

Chapter 36C

CHECK BALANCING AFTER COMBINED ENDURANCE/FINAL TEST

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AT THE CONCLUSION OF A COMBINED ENDURANCE/FINAL TEST it is obligatory to check the dynamic balance of the main shaft assembly, without removing that assembly from the engine. This chapter, which is applicable to both the Ghost 48 Mk. 1 and the Ghost 48 Mk. 2, describes the method of making this check, using the Avery type 7208, 20-2000 lb., electro-dynamic balancing machine. It is assumed that the operator is fully conversant with the calibrating, operating, and setting of the balancing machine, and with the technique of balancing; and that reference will be made, as necessary, to standard text books and to the instructions published by the makers of the balancing machine.

Unbalance at the impeller must not exceed 8 grammes, at a 10-inch radius on the impeller leading edge, and must not exceed 8 grammes at the balancing rim on the turbine disc. Unbalance at the impeller end of the main shaft cannot be corrected without removing the main shaft from the engine, which will necessitate further bench testing after the engine has been reassembled. Unbalance at the turbine end of the main shaft, if greater than the permissible maximum can, however, be corrected as described on page 8. After such correction, a check must be made to ensure that the balance at the impeller end of the main shaft has not been affected and that it is still within the limits.

Although it is impossible to correct unbalance at the impeller without removing the main shaft

from the engine, unbalance up to about 9 grammes, at a 10-inch radius on the leading edge, may be found to be within the limit of 8 grammes after the unbalance at the turbine end of the assembly has been corrected; as there is a tendency for unbalance in one plane to affect the other plane, particularly where large unbalanced forces are present.

It must be ensured that all rotating couplings and other items of balancing equipment are themselves in dynamic balance. The projections on the drive coupling which spigot on to the turbine disc should be a good fit thereon. A range of drive couplings, one for standard and three for undersize turbine spigots, is provided and, where undersize spigots are encountered, the operator must select the appropriate undersize drive coupling. If the standard size coupling seems too slack, try the next undersize coupling; if the next undersize coupling is too small, the standard coupling is the correct one to use; continue similarly if the next undersize coupling is too slack. When assembling the equipment to the engine in preparation for balancing, absolute cleanliness must be ensured, and all mating surfaces should be coated with a thin film of acid-free tallow, to reduce the likelihood of picking-up or scoring. All bolts and nuts must be tightened evenly.

Throughout this chapter, the terms "left" and "right" are used on the assumption that the operator is facing the balancing machine with the

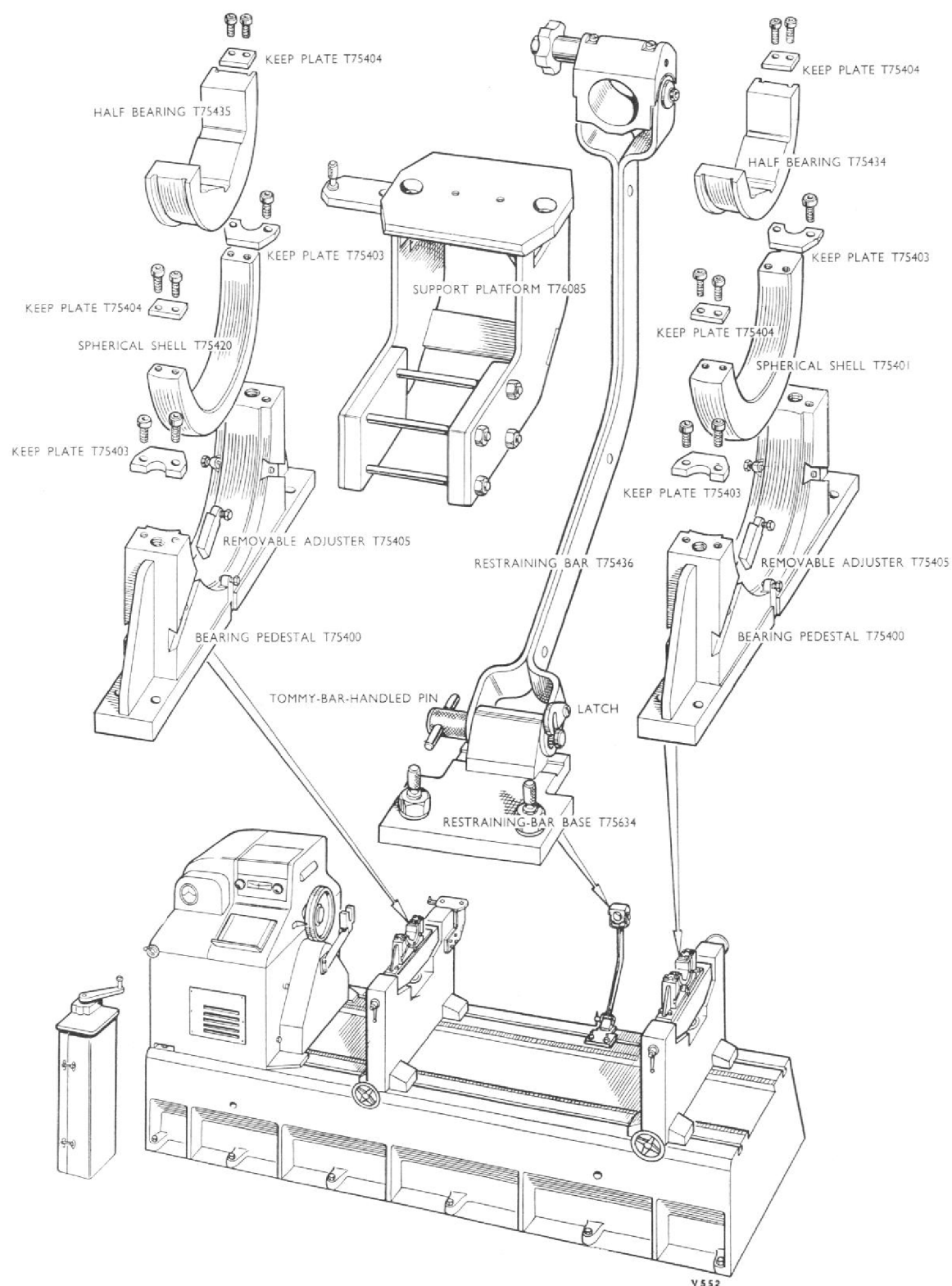


Fig. 1. Setting up Avery type 7208, 20-2000 lb., electro-dynamic balancing machine to check balance main shaft assembly without removing that assembly from engine.

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driving head of the machine on his left; that is, as the balancing machine is depicted in the majority of the illustrations.

