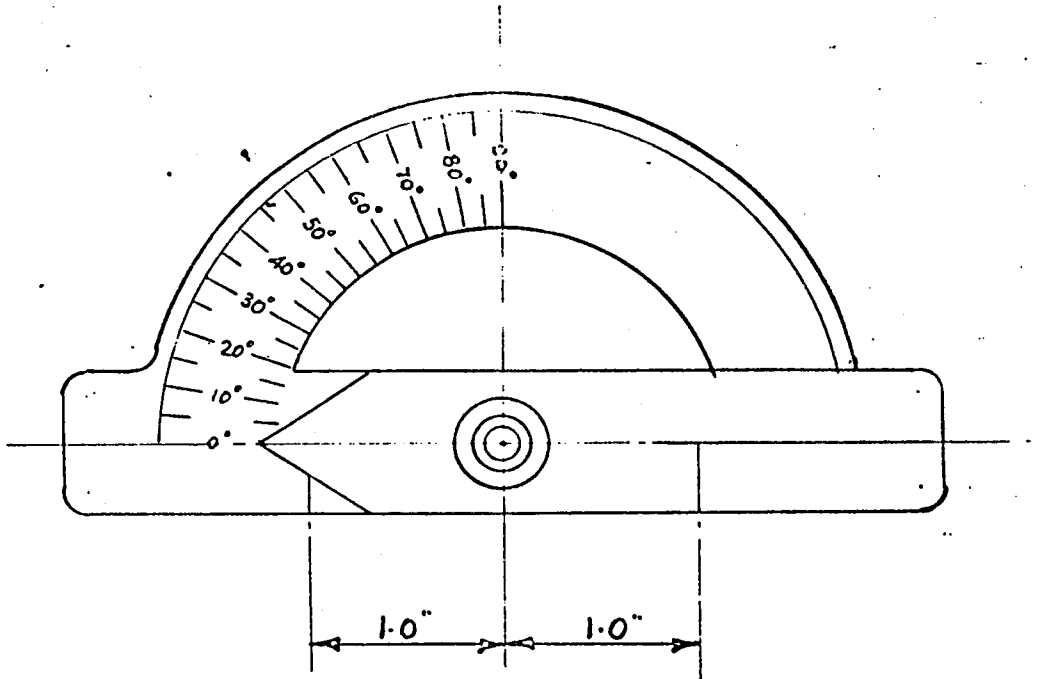
FIG: 2

(V) APPLY PROTECTIVE VARNISH SPEC: B.E.S.A 2X 17 THINLY AND EVENLY TO ALL PARTS WHERE THE ANODIC FILM HAS BEEN BROKEN, TO GIVE PROTECTION AGAINST CORROSION.

