Draft Chapter 33K

EXHAUST SYSTEM, REASSEMBLING

This draft chapter is issued for advance information pending the publication of the final chapter.

LIST OF CONTENTS

	Para.
General	1
Renewals	5
Outer cone	6
Thermocouple adapters	7
Propelling nozzle	8
Inner cone	11
Support tubes and fairings	12
Assembly	13
Outer cone and fairings	14
Inner cone	15
Inner cone front baffle	16
Inner cone, concentricity and clearance checks	17
Support tube caps and thermocouple nuts	18
Propelling nozzle	19
Fireguard	20
List of consumable parts	21
List of tools	22

LIST OF ILLUSTRATIONS

	Fig.
Using carpenter's cramp to correct regular ovality	1
Using wooden block and clamp to correct distortion and irregular ovality of the outer cone front flange	2
Method of repairing broken thermocouple adapter	3
Front support tube protrusion	4
Rear support tube protrusion	5
Assembling the air-tube in the centre of the exhaust cone	6
Checking the relationship of the inner exhaust cone to the outer cone front flange	7

GENERAL

1. The reconditioning described in this chapter is confined to the rectification of minor defects by normal sheet metal working, simple welding and the replacement of unserviceable parts of serviceable standard parts. Instructions for major repair and rectification, and the processes essential to such repairs, are contained in Chapter 31 of this handbook.

2. Consumable stores, required to replace items automatically discarded during dismantling, are listed at the end of the chapter. Tools are referred to in the text as they are used, and are also listed at the end of the chapter.

3. Throughout the text the phrase "within the limits" implies reference to the Table of Fits and Clearances contained in Chapter 38 of this handbook, to ascertain the limits permissible.

4. Before making any renewals prior to re-building, the inspection sheet must be read carefully and all work carried out as directed. Minor rectifications, which may not be entered on the inspection report, include removing any sheared screws and cleaning up damaged threads, the screws can often be removed by a further application of penetrating oil.

RENEWALS

5. With the exception of damaged threads and dents and buckles, etc., in sheet metal components, defective parts rejected by inspection are discarded and new, serviceable, or components repaired in accordance with Chapter 31, substituted. Welding should be carried out by the argon-arc process, the weld being cleaned with a rotary wire brush and only blended where specified. When applicable, the appropriate Repair Leaflet contained in Chapter 31, must be closely followed.

Outer cone

6. All large dents and buckles in the skin should be removed by normal sheet-metal repair methods. Distortion and ovality of the front end flange should be checked as illustrated in fig. 2, contained

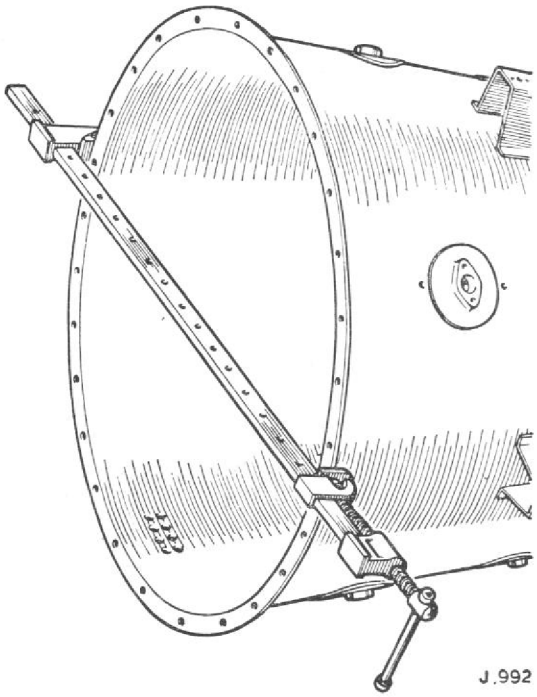

Fig. 1. Using carpenter's cramp to correct regular ovality

in Chapter 27L. Uniform ovality should be removed by the use of a single cramp (*fig.* 1). Distortion and irregular ovality should be removed with a shaped wooden block and clamp as shown in fig. 2. Ovality of the sheet-metal portion must be within the limits.