SETTING UP MACHINE (Fig. 1)

1. Place one bearing pedestal T.75400 on each of the balancing machine's vertical supports, and bolt the pedestals to the supports through the four $\frac{3}{8}$ in. elongated holes which are provided in the base of each pedestal. If the machine is being set up for the first time, great care must be taken to align the two bearing pedestals so that they are square to the centre line (working axis) of the balancing machine and are concentric with that centre line. When they have been aligned correctly, it is advisable to dowel the pedestals in position, and to mark them, so that, for each subsequent occasion, they can be refitted correctly without difficulty.
2. Engage the dovetail slide of one of the twelve removable adjusters T.75405 into each of the twelve dovetail slots, three of which are machined in each side of both pedestals; each 2 B.A. adjusting screw must be fitted so that its head is on the narrower side of the dovetail slide. Unscrew each adjusting screw until its hardened tip is flush with the surface of the slide.
3. Place spherical half bearing shell T.75420 in
4. Place half bearing T.75435 in the spherical shell on the left support, and half bearing T.75434 in the shell on the right support, ensuring that the wide shallow groove in the periphery of each half bearing locates on the spherical shell. Loosely retain each half bearing in its shell by securing two keep plates T.75404 to each shell, by means of four $\frac{5}{8}$ in. by $\frac{5}{16}$ in. Whitworth set-screws; tighten these screws finger-tight only.
5. Secure support platform T.76085 to the rear of the left support, using the four $6\frac{1}{8}$ in. by $\frac{3}{4}$ in. B.S.F. bolts and nuts provided. If the support platform is being fitted to the machine for the first time, it should be positioned in accordance with the setting dimensions given in Fig. 2; it may be necessary to adjust the width (nominally $4\frac{1}{8}$ inches) between the support platform's side plates to suit the vertical support on the balancing machine, either by grinding material off the side plate stiffeners or by inserting suitable shims.
6. Using the handles provided, traverse the

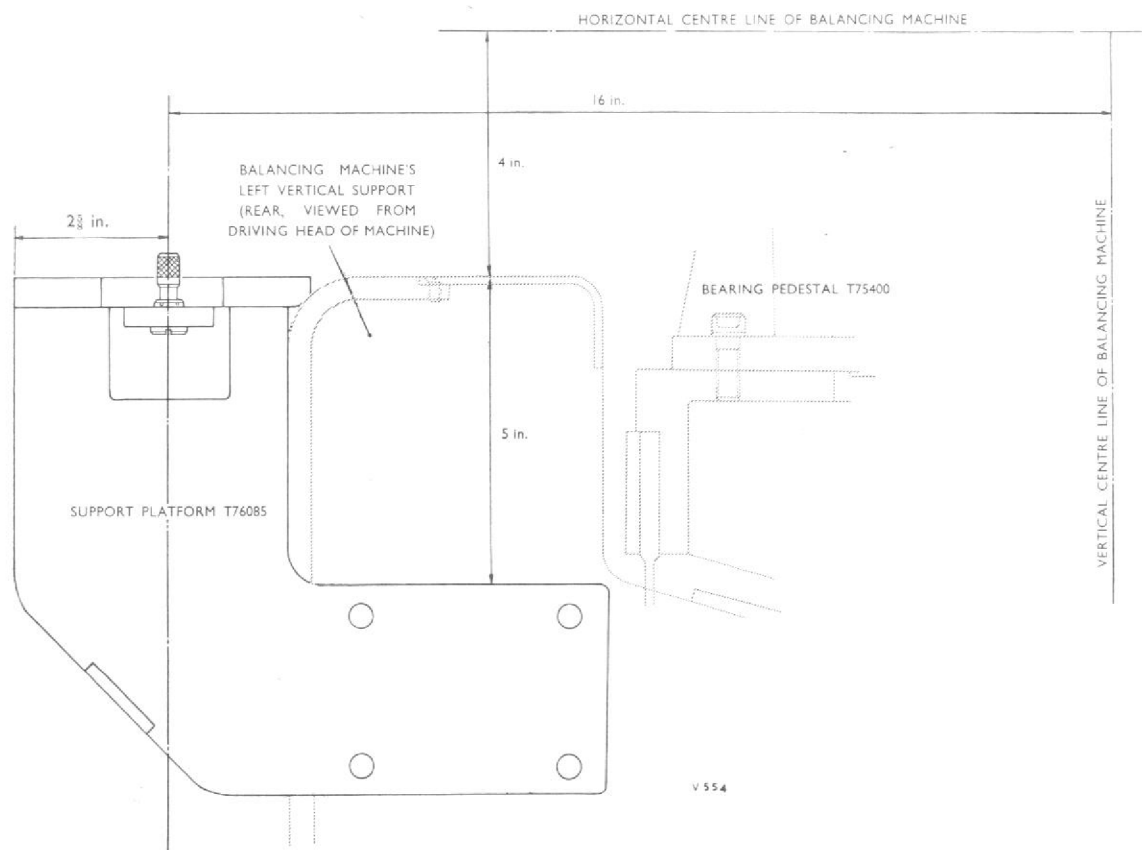


Fig. 2. Setting dimensions for positioning support platform T.76085 on balancing machine; viewed from driving head of machine.