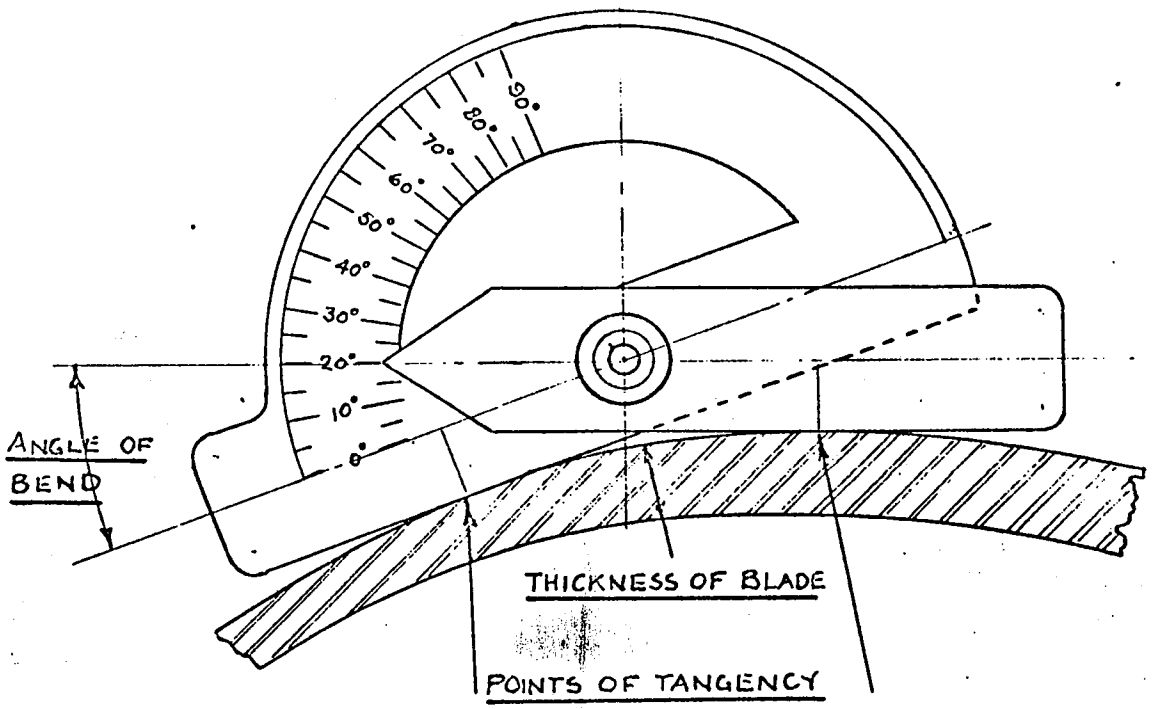
(VI) CLEAN THOROUGHLY WITH RAG ALL CONTACTING SURFACES AND RE-ASSEMBLE THE BOSSES IN THE SAME POSITION AS THEY OCCUPIED BEFORE DIS-MANTLING. REFER TO ASSEMBLY MARKS.

(VII) REPLACE BOLTS WITH THE HEAD IN THE REAR BOSS, (WASHERS FITTED UNDER THE HEADS OF THESE BOLTS MUST HAVE A 1/32" RADIUS APPLIED TO THE EDGES OF THE CENTRE HOLE WHERE THIS DOES NOT ALREADY EXIST) AND TIGHTEN ALL NUTS EQUALLY. WHERE FACILITIES ARE AVAILABLE, CORRECT ASSEMBLY CAN BE CHECKED BY PLACING THE PROPELLER ON A SURFACE TABLE. TRACK DIMS: SHOULD BE WITHIN THE LIMITS GIVEN ON SHEET N°3 OF THE APPROPRIATE SUPPLEMENT.

(VIII) EXAMINE FERODO FRICTION WASHERS IF FITTED AND REPLACE WITH NEW ONES TO DRG N° C.66307, ALL WHICH SHOW SIGNS OF WEAR OR FRAYING



