Chapter 28F

CENTRE CASING AND NOZZLE RING RENEWALS, RECONDITIONING, REPAIR, AND SALVAGE

Contents

Illustrations

THIS CHAPTER, which is applicable to the centre casing and nozzle ring, contains instructions for reconditioning and repairing worn or damaged components, and for replacing unserviceable parts by serviceable standard parts. Instructions for dismantling and reassembling these components are not given unless they are an essential part of the repair or renewal. Reference should be made to chapters 23, 24, 33, or 34, as appropriate, for further information on dismantling or reassembling individual items before, or after, repair or renewal. The information given in chapter 32 must also be read in conjunction with all repairs dealing with the fitting of "Cross" wire inserts to damaged or worn threaded holes.

Most of the repair information contained in this chapter is based on the manufacturer's turbine repair (T.R.) schemes and process specifications, and, in each instance, the relevant drawing (T.R.) number or specification number followed by its issue number, is quoted; turbine repair schemes are introduced under the cover of a modification and this modification number is quoted also. After any repair or renewal has been completed, an entry should be made in the appropriate record book of the engine in accordance with British Air Registration Board Inspection Procedures, Section ML, Leaflet 1-1. Refer also to the instructions on page 3 of chapter 32 entitled "Repair Identification".

It should be noted that these repairs and renewals must only be carried out under the supervision of an Inspection Organisation approved for such repair work by the British Air Registration Board, or an equivalent authority, or under the supervision of an appropriately licensed engineer. It is assumed also that personnel possessing the requisite skill and experience will be employed and that the recommended tools and equipment will be used.

Normally, where special tools and equipment are available for carrying out the renewals and repairs described in this chapter they are referred to in the text as they are used. Where special tools are not mentioned, reference should be made to The Service Department of The de Havilland Engine Company.

With the exception of damaged studs no additional work is necessary to renew any standard part; the defective parts rejected by inspection being discarded and new, serviceable, or repaired parts being substituted. Loose rivets or studs may be removed in accordance with standard practice and new rivets or serviceable studs fitted. To renew damaged studs 2 B.A. stud box T.70965 will be required.

RENEWAL AND REPAIR OF NOZZLE BLADES AND RING SEGMENTS

The permissible rectification of damage to nozzle blades is detailed in T.R.152. Where possible, these repairs should be carried out with the blades in situ in the inner and outer rings but, where necessary, it is permissible to remove the blades and to refit them after repair. Blades damaged beyond the permissible limits of repair must be renewed as described in these instructions. Loose

blades must be tightened by re-peening in the same manner as that employed to secure new blades into the assembly.

The following sequence of operations describes the method of renewing nozzle blades which are damaged beyond the limits of repair. Only one segment of the outer ring must be removed at a time, and the renewal of the damaged blades in that segment completed before proceeding to the next segment.

Removing an outer ring segment

Before a damaged blade or blades can be removed, the outer ring segment containing the blades must be removed from the assembly. A cracked segments must be removed in the same manner.

(1) Position the nozzle ring on a bench.

(2) Using punch T.76946, drive the blades out of the inner ring by progressive stages of disengagement until the outer ring segment, complete with its set of blades, is freed from the inner ring (Fig. 1).

Removing a blade from an outer ring segment

(1) Position the segment in extracting fixture T.76830 (Fig. 2) and press out the damaged blade.

(2) Repeat Op. 1 to remove any other damaged blades.

Preparation of serviceable blades for refitting

When each damaged blade has been removed, the blades which remain in the outer ring segment should be cleaned up, within the limits specified in T.R.152 (page 9), with a smooth file and emery cloth, and the inner extremity of the lug on each of these blades should be examined. To secure the blades in the inner and outer rings, the blade lugs are peened after assembly, and if, after removal from the inner ring, the spread of metal at the extremity of a blade lug is sufficient to prevent easy reassembly into the inner ring, that blade must be removed from the outer ring segment, as described above, and both its lugs reformed by pressing as described at the top of the next column. The working pressure—which must be found by experience—is governed by the condition of the blade; the pressure required to correct a badly distorted blade will be in the region of 25-30 tons.

(1) Position the blade in tool T.78208 (Fig. 3).

(2) Position the tool under a hydraulic press and press the blade.

Cracked outer ring segments

If an outer ring segment is cracked and has to be replaced by a new or serviceable item, all the blades must be removed from that segment, pressed and cleaned up as described in the foregoing operations.

Peening blades in the inner ring and an outer ring segment

The blades must first be assembled to the inner ring and then the outer ring segment assembled to

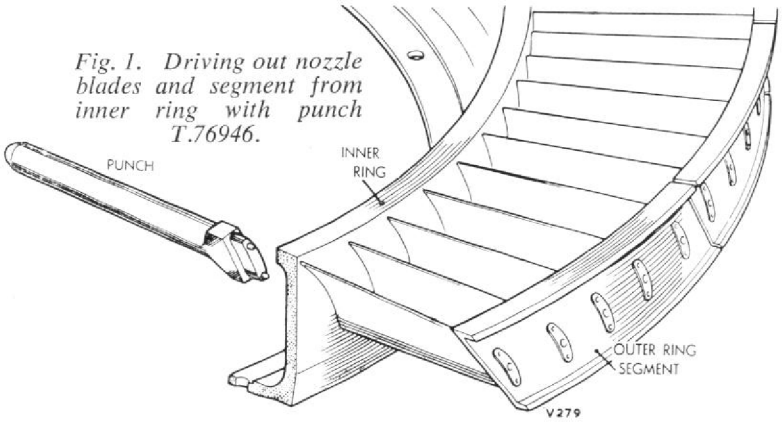


Fig. 1. Driving out nozzle blades and segment from inner ring with punch T.76946.

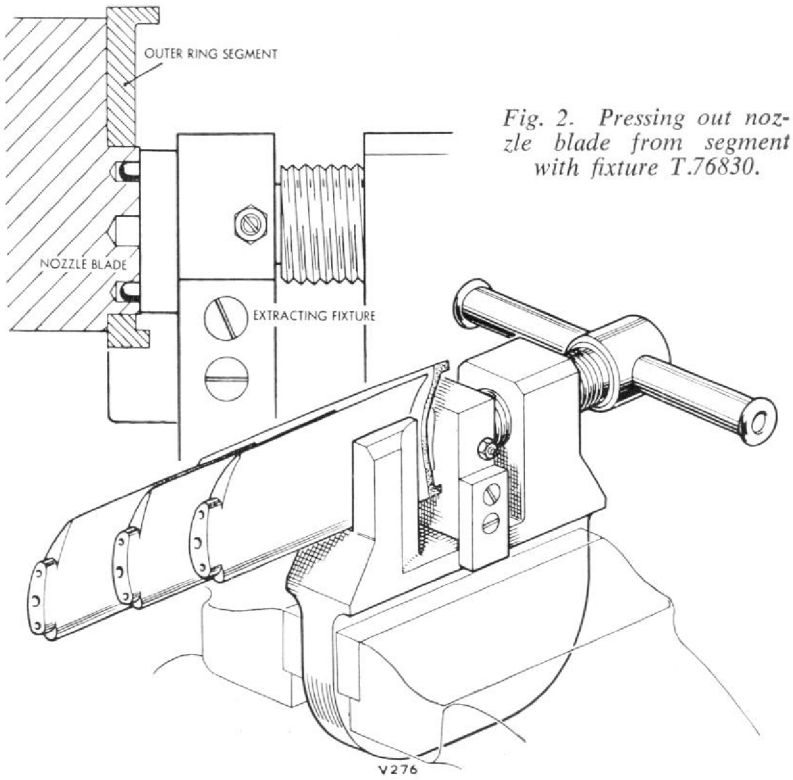


Fig. 2. Pressing out nozzle blade from segment with fixture T.76830.