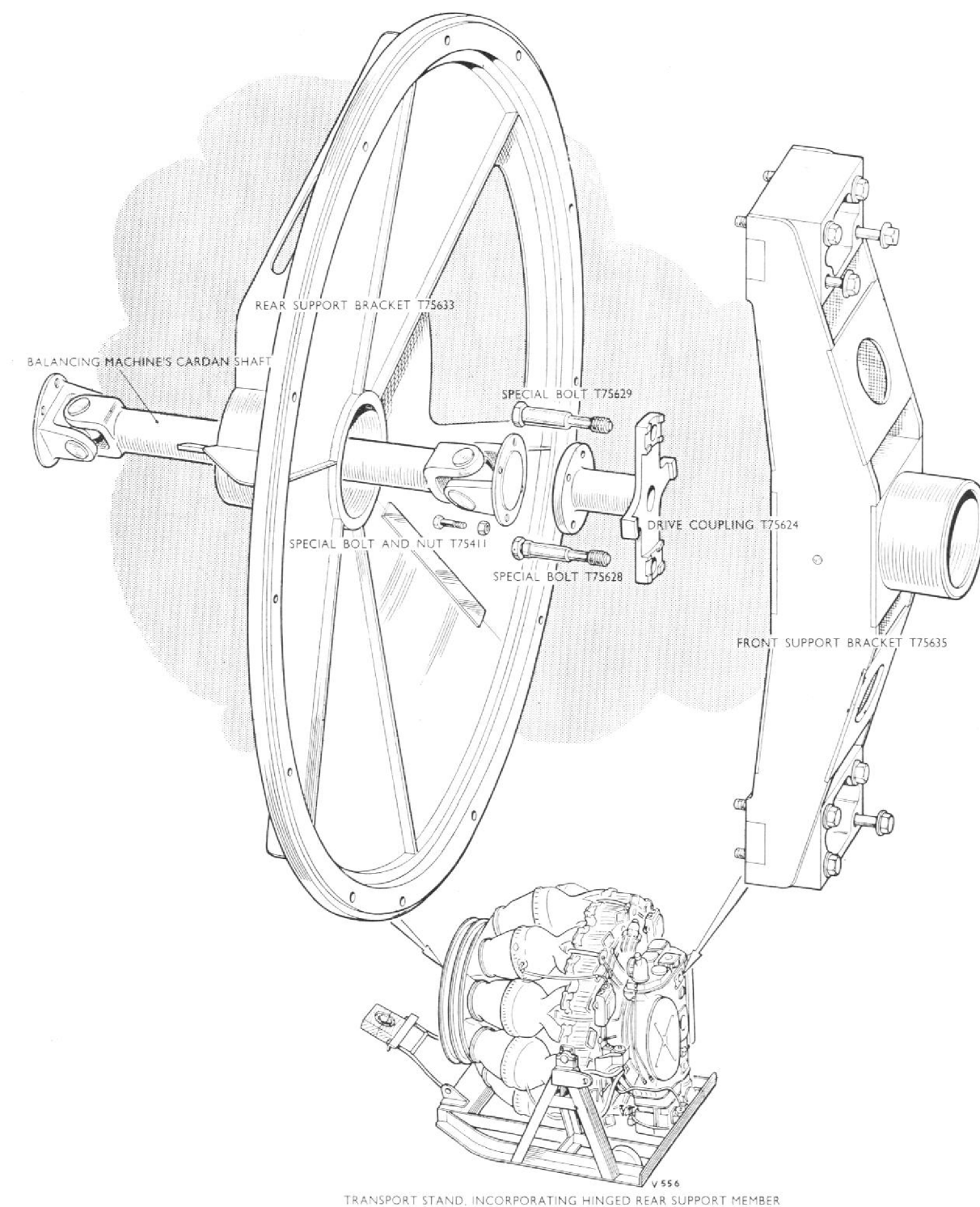


Fig. 3. Preparing engine for check balancing main shaft.

vertical supports until they are positioned to suit the length of the engine complete with support brackets; about 6 ft. 3 in. between centres.

7. Using a dial test indicator and the necessary associated equipment, align the half bearings by adjustment of the 2 B.A. adjusting screws. The half bearings should be square to the centre line (working axis) of the balancing machine, and concentric with that centre line, within 0.002 inch. When satisfactory alignment has been achieved, ensure that each 2 B.A. adjusting screw is nipping the spherical shell, and finally tighten the sixteen screws which secure the keep plates.
8. Position restraining-bar base T.75634 at the rear of the machine, between the two vertical supports, about 2 ft. 6 in. from the right support, so that the restraining-bar mounting is remote from the operator (Fig. 7), and secure the base to the bed of the balancing machine by means of the two Tee-headed bolts, plain washers, and $\frac{5}{8}$ in. B.S.F. nuts provided. Do not finally tighten these nuts until after mounting the engine in the machine, in case it is necessary to adjust the position of the base to align the restraining bar with the trunnion on the engine. Mount restraining bar T.75436 on the base so that its bent profile will follow the contour of the engine, and attach it to the base by passing the tommy-bar-handled pin through the holes at the foot of the bar and the mounting on the base; retain this pin by means of the latch provided on the restraining bar. Swing the restraining bar outwards so that it will be clear of the engine whilst the latter is lowered into the machine. Slacken off the hand nut at the upper end of the restraining bar.

PREPARING ENGINE (Fig. 3)

After the successful completion of a Combined Endurance/Final Test, the engine, less the slave accessories which were fitted for test bench purposes and the exhaust system, will arrive in the Dynamic Balancing Department either on dismantling and assembly stand T.75592 or on a suitable transport stand.

On receipt of the engine, the serial number should be checked against the accompanying documents, and a visual examination should be made of all external fittings and accessories to ensure that the engine is complete and that it has not been damaged during its removal from the test bench or in transit.

At all times, care must be taken to ensure that no foreign matter enters the engine, and, therefore, all openings should be kept properly blanked, except where it is essential to remove a blanking cover to carry out the check balance.

Allow the engine to cool to room temperature before proceeding with the operations which follow; it should, at least, be cool enough for the operator to be able to rest his hand on the engine without discomfort. This is essential, as if the support brackets and the drive coupling are assem-

bled to the engine whilst it is hot, the securing bolts may slacken off during balancing and accurate balancing will then be impossible.

When the engine was reassembled, in anticipation of this check balancing, the front engine mounting brackets should not have been fitted to the air-intake. If they are in position, they must be removed before the front support bracket can be assembled to the air-intake; ensure that these brackets and their individual shims are retained as a set for refitment after balancing—if the shims are interchanged between brackets, or the brackets are interchanged between engines, the centre line of the mounting pins may be incorrect relative to the engine-mounting diffuser bolts and trouble may ensue when an attempt is made to install the engine in an aircraft.

1. Assemble front support bracket T.75635 to the two mounting bracket faces, which are above and below the centre housing, on the front of the air-intake, taking care to ensure that the circular blocks on the support bracket spigot correctly into the recesses in the engine mounting bracket faces. Secure this bracket to the engine by means of the eight special 4 in. by $\frac{7}{16}$ in. B.S.F. bolts provided.
2. *If the engine is in a transport stand.* Release the trunnion supporting the turbine disc blanking cover and swing the rear support member of the transport stand clear of the engine. If the engine is mounted in an early type of transport stand, which does not incorporate a hinged rear support member, it will be necessary to use lifting sling T.78478*, and a suitable crane, to hoist the engine out of the stand and to return it to the stand so that the turbine end is remote from the rear support member of the stand, in order to obtain access to the turbine end.
3. Remove the six $\frac{3}{8}$ in. B.S.F. plain nuts and bolts which secure the turbine disc blanking cover to the turbine shroud, and remove the blanking cover.
4. Use a $\frac{1}{2}$ in. B.S.F. socket, in conjunction with a suitable wrench, to remove the two turbine disc bolts which pass through the centre hole in each of the two triple tab washers. In anticipation of this operation, the heads of these bolts should not have been locked when the engine was assembled prior to bench testing. Do **not** unlock or disturb the eight nuts which secure the turbine disc also.
5. Assemble drive coupling T.75624 to the rear face of the turbine disc, ensuring that the projections on the face of the coupling fit correctly over the spigot on the turbine disc and aligning the bolt holes in the coupling with those in the disc from which the two turbine disc bolts were removed in Op. 4. It is essential to ensure that the tab washers do not foul the drive coupling, which is cut away to clear them; if they do, it will be impossible for the coupling to seat squarely on the turbine disc, and this will make accurate balancing impossible. Secure the coupling to the turbine disc

* Where mod. 1140 (box type turbine entry duct) has been embodied, a different lifting sling is required.