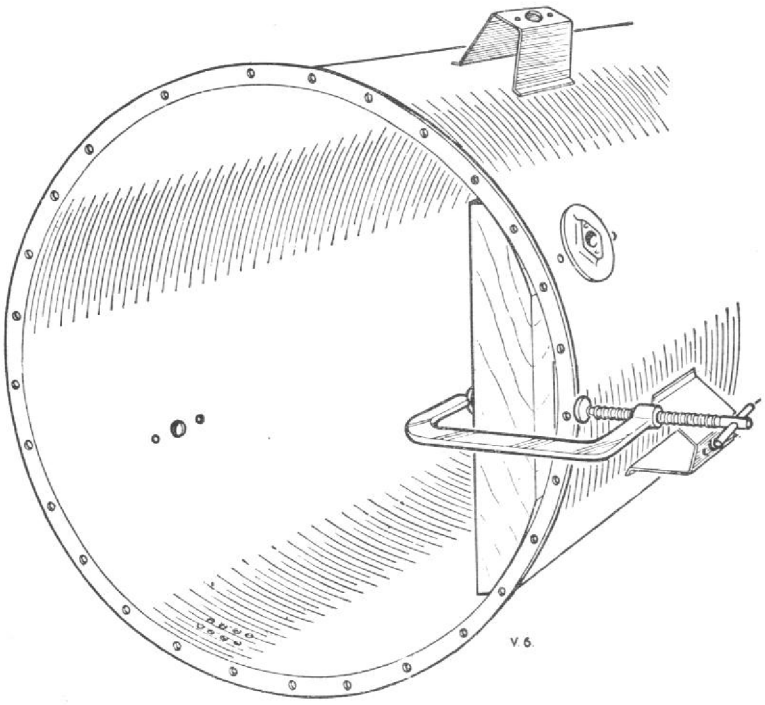

Fig. 2. Using wooden block and clamp to correct distortion and irregular ovality of the outer cone front flange

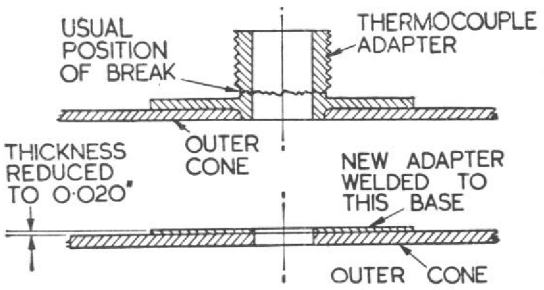

Fig. 3. Method of repairing broken thermocouple adapter

Thermocouple adapters

7. A thermocouple adapter which is sheared due to a seized cap-nut can be rectified, as shown in fig. 3, by grinding the adapter back until the base is approximately 0·020 in. thick and welding a new adapter to this base. To replace the support tube bush will necessitate welding a new bush into position.

Note . . . *An installed engine uses one thermocouple lead only, an additional three leads are inserted through the fireguard apertures for use during test bed running.*

Propelling nozzle

8. Dents and distortion can be rectified by normal sheet-metal repair methods. Ovality can be removed by the use of wooden formers and clamps in a similar manner to that employed for the exhaust cone flange.

9. The correct size propelling nozzle to control the jet pipe temperature for a particular engine is determined by test-bench calibration. Therefore, if the propelling nozzle is rejected as beyond repair, it is important that it is replaced by one with the same internal diameter. The replacement may be either of the fixed or adjustable type, comparative diameters being given in the following table. A different size nozzle must not be fitted except as the result of subsequent bench testing.