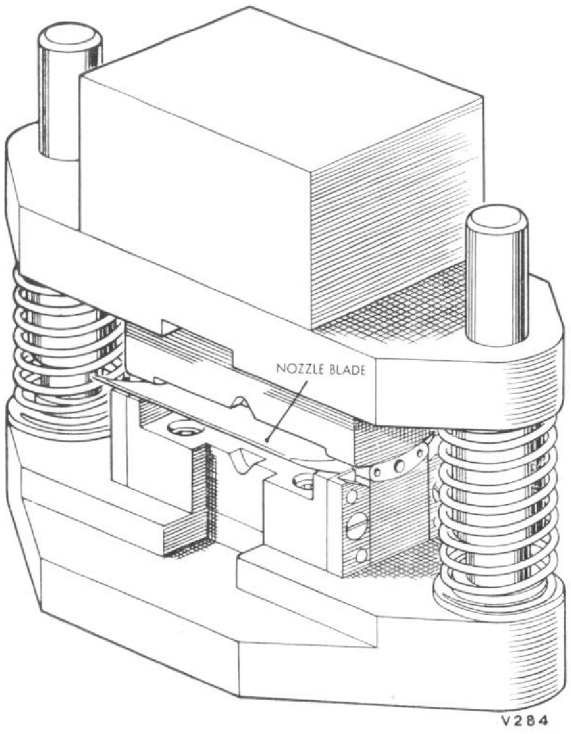


Fig. 3. Nozzle blade in tool T.78208; reforming damaged lugs.

the blades, and secured by peening. First examine the inner ring and the outer ring segment for burrs and rectify as necessary.

(1) Position the integral lug on the blade into the slot in the inner ring, then tap the blade into position with a mallet.

(2) Repeat this operation for the remaining blades.

(3) Assemble the outer ring segment to the blades, locating the integral lug on the blades in the slots in the outer ring segment.

(4) Position the assembly on peening fixture T.76947.

(5) Move the fixture table to apply the inner snap T.76948 and the outer snap T.76949 to the first blade.

(6) Operate the foot control and peen the lugs of the first blade.

(7) Release the control, reset the snaps to the next blade and repeat the operation.

(8) Repeat the procedure for the remaining blades.

(9) Remove the assembly from the fixture.

Machining outer ring segments

New outer ring segments are supplied approximately $\frac{11}{64}$ in. oversize on the width. Therefore if one or more new outer ring segments have been fitted, the new segments must be machined, after the nozzle blades and rings have been peened, to bring the overall width of the complete assembly within the limits specified in Fig. 4. Considerable machining can be avoided if serviceable used segments are employed instead of new segments.

(1) Set up the complete blade and ring assembly on a suitable grinding machine.

(2) Set the spigot "Z" to run true and check that the outside diameter of the rear flange of the outer ring is within the limits specified in Fig. 4.

(3) Grind the front and rear faces of each new outer ring segment to bring them into the same plane as the original segments and within the

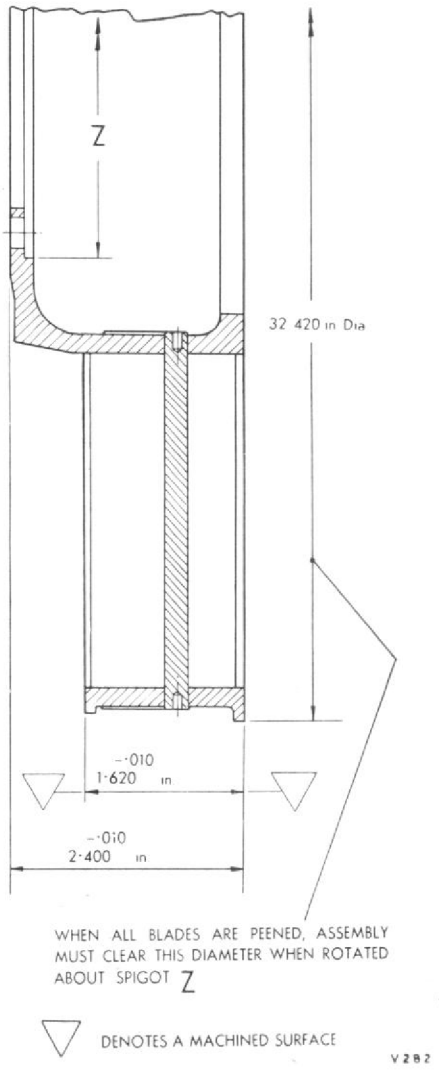


Fig. 4. Machining dimensions for outer ring segment.

limits indicated in Fig. 4. In some instances it may be difficult to grind the new segments without removing metal from the original segments. When this occurs, continue grinding only until the wheel just marks the original segments and complete the facing of the new segments by careful hand filing.

NOZZLE RING, DISCHARGE NOZZLE
T.R.247 issue 5—Mod. 311

This repair may be applied to all pre-mod. 1140 Ghost Forty-eight discharge nozzle assemblies; it is not applicable to Ghost 53 Mk. 1 nozzle assemblies. No replacement parts are required.

A single crack which runs from an inner, or outer, flange bolt hole to the edge of the flange farthest from the discharge nozzle port (see Fig. 5) is permissible, and need not be repaired; an assembly is acceptable even if all the bolt holes are so damaged. A crack which extends from a bolt hole towards the discharge nozzle port, must be repaired for its entire length. If more than ten cracks in the outer flange, or more than five cracks in the inner flange require repair, or if two adjacent bolt holes in either flange have cracks which extend right across the flange, the assembly is beyond repair and must be rejected.

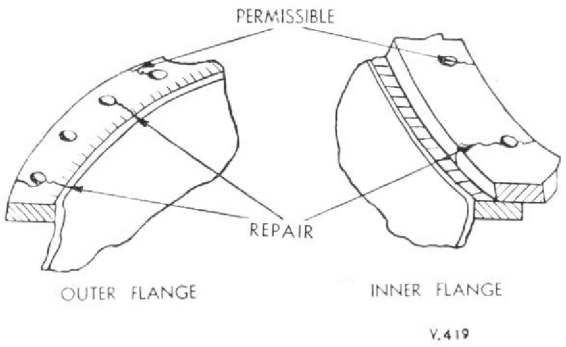


Fig. 5. Discharge nozzle inner and outer flanges, showing examples of cracks which are permissible without repair and cracks which must be repaired.

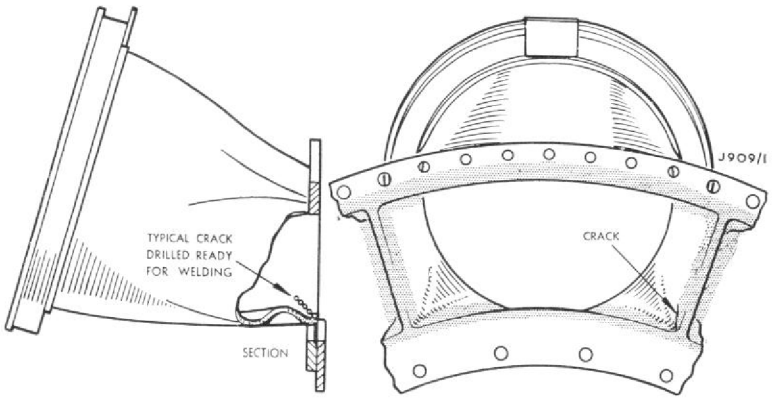


Fig. 6. (Right) possible location of cracks in discharge nozzle indicated by shading; (left) example of crack prepared for welding.