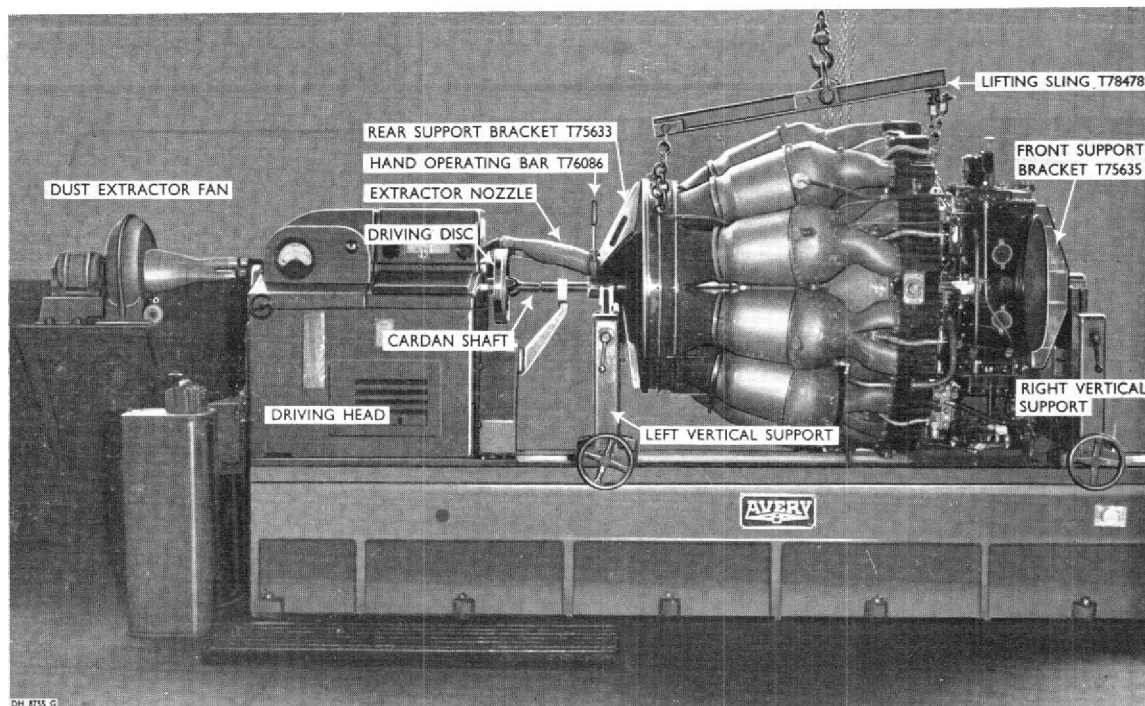


Fig. 4. Mounting engine in balancing machine.

by screwing the two special bolts (T.75628 pre-mod. 279 or T.75629 mod. 279) through the holes in the coupling and in the turbine disc into the threaded holes in the hub shaft flange; the threads of these bolts should be lubricated with a thin film of Ragosine L.M. paste, and great care must be taken to ensure that the honed holes in the turbine disc are neither scratched nor damaged. Tighten these bolts evenly and progressively to not more than the torque loading specified, for the normal turbine disc bolts, in chapter 22. The two special bolts must form a pair in which each bolt is **exactly** the same weight as the other; no difference in the weights is permissible. If the spigot on the turbine disc is undersize, use:—

Drive coupling	Undersize
T.75625	0.005 in.
T.75626	0.010 in.
T.75627	0.015 in.

6. Disconnect the balancing machine's Cardan shaft from the machine's driving disc and connect this Cardan shaft to the drive coupling on the turbine disc by means of the four special bolts and nuts T.75411; ensure that the spigot on the Cardan shaft flange fits correctly into the recess in the drive coupling flange, and tighten the nuts evenly. The four

bolts and the four nuts must form a set in which all four bolts are the same weight as each other and all four nuts are the same weight as each other; no difference in the weights is permissible.

7. Pass rear support bracket T.75633 over the Cardan shaft, and secure the bracket to the turbine shroud, so that the 'window' in the bracket is towards the port side of the engine, by means of twelve slave $\frac{3}{8}$ in. B.S.F. bolts and nuts.

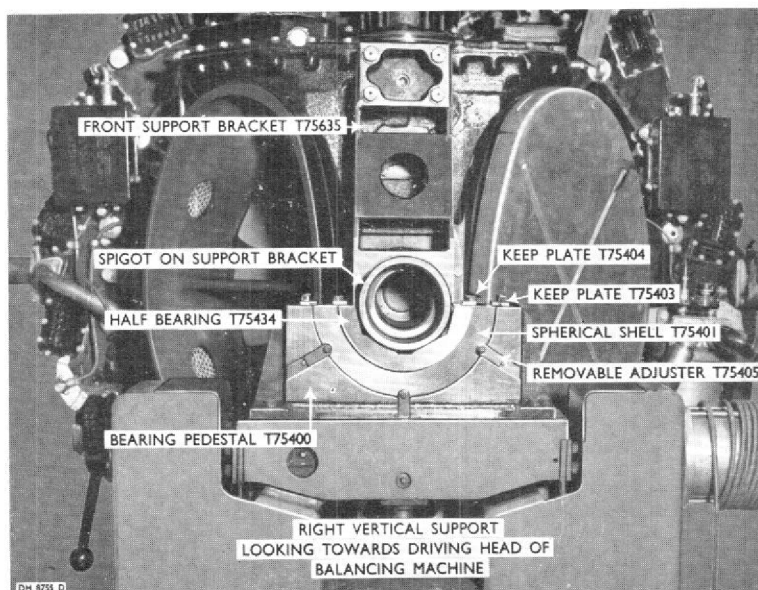


Fig. 5. Spigot on front support bracket in position in half bearing shell on right vertical support.