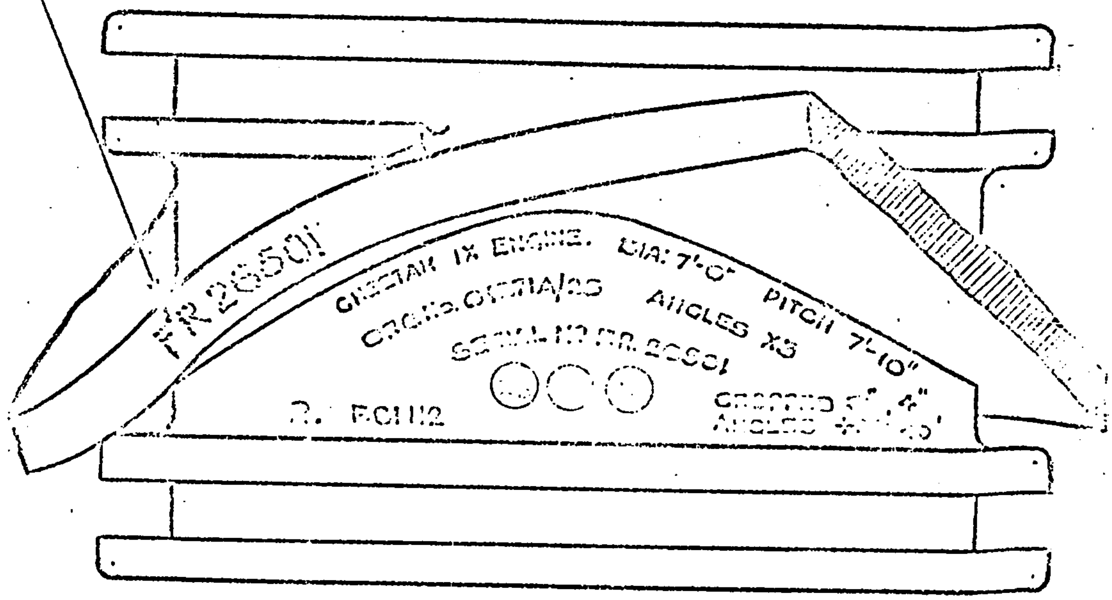
PROTRACTOR



METHOD OF MEASUREMENT OF ANGLE OF BEND ON BLADE

TYPICAL EXAMPLE OF MARKING ON REPAIRED PROPELLERS

THE F.R. Nº WHICH WILL BE FOUND LIGHTLY ENGRAVED HERE IS THE ONLY MARKING TO APPEAR ON THE BLADE SHEET.



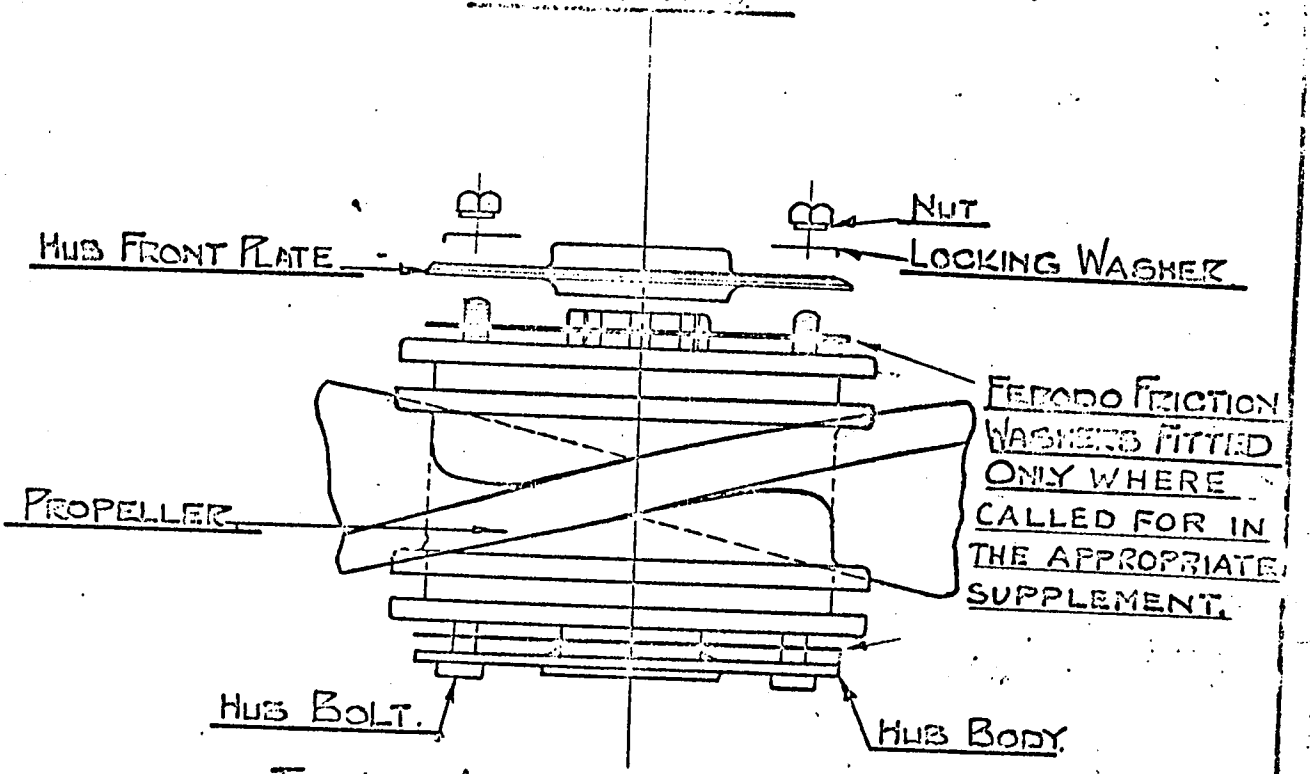
THE EXAMPLE SHOWN ABOVE REPRESENTS AN ANSON PROPELLER THAT HAS BEEN REPAIRED ON TWO OCCASIONS BY THE FAIREY AVIATION CO LTD