Cracking of the welded joints in the area shown dotted in Fig. 6, may be repaired irrespective of length, but cracks in the bore of each entry duct—an example is shown in Fig. 6—may be repaired only provided that no crack exceeds 1·500 in. in length. All cracks must be argon-arc welded using filler rod to Specification D.T.D.549.

The following tools will be required:—

Tool No.	*Description*
T.77126	Restraining ring
T.78776	Welding jig
T.79427	Adjusting tool
T.79434	Checking fixture
Standard	Seventy $\frac{5}{16}$ in. B.S.F. bolts
Standard	Seventy $\frac{5}{16}$ in. B.S.F. nuts
Standard	Twenty $\frac{3}{8}$ in. B.S.F. bolts
Standard	Twenty $\frac{3}{8}$ in. B.S.F. nuts

On receipt of the component which is to be repaired, its part number and serial number should be checked against the accompanying documents.

To carry out this repair proceed as follows:—

1. Mount the discharge nozzle assembly on welding jig T.78776, fit the ten bottom segments as shown in Fig. 7, and expand the nozzle ports in an outward direction. The amount by which it will be necessary to expand the ports can be found only by experience, but, as a general guide, the segments should be at an angle of approximately 20 deg. to the base plate of the welding jig.

2. Place the centre spider and the ten top segments in position, Fig. 8, and tighten down the centre spider.

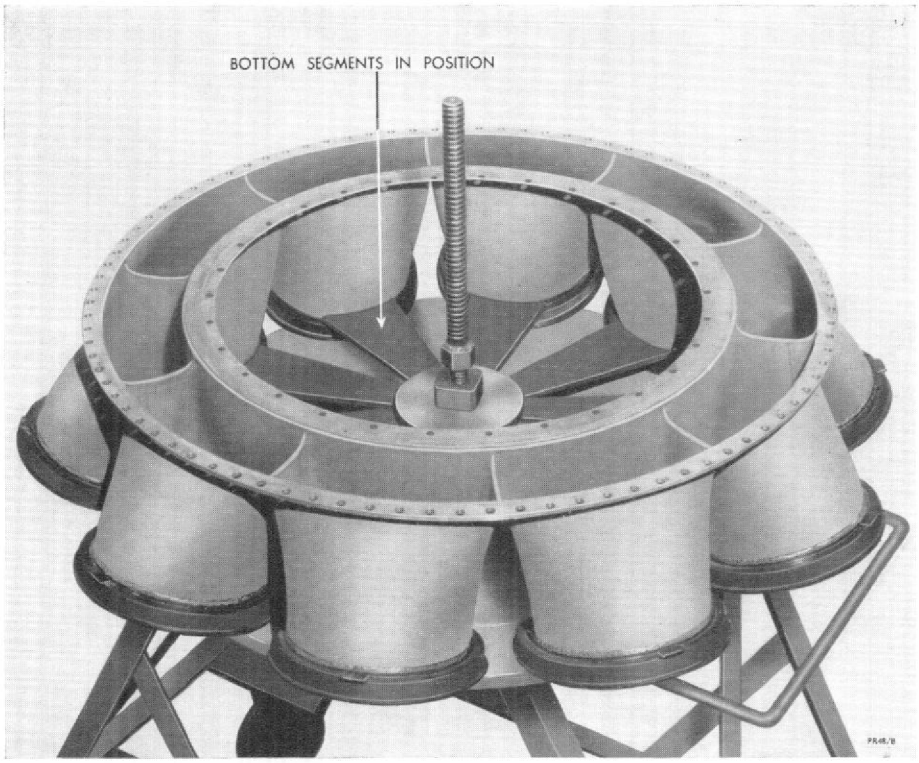


Fig. 7. Discharge nozzle mounted on welding jig with bottom segments in position.

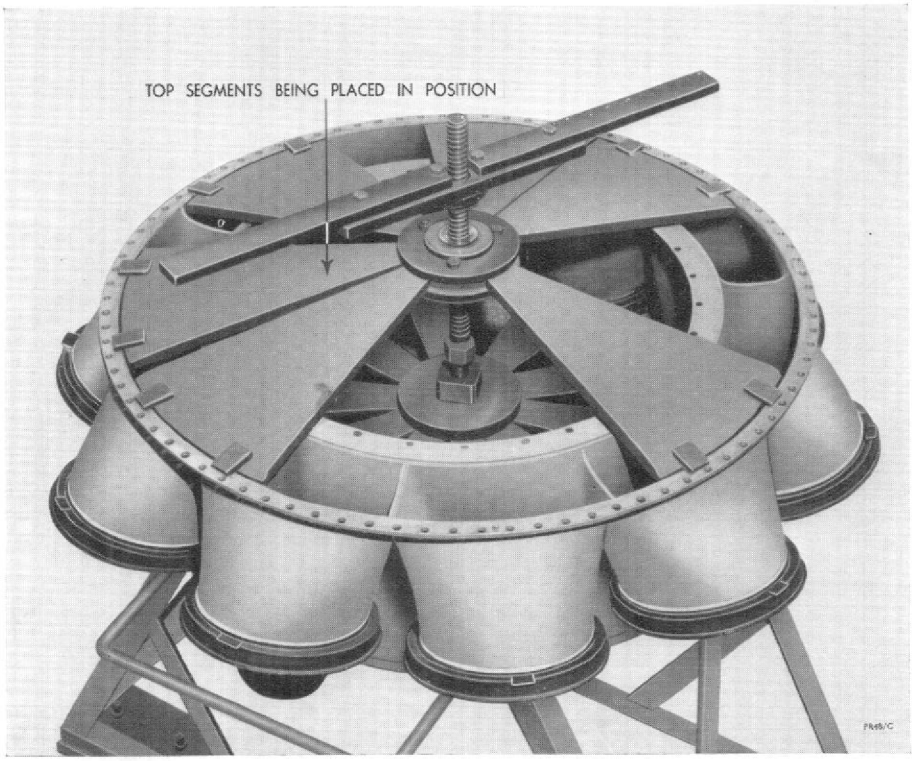


Fig. 8. Showing method of fitting top segments to discharge nozzle.