10. The size of an adjustable nozzle and the radial position, and the number of trimming strips required to give the specified performance are recorded in the engine log book. Each detachable trimming strip takes the form of a segment one-eighth of the circumference of the propelling nozzle in length, and is secured in the propelling nozzle by three 2 B.A. countersunk socket screws, spring washers and plain nuts; the screws being fitted so that the heads are inside the propelling nozzle. Each trimming strip must be fitted so that its radiused edge faces the front of the engine; offset holes in the trimming strips prevent their being fitted incorrectly.

Table of propelling nozzle sizes

Diameter of adjustable nozzle	Number of trimming strip segments in position	Equivalent fixed nozzle diameter
$18\frac{5}{8}$ in.	4	$18\frac{1}{2}$ in.
$18\frac{5}{8}$ in.	None	$18\frac{5}{8}$ in.
$18\frac{7}{8}$ in.	8	$18\frac{3}{8}$ in.
$18\frac{7}{8}$ in.	4	$18\frac{3}{4}$ in.

Inner cone

11. Normal sheet metal tools are sufficient to remove dents and buckles, but to facilitate working at the apex end of the cone a special anvil shaped to fit the cone behind the small diaphragm should be used. This anvil, which is detailed in Chapter 21, should be manufactured from local resources. Cracking of the support tube holes and reinforcing flanges should be welded provided that the cracks are not more than 2 in. length. It is also permissible to weld cracks from the key-hole slots in the large and small diaphragms. Parting of the diaphragm from the skin may be repaired in the following manner. The number of spot welds on each section between the key-hole slots of the large diaphragm is increased to six, and the size of the spot weld is increased to $\frac{3}{16}$ in. diameter. The small diaphragm is re-spot welded but retains four spot welds and the $\frac{1}{8}$ in. diameter spot. Later type inner cones have threaded plates secured by rivets and damaged plates can be rectified by fitting new plates.

Support tubes and fairings

12. Support tubes should be checked using v-blocks and a D.T.I., and if necessary placed between two blocks of wood and straightened with a rubber mallet. Fretting which is not deeper than 0·010 in. should be blended. Deeper fretting must be restored by welding as described in the relevant Repair Leaflet (TR 217). Cracks in the fairings can be repaired by welding as described in the relevant Repair Leaflet (TR 241).