THE MARKING SHOWS THAT:-

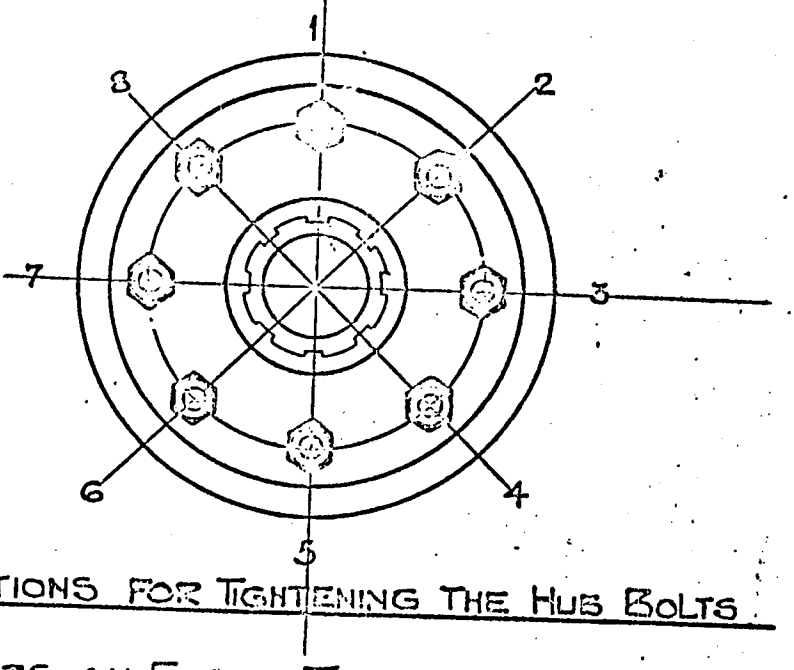
THE FIRST REPAIR WAS A "COLD" REPAIR (C1) AND THAT EACH BLADE HAS BEEN REDUCED IN LENGTH 1½" (3" ON DIA:). TO COMPENSATE FOR THIS THE BLADE ANGLES HAVE BEEN INCREASED ... 30'

THE SECOND REPAIR WAS A "HOT" REPAIR (H2) NECESSITATING ANNEALING. A FURTHER REDUCTION OF BLADE LENGTH AND INCREASE IN BLADE ANGLES HAS TAKEN PLACE, SO THAT THE DIA: IS NOW -4" AND THE

ASSEMBLY OF THE BLACKED TYPE METAL PROPELLER ON [illegible] HUB.



THE HUB ASSEMBLY SHOWN ABOVE IS TYPICAL ONLY.



INSTRUCTIONS FOR TIGHTENING THE HUB BOLTS.

(i) RUN ALL NUTS ON FINGER TIGHT.

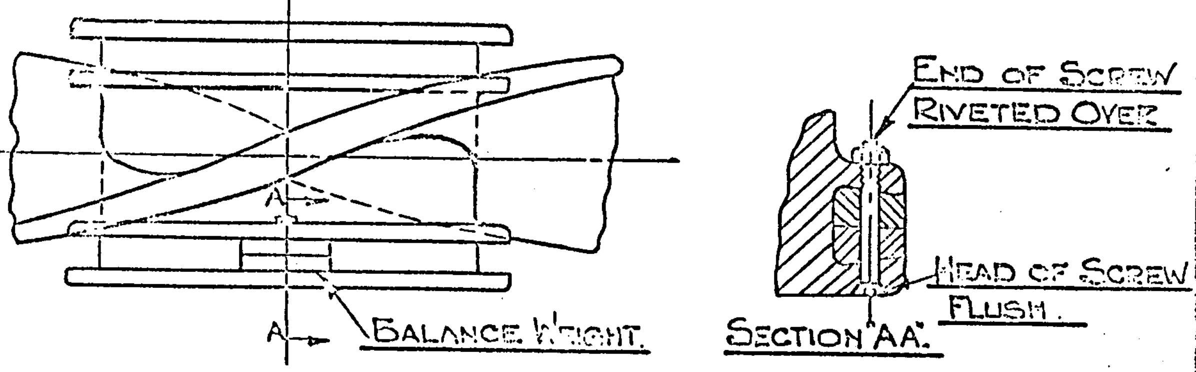
(ii) TIGHTEN NUTS ONE HALF OF A TURN AT A TIME IN THE FOLLOWING ORDER 3,7,1,5,2,6,4,8. REPEAT IN THIS ORDER TILL ALL NUTS ARE TIGHTENED.