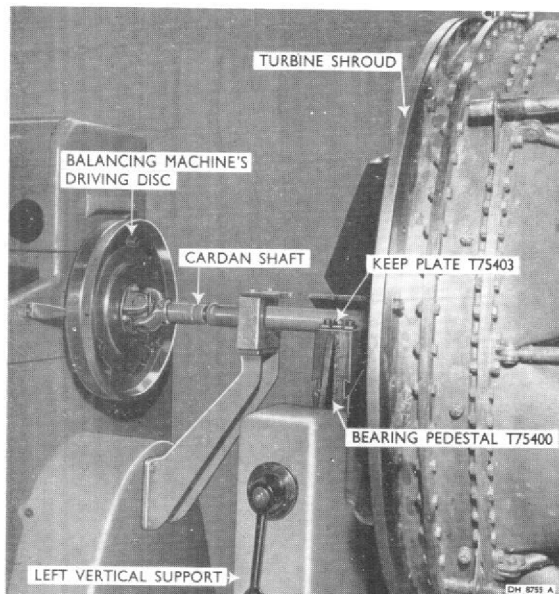


Fig. 6. Cardan shaft coupled to balancing machine's driving disc; note set-screws replaced by studs and nuts, see text.

MOUNTING ENGINE IN MACHINE (Fig. 4)

1. Lower lifting sling T.78478* into position over the engine and couple the shackles to the lifting eyes on the diffuser casing and on the turbine shroud. Ensure that the eye on the sling beam is positioned so that the load will balance evenly and that the shackles are hanging vertically so that no side or bending loads will be imposed on the engine when it is lifted.
2. If the engine is in a transport stand. Just take the weight of the engine on the crane and release the trunnions. Carefully raise the engine clear of the stand, taking care to ensure that it does not swing and become damaged by accidental contact with the stand.

If the engine is in the dismantling and assembly stand. Just take the weight of the engine on the crane and remove the eight bolts which secure the engine to the stand arms. Carefully raise the engine clear of the stand, taking care to ensure that it does not swing and become damaged by accidental contact with the stand.

Before lowering the engine into the balancing machine, and before taking it out of the machine, it is essential to ensure that the machine's bearing pedestals are **LOCKED**. Failure to do this may result in damage to the machine.

3. Transfer the engine to the balancing machine and lower it into position, so that the turbine end will be towards the driving head of the machine.
4. As the engine is lowered into position, guide the spigots on the front (Fig. 5) and rear

* See footnote on page 5.

support brackets into the half bearing shells on the vertical supports of the balancing machine; making any necessary final adjustments to the positioning of the vertical supports. During this operation, the Cardan shaft must be steadied and guided so that it does not knock against the driving head of the machine and thus become damaged or cause damage to the machine.

5. Couple the Cardan shaft to the balancing machine's driving disc by means of the four special set-screws provided with the machine (Fig. 6). Continual removal and refitting of these set-screws tends to wear the threaded holes in the machine's driving disc, and may, ultimately, necessitate the renewal of this comparatively expensive component; this can be avoided by replacing these set-screws by studs and nuts. These studs and nuts must form a set in which each stud is the same weight as the others and each nut is the same weight as the other nuts; no difference in the weights being permissible.
6. If the engine was transferred from the dismantling and assembly stand. Use four spring washers, Part No. AGS.162/G or SP.47L, and bolts, Part No. 6A1/3L, to secure a mounting trunnion, Part No. 29658, to the mounting face on the port side of the diffuser casing.
7. Adjust the position of the restraining-bar base, and engage the trunnion block at the upper end of the restraining bar over the engine mounting trunnion on the port side of the diffuser casing (Fig. 7). Finally tighten the nuts which secure the base to the bed of the balancing machine, and tighten the hand nut at the upper end of the restraining bar to clamp the trunnion block to the engine mounting trun-

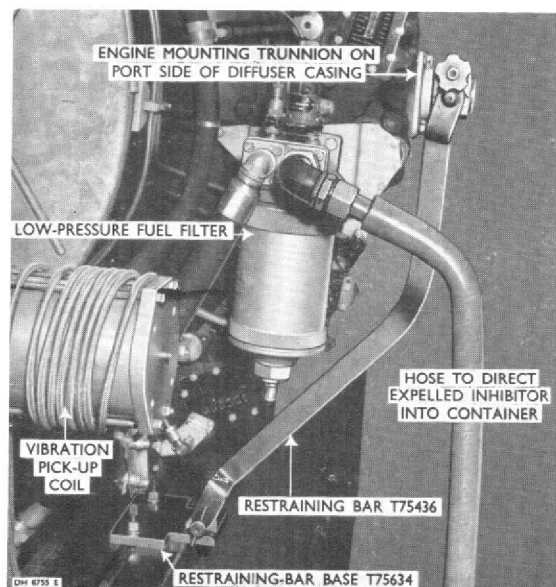


Fig. 7. Restraining bar connected to trunnion on engine, and hose connected to low pressure fuel filter inlet to direct expelled inhibitor into a container.

nion. This operation must be completed whilst the engine is still steadied by the crane.

8. There is no need to remove the lifting sling or disconnect it from the crane; just lower it until the lifting chains are slack and the entire weight of the engine is resting on the balancing machine.
9. If it is required to check the drive coupling for concentricity (that is, that it is mounted squarely on the rear face of the turbine disc), or to check the rear face of the turbine disc for swash. Replace keep plate T.75403 on the operator's side of the left bearing pedestal by combined lock plate and dial-test-indicator stand T.75637. Screw dial-indicator-standard base T.72918 into the $\frac{5}{16}$ in. B.S.F. threaded boss on lock plate T.75637, and use a dial test indicator, supported from this base, to make the required checks.
10. *Ghost 48 Mk. 1.* For balancing purposes, the main shaft assembly is rotated in the reverse direction to normal. To relieve the pressure generated in the fuel system, and so prevent damage to the B.P.C. or the air-fuel ratio control, disconnect one end of the pump-delivery pressure pipe (Part No. 91424) which connects the fuel pump to the B.P.C., and leave the disconnected end of the pipe and the union open to atmosphere (Fig. 8); normally, it will be sufficient to slacken off the union nut and gently ease the pipe clear of the union.

Ghost 48 Mk. 2. For balancing purposes, the main shaft assembly is rotated in the reverse direction to normal. To relieve the pressure generated in the fuel system, the following pipes must be disconnected and plugs removed; normally it will be sufficient

to slacken off the union nuts and gently ease the pipes clear of the unions, and to loosen the plugs.

- (a) Cooling return pipe (valve group unit to fuel supply pump inlet).
 - (b) Spill pipe from air-fuel ratio control unit to fuel supply pump inlet.
 - (c) Cooling feed pipe (fuel supply pump inlet to valve group unit).
 - (d) Blanking plug in fuel supply pump, indicated on diagram.
 - (e & f) Two blanking plugs in circulating pump and valve group unit; indicated on diagram.
- (Fig. 9)
11. For the reason stated in Op. 10, remove the blank from the low pressure fuel filter inlet and connect a suitable length of hose to the filter inlet (Fig. 7). Put the open end of the hose into a container so that it will receive the inhibiting fluid which will be expelled when the main shaft is rotated. This loss of inhibitor is not detrimental to the inhibiting of the fuel system, as the internal surfaces of the components and pipes will remain wet with inhibitor.
 12. Remove the blank from one of the air-intake apertures. This will permit the operator to listen for noises from the front bearing, which may have been inaudible during the run-down on the test bench.