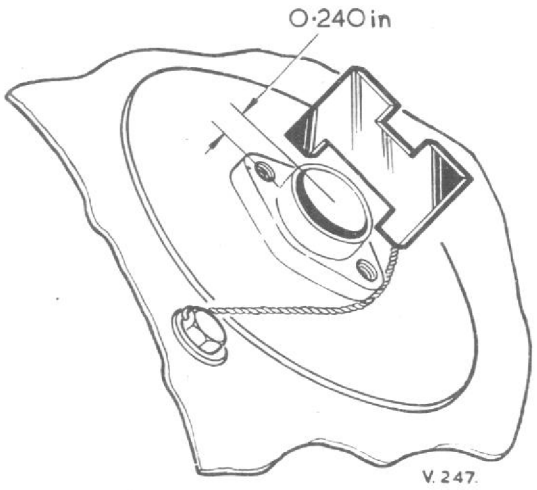

Fig. 4. Front support tube protrusion

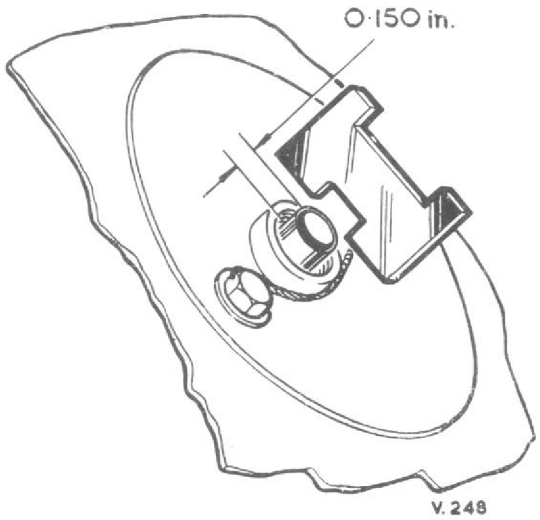

Fig. 5. Rear support tube protrusion

ASSEMBLY

13. The dismantling chapter advised that the components should be marked to indicate their relative positions and as far as possible the original correlation of the components should be preserved. The assembly is carried out in the horizontal position on stand T75700. All screw threads should be coated with anti-seize grease (D.T.D. 392 or similar) to reduce risk of seizure and to facilitate dismantling at a later date. The outer cone should have the minimum amount of ovality, to ensure efficiency of alignment on re-assembly.

Outer cone and fairings

14. Ensure that the four fairings are free from dents and that the threads in the screw-holes are clean; check by screwing one of the set-screws into each hole. Ensure that the four support tube holes are free from burrs; one of the front support tubes is slightly longer than the other and must be assembled nearest the front flange of the outer cone. New support tubes are supplied over-length and must be trimmed on assembly.

(1) Position stiffening ring T 78312 on to the rear end of the outer cone and secure it with locking wire to the four thermocouple adapters; holes are drilled in the stiffening ring for this purpose.

(2) Place the outer cone on Stand T75700

(3) Assemble one of the fairings to its original position, as denoted by the marks in the outer cone, and secure it, finger tight only, with the four plain washers and $\frac{5}{16}$ in. B.S.F. set-screws.

(4) Repeat operation 3 for the remaining three fairings.

(5) Slide each of the support tubes through the outer cone and the fairings. Align the fairings with the support tubes and tighten the fairing set-screws.

(6) Wire-lock each pair of set-screws with 22 S.W.G. stainless steel locking wire.