(iii) TURN OVER TAB OF LOCKING WASHER, OR FIT LOCKING

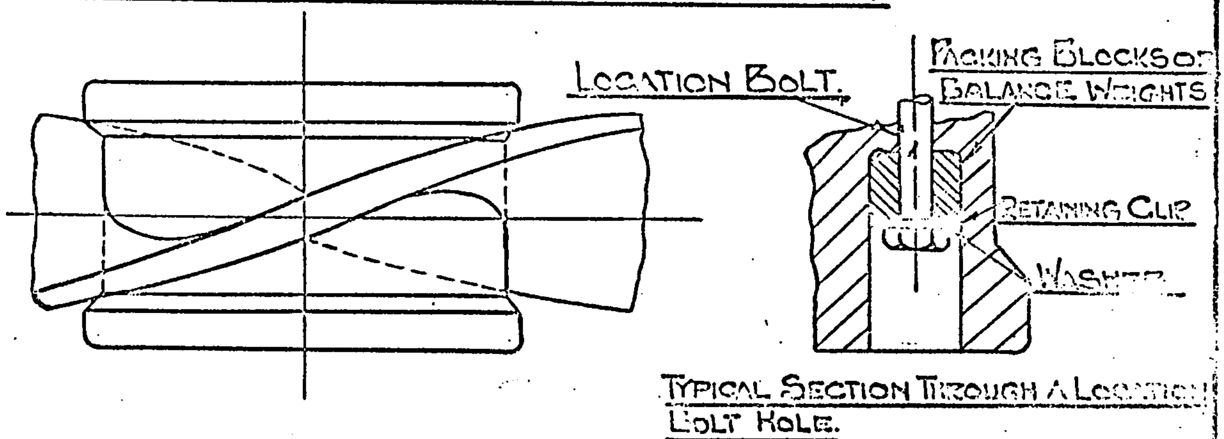
Balance Weights – Fairey Two Bladed Metal Propellers.

The Illustrations Below Show the Method of Securing Mass Balance Weights to Fairey Two Bladed Metal Propellers. These Weights are Fitted by the Makers and must not be Disturbed When Removing Bosses From the Propeller Blade. Any out of Balance Caused by the Removal of Damaged Material From one Blade Must be Corrected by Removing a Similar Amount of Material From the Other Blade, NOT by altering the Size or Position of these Weights.

Propellers Fitted with Metal Bosses.



Propellers Fitted with Phenolic Bosses.