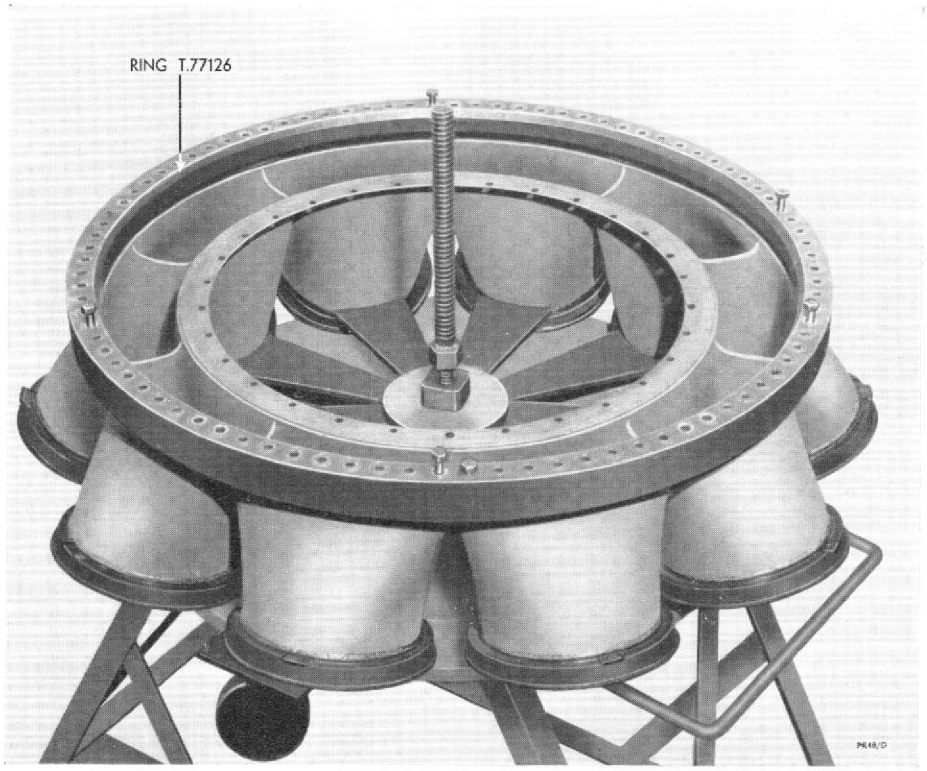


Fig. 9. Restraining ring in position on outer flange of discharge nozzle.

3. Pre-heat the outer flange by playing the flame of a gas jet onto it. Slowly turn the complete assembly to ensure even heating and expansion, and, at the same time, progressively tighten down the centre spider. This operation is to enable restraining ring T.77126 to be bolted in position on the flange, and the amount by which the flange will have to be expanded can be found only by experience. If the discharge nozzle assembly is not unduly distorted it may be possible to fit the ring without pre-heating, or expanding the flange, and this should be checked before commencing this operation.

4. Allow the flange to cool down, and remove the ten top segments, and the centre spider. Position restraining ring T.77126 on the flange, Fig. 9, and secure it in place with ninety slave bolts and nuts. The assembly is now ready for welding.

5. Remove metal along each crack by drilling $\frac{1}{16}$ in. diameter holes to the depth, and length, necessary to remove the original outline of the crack. Clean off any oil or grease, and, using a rotary wire brush, thoroughly clean in and around the crack until bright metal is exposed. Using the recommended filler rod, argon-arc weld the crack.

6. File, or grind, the welds in the bore of each entry duct until they are flush with the skin; similarly, blend the welds which protrude above the flanges until they are flush with the surrounding face.

7. Remove the slave nuts and bolts, and lift off the large ring. Place a long straight-edge across the flanges, and check with feeler gauges that the face of the inner flange is in the same plane as the face of the outer flange; the face of the inner flange is permitted to be within the limits of 0·040 in. above, and 0·015 in. below, the face of the outer flange.

8. Transfer the discharge nozzle assembly to checking fixture T.79434, Fig. 10, and secure it in position by tightening the ten locking plates over the outer flange. Swing the arm of the checking pointer over and into the adjacent

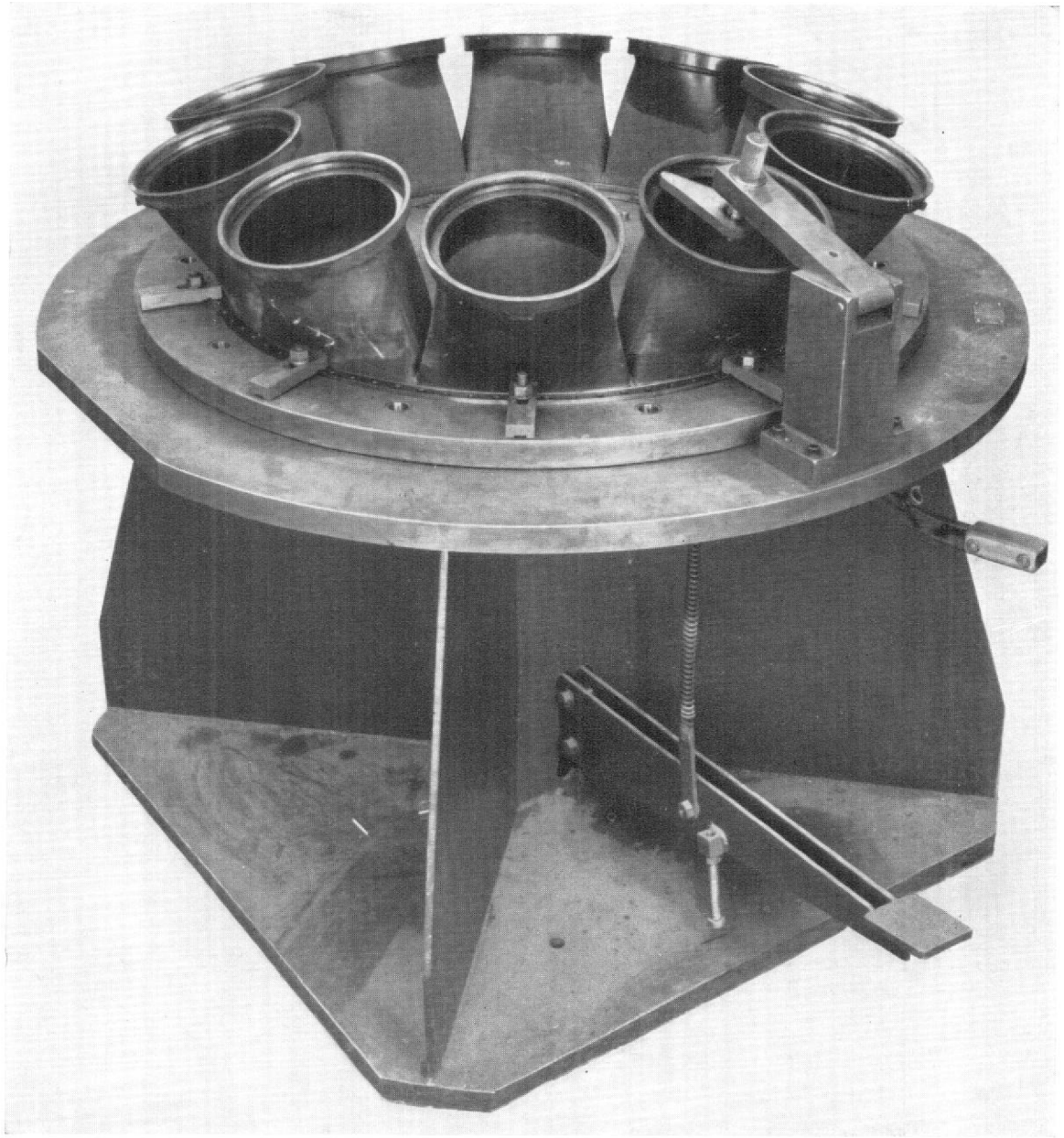


Fig. 10. Discharge nozzle assembly mounted on checking fixture T.79434.

discharge nozzle entry duct, and check with feeler gauges that ovality of the nozzle does not exceed 0·015 in. Ovality can be corrected by judicious use of a steel drift, or with a circular expanding tool. If, however, use of the checking pointer indicates that the complete port has moved in relation to the centre line of the assembly, this movement can be corrected by using adjusting tool T.79427. When using this tool, the bar should be given a short, sharp pull, as a steadily increasing pull will result in the port springing back when the tool is released. To repeat this check in each of the remaining nozzles, swing clear the checking pointer, operate the hand locking-bar, and depress the foot pedal to permit the discharge nozzle assembly to be rotated and the next entry duct to be locked in position.