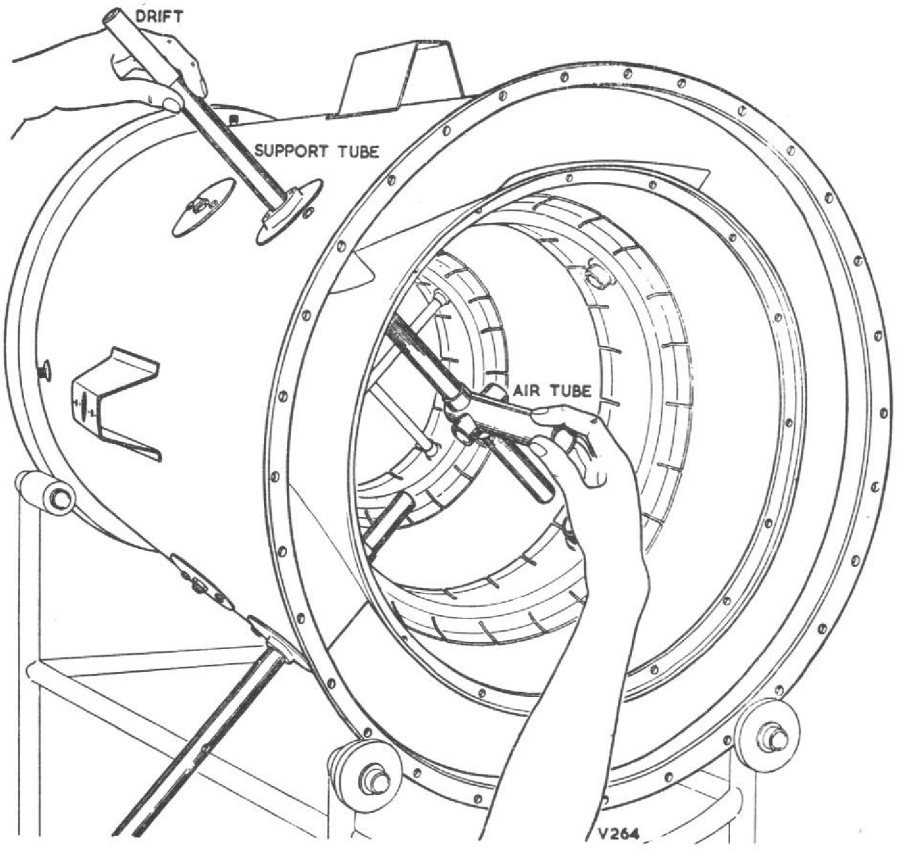

Fig. 6. Assembling the air-tube in the centre of the exhaust cone

(7) Adjust the protrusion at each end of the front support tubes. Measured with the gauge shown in fig. 4 and 5, the projection should be not more than 0·240 in. above the bosses at each end (*fig.* 4). If necessary the correct protrusion must be obtained by filing one end. The gauge, which is detailed in Chapter 21 should be manufactured from local resources.

(8) Adjust the protrusion at each end of the rear support tube. This should be not more than 0·150 in. above the bosses at each end (*fig.* 5). If necessary the correct protrusion must be obtained by filing one end.

(9) Mark the outer cone and each tube with greasy crayon or paint, to identify correct assembly relationship.

(10) Remove the support tubes from the outer cone.

Inner cone

15. Before assembling the inner cone ensure that each support tube slides freely in the bosses.

(1) Position the inner cone inside the outer cone.

(2) Apply a thin film of anti-seize grease to each support tube.

(3) Slide one of the front support tubes through the outer cone and fairing until it enters the first of the two bosses in the inner cone.

(4) Slide one of the rear support tubes through the outer casing and fairing until it enters the first of the two bosses in the inner cone.

(5) Repeat operations 3 and 4 with the second front and rear support tubes.

(6) Using a soft drift, tap each support tube through the inner cone, the opposite fairings and the outer cone.

(7) Withdraw each front support tube a little over half-way from the assembly.

(8) Support the air tube in position in the centre of the cone (*fig.* 6) and lightly tap each support tube through the inner cone, the opposite fairing and the outer cone.

(9) Adjust and re-check the support tube protrusion.

Inner cone front baffle

16. Before assembling the front baffle, ensure that it is free from burrs, and that the set-screws will screw freely into the stiffening ring at the front edge of the inner cone.

(1) Position the sleeve at the centre of the baffle over the air tube.

(2) Align the holes in the baffle with the holes in the inner cone stiffening ring and push the baffle into position in front of the inner cone.

(3) Place a new tab-washer (Part No. N 3746) on each of the sixteen set-screws.

(4) Secure the baffle with the sixteen screws and bend up the tabs.

Inner cone, concentricity and clearance checks

17. The following checks must be made to ensure concentricity of the inner cone with the outer cone. If the checks do not satisfy the required limits it will be necessary to select another inner cone.

(1) Using a pair of roller brackets T 71244, place the assembly on a surface table so that the front flange is supported on one pair of rollers and the stiffening ring on the other. Pack up the rear roller bracket with parallel strips until the front flange is truly perpendicular.

(2) Position the pointer of a height gauge on the apex of the inner cone.

(3) Rotate the exhaust cone assembly about its horizontal axis and check that the concentricity is within the limits.

(4) Position the pointer of the height gauge on the outside surface at the forward end of the inner cone.

(5) Rotate the exhaust cone assembly and check the concentricity. The apex of the inner cone should be concentric to the outer cone within 0·200 in. The forward end, or base, of the inner cone should be concentric within 0·075 in.

(6) Position the pointer of the height gauge on the outside surface of the outer cone.

(7) Rotate the exhaust cone assembly and check that the concentricity is within the limits.

(8) Using feeler gauges, check that the clearance between each fairing and the inner cone is within the limits.

(9) Place a straight-edge across the front flange of the outer cone and using the GO and NOT GO gap gauge as shown in fig. 7, check that the gap between the straight-edge and the flange of the inner cone is between 0·280 and ·320 in. The gauge, which is detailed in Chapter 21, can be manufactured from local resources.