DYNAMIC BALANCING

As stated previously, it is assumed that the operator is fully conversant with the calibrating, operating, and setting of the balancing machine, and with the technique of balancing; and that he will refer, as necessary, to standard text books and to the instructions published by the makers of the balancing machine. When the amount and direction of the unbalanced forces, at both ends of the main shaft, have been ascertained, this information must be recorded by the inspection authority. If the unbalance at the turbine end exceeds the limit specified on page 1, correction may be effected, without dismantling the engine, as described in the paragraphs which follow; if the unbalance at the impeller end is only just outside the limits, proceed with the correction of the turbine end and recheck the balance at both ends in case correction at the turbine end has affected the unbalance at the impeller.

CORRECTING UNBALANCED FORCES (Fig. 10 to 13)

Unbalance at the turbine end of the main shaft can be corrected as described on pages 10, 11, and 12. There is a 'window' (Fig. 10) in the rear support bracket through which a grinding wheel can be applied to the balancing rim on the rear of the turbine disc. Throughout these pro-

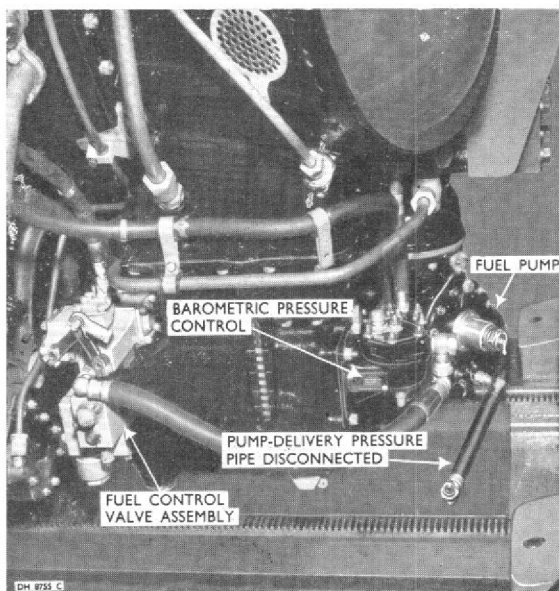


Fig. 8. *Ghost 48 Mk. 1.* Pump-delivery pressure fuel pipe, fuel pump to B.P.C., disconnected to relieve pressure generated in fuel system when engine is rotated in reverse direction to normal.

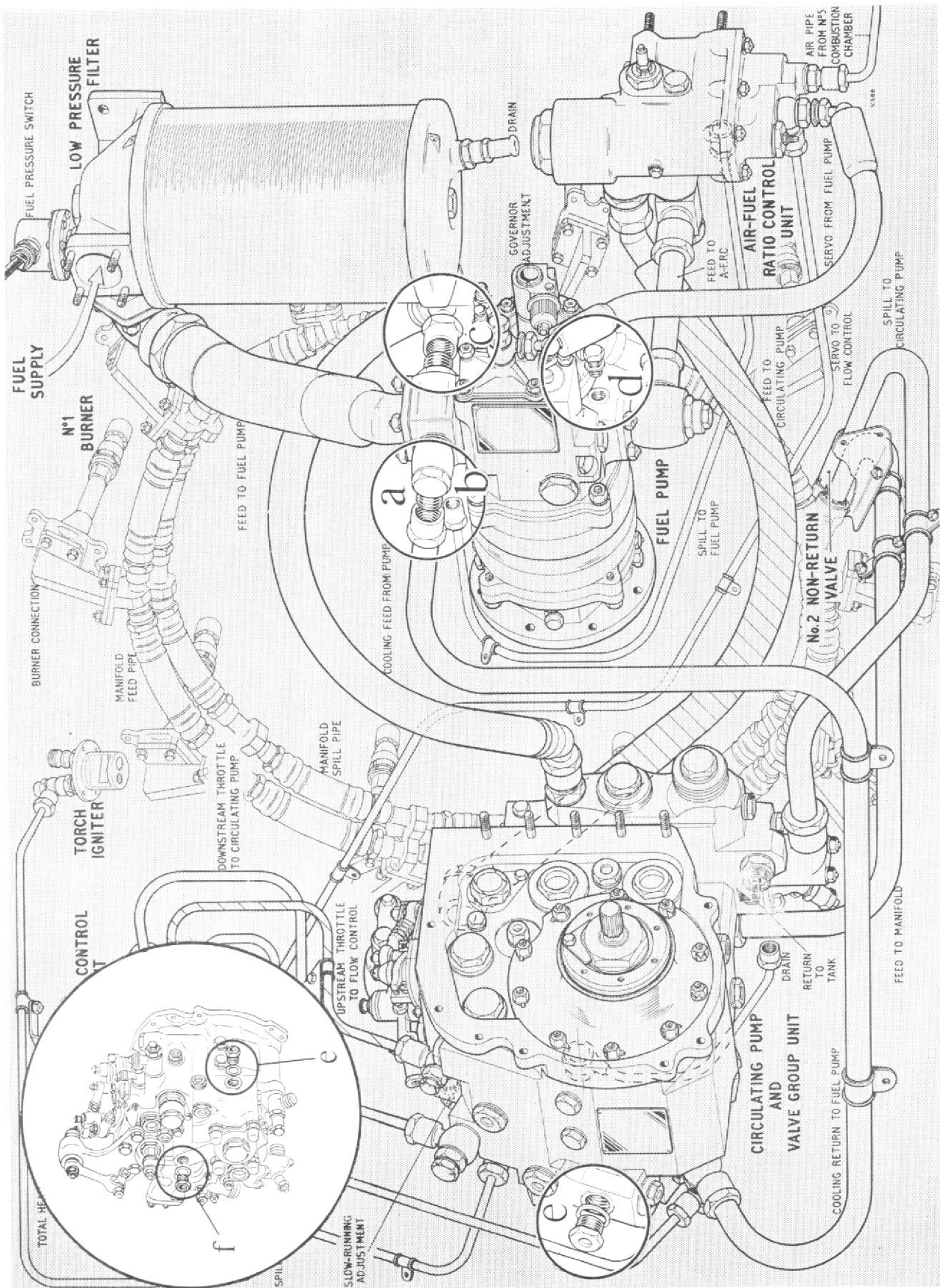


Fig. 9. Ghost 48 Mk. 2. Diagram showing pipes and plugs which must be disconnected, or removed, to relieve pressure generated in fuel system when engine is rotated in reverse direction to normal. The letters a, b, c, d, e, and f, which indicate the pipes which have been disconnected and the plugs which have been removed, correspond to the letters used for the sub-paragraphs in Op. 10 on the facing page.