9. If this is the first time that this repair has been applied, lightly etch T.R.247 adjacent to the existing part number on the discharge nozzle assembly. Make the appropriate entry in the engine log book.

Revised by Amendment No. 134
July, 1957

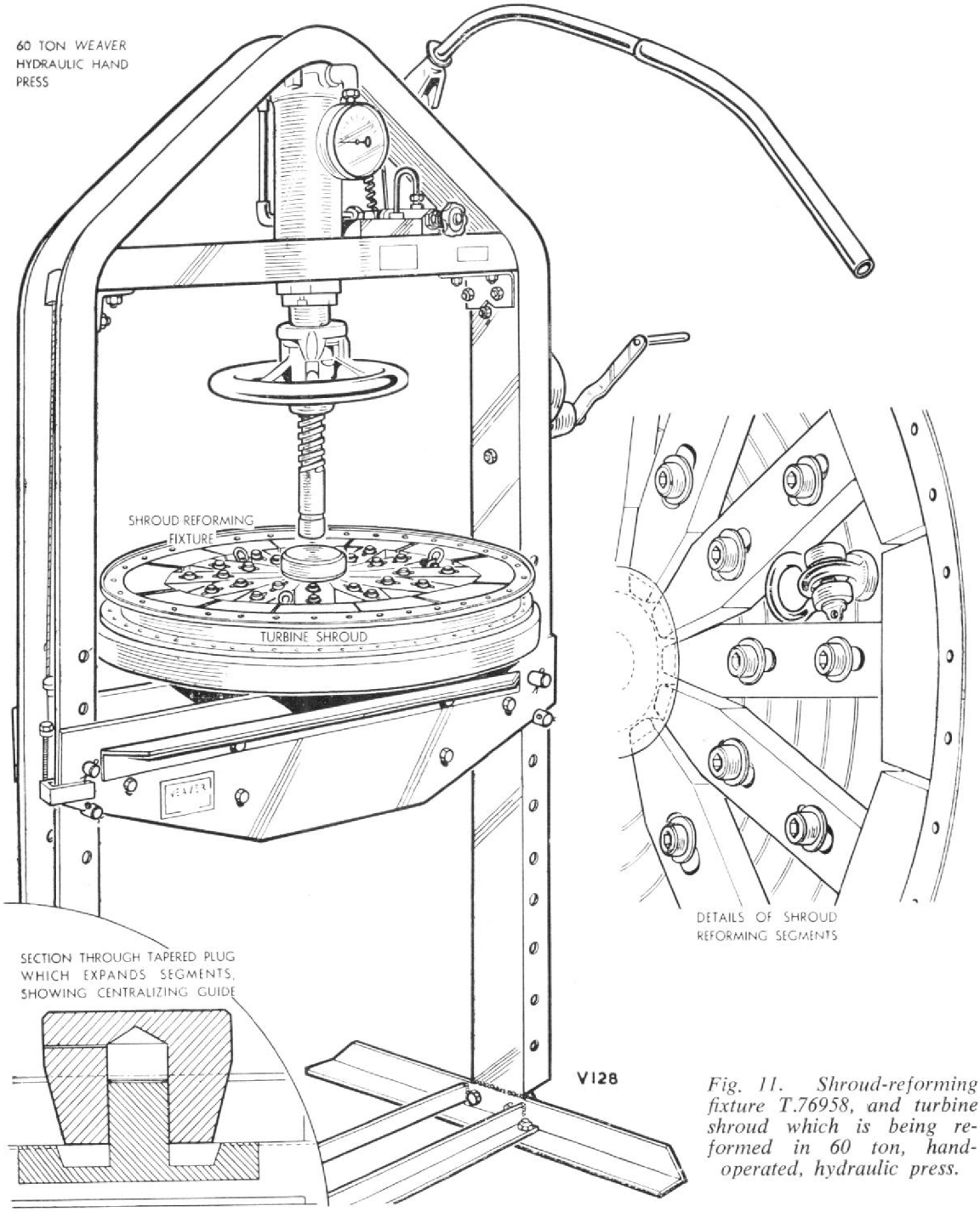


Fig. 11. Shroud-reforming fixture T.76958, and turbine shroud which is being reformed in 60 ton, hand-operated, hydraulic press.

TURBINE SHROUD, DISTORTED BORE
T.R. 376 issue 4—Mod. 1114

This repair may be applied to all Ghost Forty-eight turbine shrouds, pre-mod. 1140.

Turbine shrouds which have become distorted may be repaired in accordance with these instructions. It should be noted that cracks running from any hole, or all holes, towards the outer flange edge are permissible without repair, but if any crack extends inwards from any hole, as shown in Fig. 12, the turbine shroud must be replaced.

SEQUENCE OF OPERATIONS

1. Stress relieve the component at 1050 deg. C. for 30 minutes.

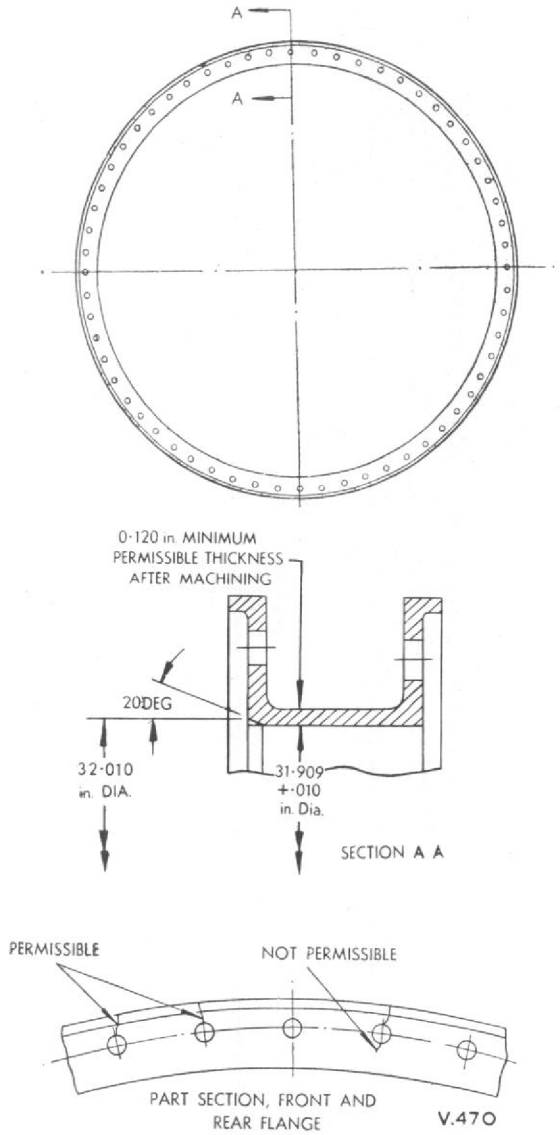


Fig. 12. Limits of cracking and machining dimensions for turbine shroud.

2. Restore the circularity of the distorted shroud as nearly as possible, by applying pressure internally with shroud-reforming fixture T.76958 in conjunction with a 60 ton hydraulic hand press as illustrated in Fig. 11 (facing page), or, if this equipment is not available, with a tool such as that illustrated in chapter 17, or by any similar method. If, prior to this operation, the ovality on the diameter is in excess of 0·060 inch, stress relieve the component at 1050 deg. C. for 15 minutes.