(10) Remove the assembly from the roller blocks and transfer to stand T75700

Support tube caps and thermocouple nuts

18. Ensure that all threads are clean and that the support tube ends are free from burrs.

(1) Place a new copper washer (Part No. N 1494) over each rear support tube.

(2) Apply anti-seize grease to the threads and screw the four cap-nuts into the outer cone over the ends of the support tubes.

(3) Screw the pressure point and thermocouple connection blanking nuts on to their respective bosses and wire-lock.

Propelling nozzle

19. (1) Remove the support ring from the rear of the outer cone.

(2) Position the propelling nozzle on the rear of the outer cone.

(3) Secure the nozzle with thirty-six $\frac{1}{4}$ in. B.S.F. bolts and nuts and four lock-wire tabs which should be fitted in line with the thermocouple bosses.

Note . . .

The bolts must be fitted so that the heads are inside the exhaust cone.

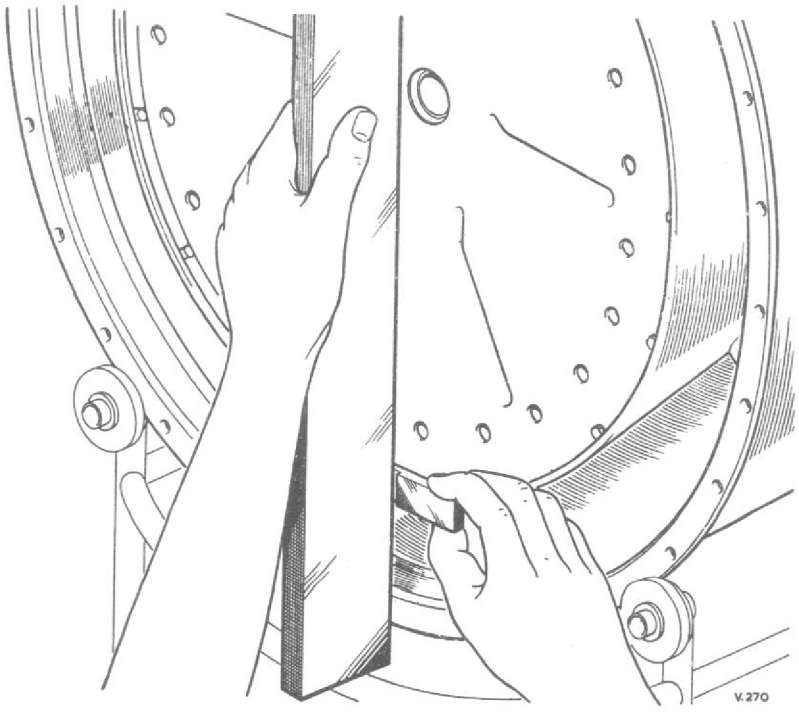

Fig. 7. Checking the relationship of the inner exhaust cone to the outer cone front flange

Fireguard

20. Fit the three caps to the thermocouple flanges. The fireguard is not, normally, assembled to the exhaust cone until the latter has been attached to the engine; if, however, the exhaust cone and fireguard are to be packed for dispatch, they should be assembled together. Position the fireguard over the exhaust cone assembly and secure it with eight plain washers and screws.

LIST OF CONSUMABLE PARTS

21. The following is a list of consumable parts which will be required during assembly of the exhaust cone:—

Part No.	*Description*	*Quantity*
N 3746	Tab-washer, inner cone front baffle	16
N 1494	Plain washer, rear support tubes	4

LIST OF TOOLS

22. The following tools are required for assembly of the exhaust cone:—

Tool No.	*Description*
T 78312	Stiffening ring
T 75900	Stand, exhaust cone
T 71244	Roller brackets pair
Standard	Parallel strips
Standard	Height gauge