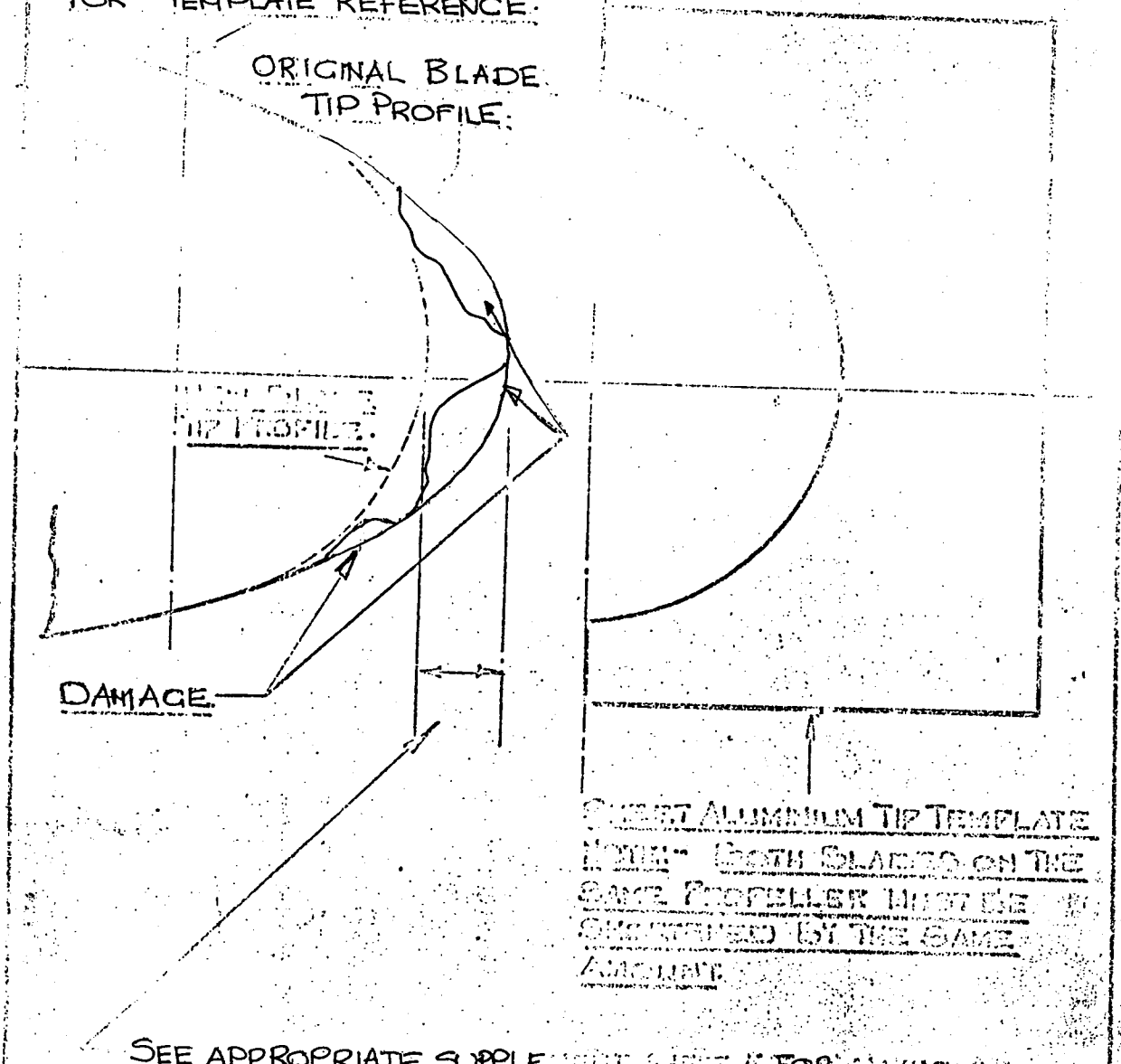
Packing Blocks of Light Material such as Alum^{n} or Dural are Fitted Under the Nuts & Bolt Heads of the Four Location Bolts. Where Balance Weights are Required a Heavier Material Such as Steel is Substituted for Some or All of the Light Packing on Two of the Bolts. Packing Blocks and/or Balance Weights are Retained in the Counterbores by Spring Clips Which Must not on any Account be Removed. Any out of Balance caused by the Removal of Damaged Material From one Blade Must be Corrected by Removing a Similar Amount of Material From the Other Blade Not by Altering the Size or Reversing the Position of these Weights.

Repair Specification. N°F.A.C.I. APPENDIX VIII

Repair on Blade Tips.

MARK PENCIL LINE ON BLADE FOR TEMPLATE REFERENCE.

REFERENCE EDGE OF TEMPLATE



CORRECT ALUMINIUM TIP TEMPLATE USED. BOTH BLADES ON THE SAME PROPELLER MUST BE SHORTENED BY THE SAME AMOUNT.

SEE APPROPRIATE SUPPLEMENT SHEET FOR MAXIMUM AMOUNT WHICH MAY BE REMOVED FROM THE TIP OF PARTICULAR PROPELLER.