3. Check the bore and side faces. Ovality of the bore, measured radially, must not exceed 0·017 inch total indicator reading, and the side faces must be flat to within 0·030 inch total indicator reading.

4. If ovality of the bore exceeds the limit allowed, machine the bore to the dimensions shown in Fig. 12.

5. If the bore has been machined as in operation 4, stress relieve the component at 1050 deg. C. for 15 minutes and re-check the bore and side faces.

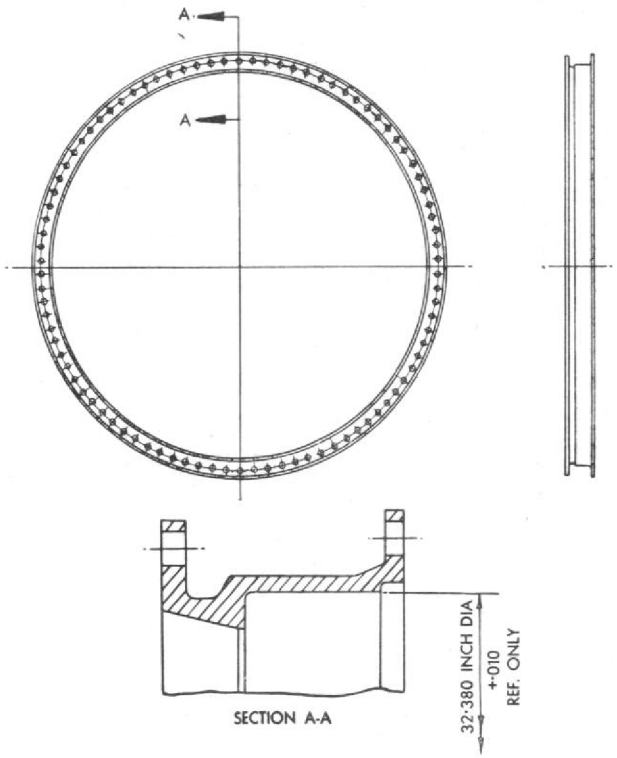
6. Etch T.R.376 adjacent to the existing part number and make an entry in the appropriate record book of the engine.

On page 8, alter issue number of T.R.376 from 4 to 5

NOZZLE SHROUD, DISTORTED BORE
T.R.416 issue 2—Mod. 1267

This repair may be applied to all pre-mod. 1140 Ghost Forty-eight nozzle shrouds.

Nozzle Shrouds which have become distorted may be repaired in accordance with these instructions. It should be noted that a crack which runs from a hole towards the outer edge of a flange is permissible without repair, and any number up to all the holes may be so damaged, but if any crack extends inwards from a hole, the nozzle shroud is beyond repair.



To carry out this repair proceed as follows:—

1. Stress relieve the component at 1050 deg. C. for 30 minutes.

2. Restore the circularity of the distorted shroud, as nearly as possible, by applying pressure internally, using shroud - reforming fixture T.76958 in conjunction with a 60 ton hydraulic hand press, such as that illustrated in Fig. 11 (facing page). If this equipment is not avail-

able, a method similar to that described in chapter 17 for a turbine shroud may be used.

3. Stress relieve the component at 1050 deg. C. for 15 minutes.

4. Check the bore for ovality which must not exceed 0·030 inch total clock reading. Check the side faces, which must be flat to within 0·030 inch total clock reading.

If the limits shown in sub-paragraph 4 above are exceeded, proceed as follows:—

1. Warm the nozzle shroud by suspending it in the vapour rising from a trichlorethylene tank until condensation ceases.

2. Remove the shroud, assemble it to fixture T.76958, and allow it to cool.

3. Recheck the bore for ovality, and the side faces for flatness.

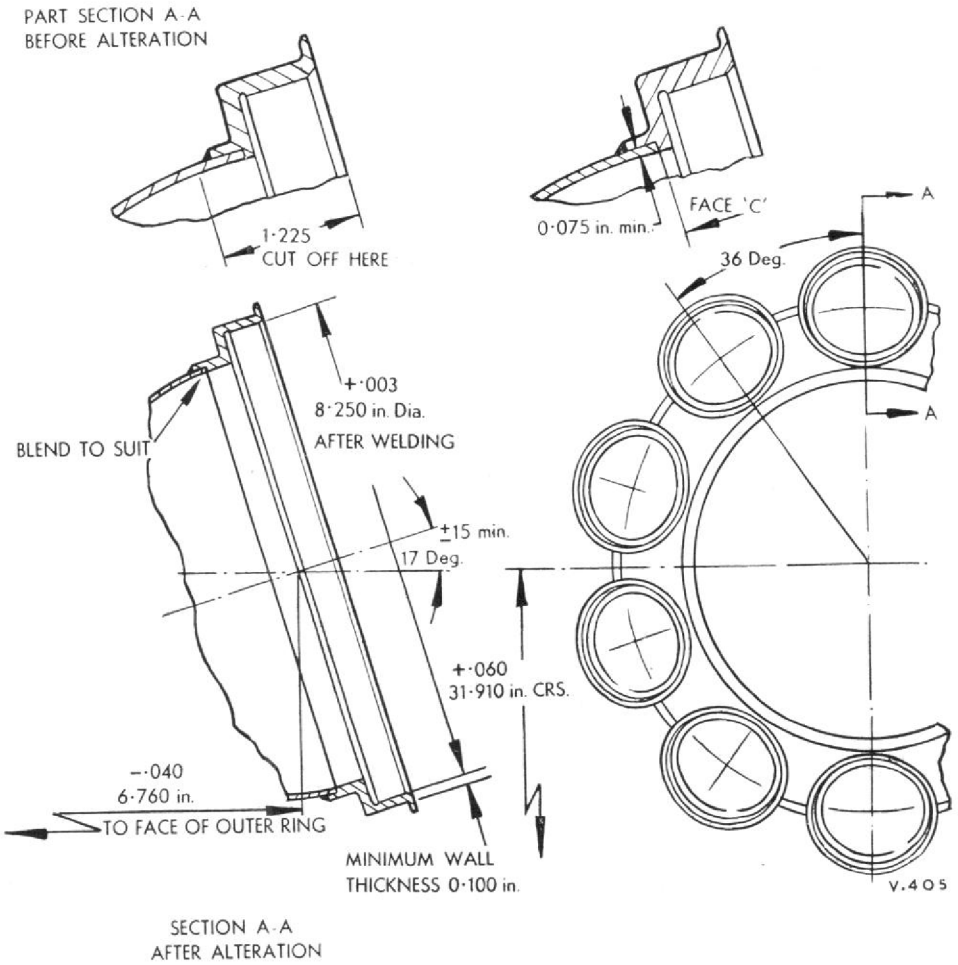
On completion of the repair, and if this is the first time that this repair has been applied, lightly etch T.R.416 adjacent to the existing part number on the nozzle shroud. Make the appropriate entry in the engine log book.

DISCHARGE NOZZLES ASSEMBLY, JOINT RING

T.R.341 issue 3—Mod. 1080

For Information only

If the number T.R.341 is found on a discharge nozzle assembly, adjacent to the normal part number, this indicates that an incorrectly machined joint ring has been replaced either by a new standard joint ring Part No. 93990, or by a special modified joint ring Part No. 603425. This in no way affects the interchangeability of the component nor does it affect its dismantling, inspection, repair, or reassembly.