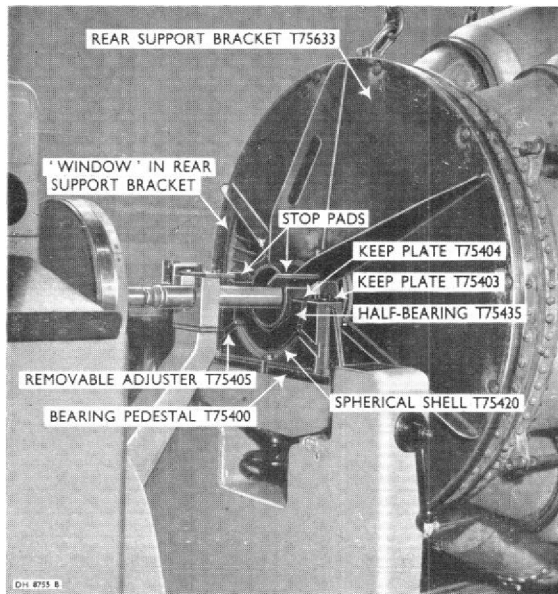


Fig. 10. Rear support bracket on engine in balancing machine, showing 'window' through which grinding attachment can be applied to balancing rim on turbine disc.

ceedings it is essential to ensure that no grinding dust, swarf, or other foreign matter enters the engine.

When grinding attachment T.76082 is not being used, or when it is necessary to dress the grinding wheel, the attachment should be mounted on parking and dressing fixture T.76081 (Fig. 11). This parking fixture should be situated a little distance away from the balancing machine so that the abrasive dust, which is produced when dressing the grinding wheel, will not enter an engine which is mounted in the balancing machine. It is essential that the grinding wheel is neither chipped nor damaged in any way; use diamond truer T.75689, which forms part of the parking fixture, to dress the grinding wheel as necessary—refer to Fig. 12 for the correct wheel dressing dimensions.

The depth to which metal may be removed from the balancing rim on the rear face of the turbine disc must not exceed the depth of the balancing rim above the general level of the turbine disc, and must be blended smoothly into the remainder of the rim; scratches and grinding marks should be removed by polishing. Experience, and trial and error, will enable the amount of metal to be removed to correct a specific amount of unbalance to be estimated. As a guide, if a segment of the balancing rim is removed to the maximum depth permissible, the removal of a

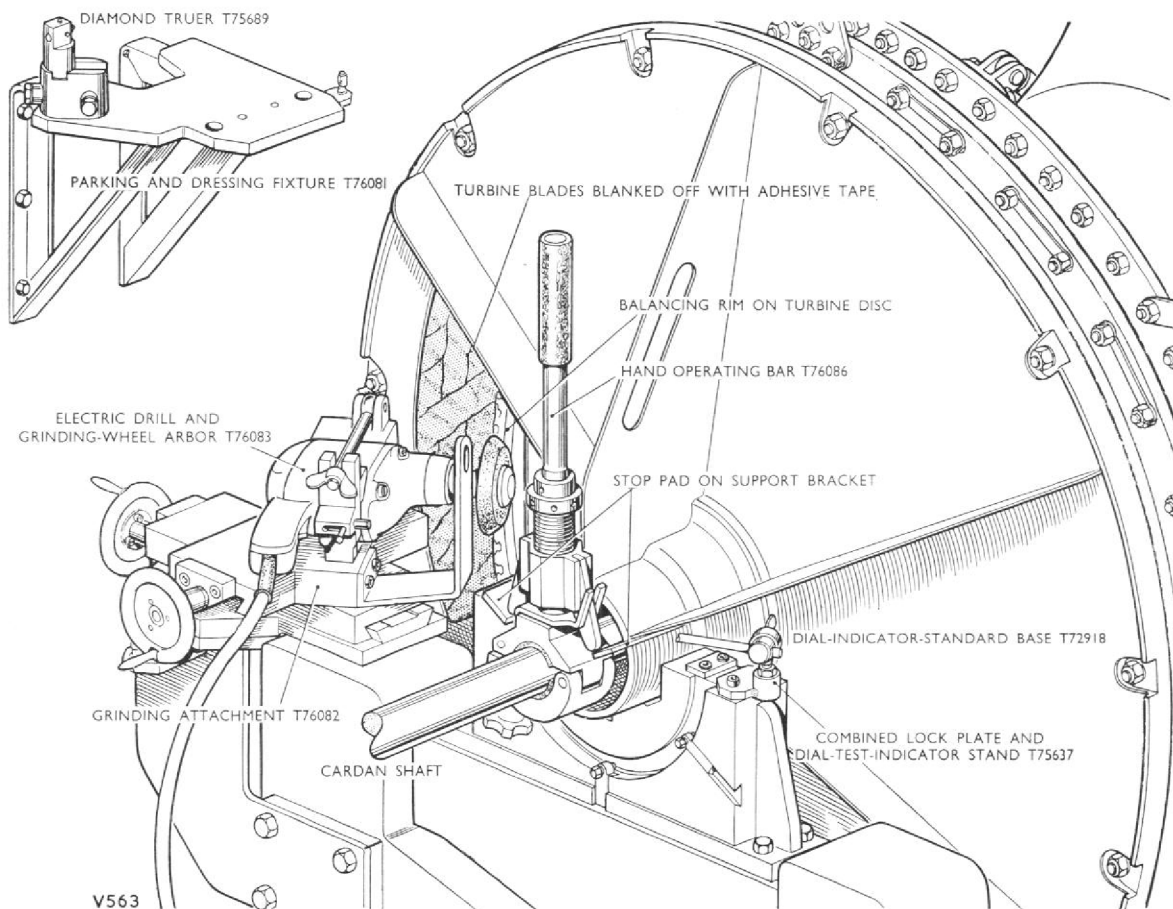


Fig. 11. Tools used when correcting unbalanced forces; extractor nozzle omitted for clarity.