T.R.341. Discharge nozzle joint rings.

NOZZLE BLADES, REPAIR
T.R. 152 issue 6—Mod. 311

This repair may be applied to all Ghost Forty-eight nozzle blades.

1. DOWNSTREAM (TRAILING) EDGE KINKED. The damage must be completely filed out and the edge blended smooth and radiused; see sketch indicating maximum amount that may be filed out. If any doubt exists concerning damage that is slight, it must be rectified similarly. The complete downstream edge may, if necessary, be filed back to the permitted depth of $\frac{3}{32}$ inch, provided that any damage to adjacent blades is of a minor character.

2. SURFACE PITTING. Damage of a depth equal to one-third the local thickness may be tolerated, provided that any ragged edges are smoothed off to conform to the general profile.

3. BRUISING. If the surface is bruised to the extent of raising a hump on the opposite side of the blade, the bruise must be filed and polished smooth. In many cases this damage is quite smooth and difficult to rectify *in situ*, in such a case it is preferable to leave it as it is.

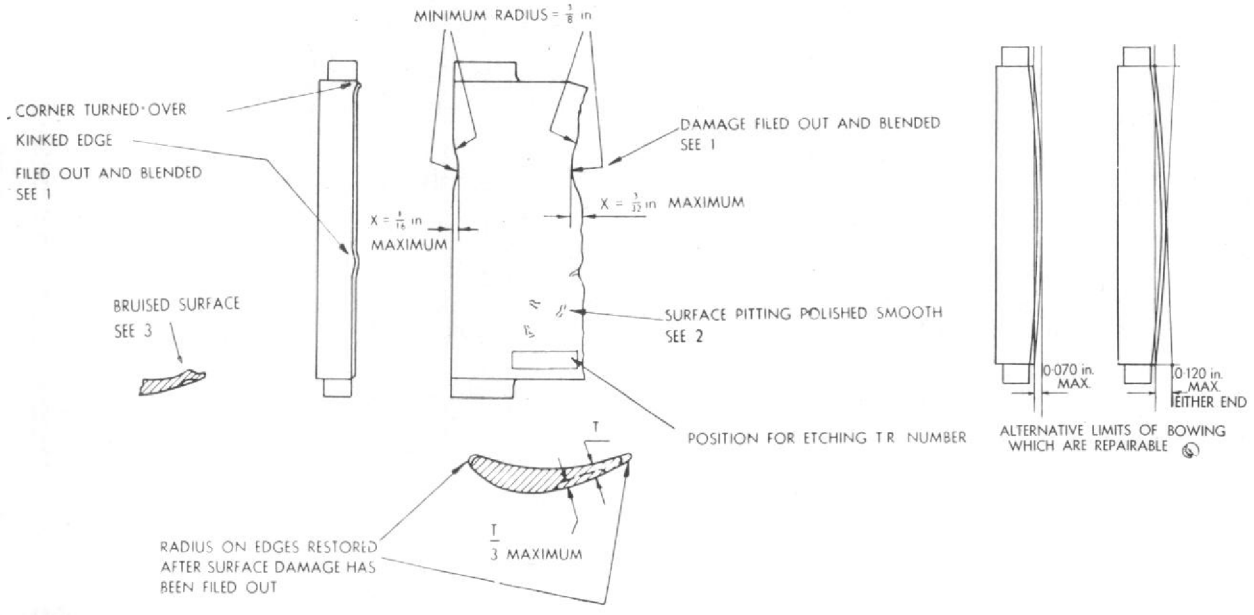
4. UPSTREAM (LEADING) EDGE. Damage on this edge is comparatively rare, due to the robust section of the blade. Pitting and bruising must be filed out and polished and the radius restored. The complete upstream edge may, if necessary, be filed back to the maximum permissible depth of $\frac{1}{16}$ inch, provided that the peening of the blade is not disturbed, and that damage to adjacent blades is not extensive.

5. DOWNSTREAM (TRAILING) EDGE BOWED. Where the amount of bowing does not exceed either of the limits shown, it is permissible to straighten the blade.

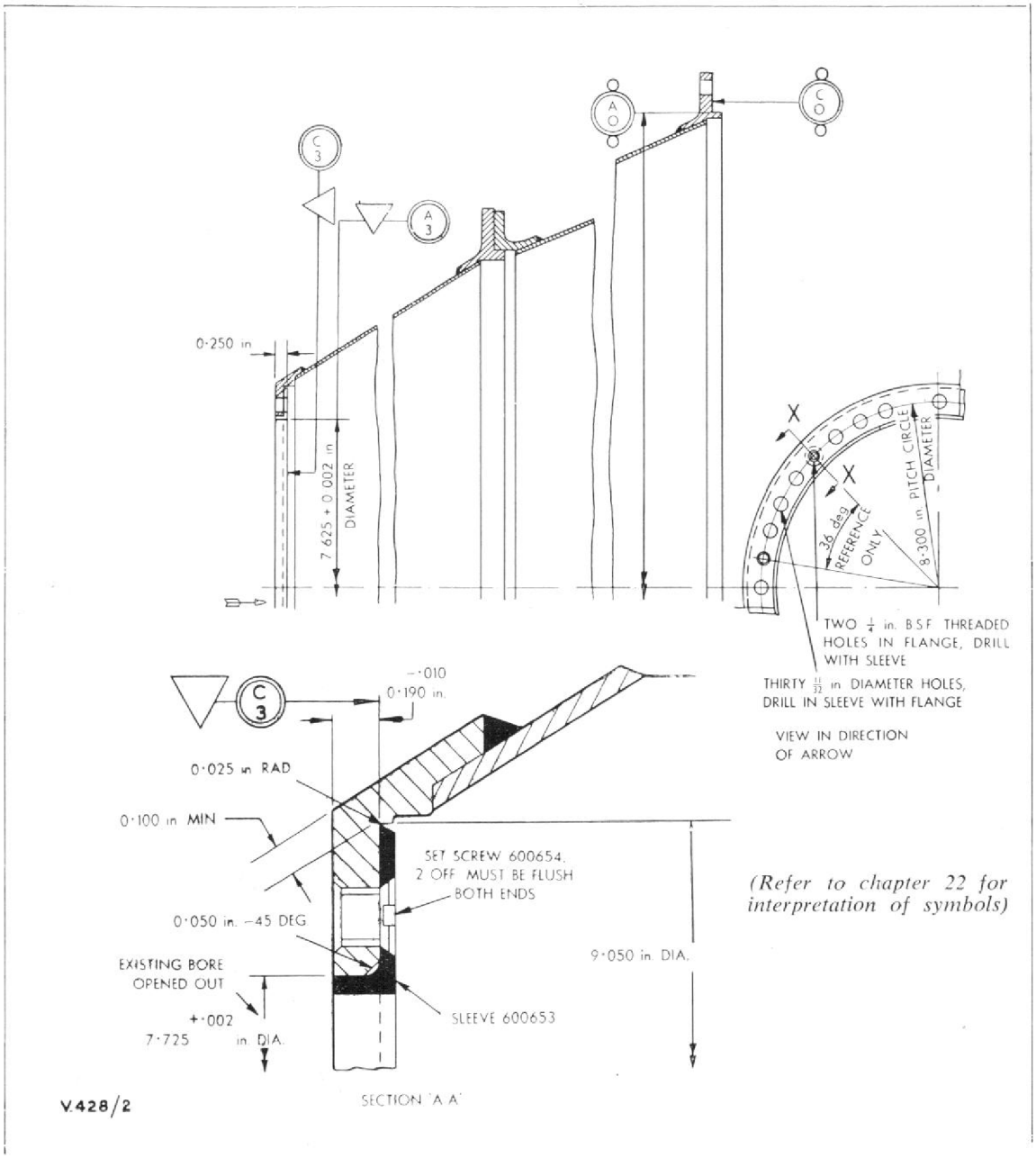
6. CRACKS IN BLADES. Cracks in the upstream and downstream edges may be removed by filing, provided that the limits stipulated in Note 1 and 4, and indicated in the sketch are not exceeded. If a cracked blade requires metal to be removed beyond these limits, it must be replaced by a new blade.

Blades which require blending, or straightening, beyond the limits specified must be replaced by new blades.

All repairs must be polished free of file marks and scratches, and blades which have been repaired in accordance with these instructions must have T.R.152 lightly etched in the position indicated by the sketch.



T.R. 152. Limits of repair to nozzle blades.



(Refer to chapter 22 for interpretation of symbols)

CENTRE CASING, FRONT AND REAR CONE, REAR FLANGE T.R. 312 issue 4—Mod. 751

This repair may be applied to all Ghost centre casings.

Front and rear cones on which the eccentricity of the rear flange exceeds the limits specified in chapter 38, can be rectified in accordance with these instructions.

SEQUENCE OF OPERATIONS

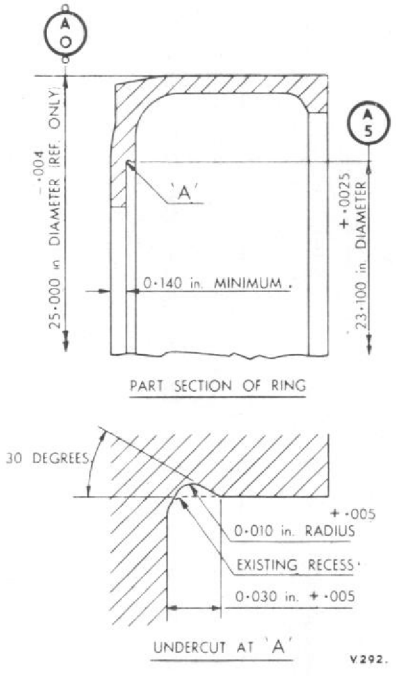
1. Open out the bore of the rear flange and increase the depth of the recess to the dimension given in the sketch.
2. Fit sleeve Part No. 600653 in position in rear flange and mark off and drill holes as indicated.
3. Screw in the two set screws Part No. 600654 ; tighten up and then lock by peening. Both ends of the set screws must be flush with the flange surface.
4. Open out the sleeve bore to the finished dimension given in sketch.
5. Etch T.R.312 adjacent to the existing part number and make an entry in the appropriate record book of the engine.

NOZZLE RING, INNER, DIAPHRAGM RECESS, SHRINKAGE OR DISTORTION

T.R. 343 issue 3—Mod. 1043

This repair may be applied to all Ghost inner nozzle rings.

Inner nozzle rings which have become shrunk or distorted, may be rectified by machining the recess to the standard diameter.



(Refer to chapter 22 for interpretation of symbols)

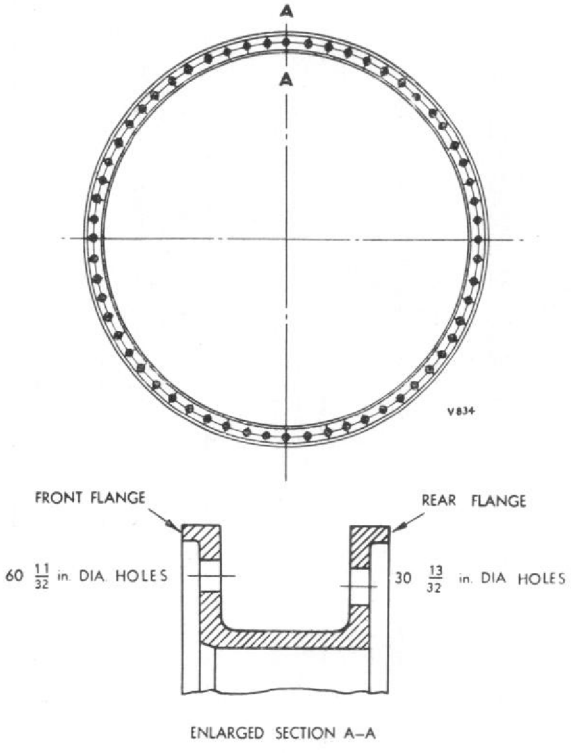
If the diameter of the recess at any point is below 23·060 inch, the nozzle ring cannot be salvaged. The bolt holes in the nozzle ring and diaphragm must not be elongated to assist the fitting of securing bolts on assembly.

On completion of this repair, etch T.R.343 adjacent to the existing part number and make an entry in the appropriate record book of the engine.

TURBINE SHROUD, FRONT FLANGE

T.R.417 issue 4—Mod. 1267

"In the field," it is permissible for any one or more of the sixty $\frac{11}{32}$ inch diameter bolt holes in the front flange of a pre-mod. 1140 turbine shroud to be opened up to $\frac{23}{64}$ inch diameter, or to be elongated up to a maximum of $\frac{1}{16}$ inch.



This T.R. gives authority for any turbine shroud in which either one, or both, of these operations has been carried out, to be accepted for refitting at overhaul.

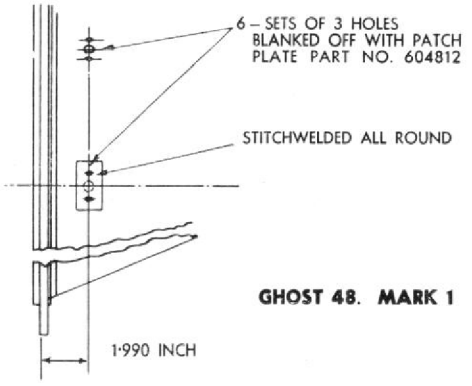
The identity of a turbine shroud which is refitted in accordance with these instructions is not affected, and, therefore, the T.R. number should not be marked on the component, or recorded in the engine log book.

T.R. 389 overleaf

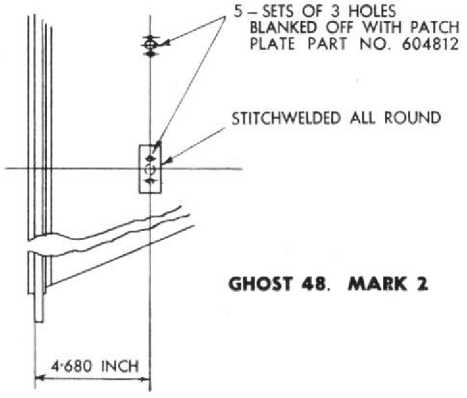
FRONT SUPPORT CONE
T.R.389 issue 1—Mod. 1110

For Information only

If the number T.R.389 is found on a front support cone, adjacent to the normal part number, this indicates that the rivet holes which, prior to mod. 1071, were used to secure the pads for the rear fire extinguisher ring, have been blanked off in accordance with Part 2 of that modification. This in no way affects the interchangeability of the component, nor does it affect its dismantling, inspection, repair, or reassembly.



GHOST 48. MARK 1



GHOST 48. MARK 2