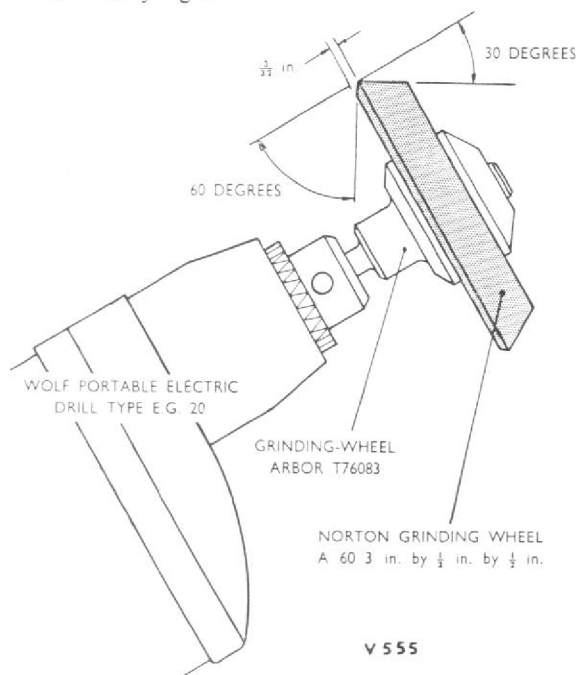


Fig. 12. Dimensions to which grinding wheel must be dressed.

1-inch segment is equivalent to a correction of about 2.25 grammes. Alternatively, if metal is removed from a segment covering two turbine blades, to a depth of $\frac{1}{4}$ of the depth of the balancing rim, the correction will be about 1 gramme; that is, a segment covering 10 blades by $\frac{1}{4}$ of the depth of the rim equals a correction of about 5 grammes. Neither of these guides is infallible as, during previous balancing operations, a shallow cut may have been taken from the balancing rim, and the extremities of this cut may lie beyond the limits of vision through the 'window' in the rear support bracket. In such cases, the removal of the suggested segments of balancing rim will effect a correction of less than the anticipated amount in proportion to the depth of the previous cut.

Having ascertained the amount and direction of the excessive unbalance at the periphery of the turbine disc, turn the main shaft until that portion of the balancing rim from which metal is to be removed, is visible through the 'window' in the rear support bracket, and proceed as follows.

1. To ensure that no abrasive dust can enter the engine, the turbine must be masked completely by means of adhesive tape (Fig. 11 and 13), or by any other suitable means. Efficient blanking of the turbine is essential as no dust ex-

tractor can be 100 per cent. efficient. Cover the turbine blades for about 12 inches on either side of the unbalance datum, right up to, but not covering, the balancing rim; leave the turbine disc free to rotate.

2. Mount grinding attachment T.76082, complete with grinding wheel arbor T.76083, on the support platform which is mounted at the rear of the left vertical support on the balancing machine (Fig. 11 and 13); support platform T.76085 was fitted to the machine whilst it was being set up, page 3, Op. 5. Grinding-wheel arbor T.76083 should be regarded as an integral part of its own individual electric drill and grinding attachment T.76082 as these are manufactured in the same tool room and at the same time, and an arbor which is transferred from one grinding attachment to another may not run true.
3. Clamp hand operating bar T.76086 to the $1\frac{1}{2}$ -inch Cardan shaft, positioning it so that the segment of the turbine disc balancing rim from which metal is to be removed, will be accessible, through the 'window' in the rear support bracket, to the grinding wheel, and so that the stops on the hand operating bar will engage the two stop pads which are welded to the rear support bracket. Using a small $\frac{5}{16}$ inch tommy bar in the six tommy-bar holes provided in the adjusting screw, adjust the stops so that the turbine disc can be swung through an arc which will permit the grinding wheel to remove sufficient metal to correct the unbalance.
4. Position extractor nozzle T.79056 over the grinding wheel, and clamp it to the anchor bracket on the grinding attachment by means of the $\frac{1}{4}$ in. B.S.F. wing nut and special plain washers. Carefully adjust the position of the nozzle so that the leading edge of its rubber

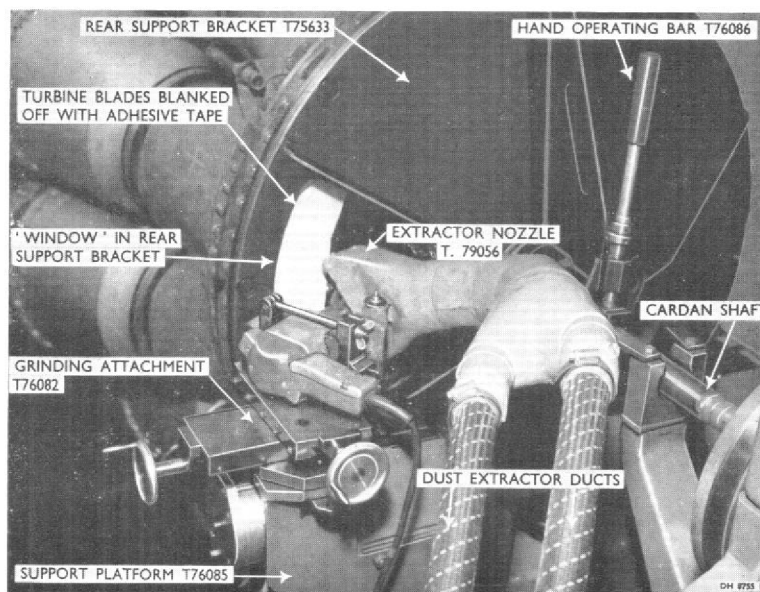


Fig. 13. Extractor nozzle in position ready for grinding.

nose bears lightly on the turbine disc balancing rim when the grinding wheel is just touching the rim; to ensure the maximum efficiency in the extraction of the abrasive dust which will be produced during the grinding operation. The reduction in grinding wheel diameter consequent upon successive re-dressing will necessitate readjustment of the positioning of this nozzle. Connect the outlet from the nozzle to a suitable dust extractor (Fig. 13).

5. Use the grinding attachment to remove the requisite amount of metal from the balancing rim on the turbine disc; refer to page 10. If the operator is inexperienced, or if a large correction is required, commence by removing half the estimated amount of metal and recheck the balance before removing any more; in case the direction of the unbalanced force has been altered. Where the specified grinding equipment and operating bar are not available, the required amount of metal may be removed by hand, **provided that great care is taken**, using a suitable portable hand grinder and grinding wheel. *Whichever method is employed, some efficient form of dust extraction is essential* to prevent the abrasive dust and swarf entering the engine. An alternative is to cover the whole of the turbine wheel with a sheet of waxed paper, sealing it to the turbine shroud with adhesive tape. Make a small hole in the paper, just large enough to expose the balancing rim over the area in which the correction is to be made, and seal the edges of this hole to the turbine disc by means of adhesive tape; when making corrections by hand, it is not necessary for the turbine disc to be free to rotate, as the necessary relative movement will be obtained by moving the hand grinder.
6. Remove the extractor nozzle, the grinding attachment, and the hand operating bar. Return the grinding attachment to the parking fixture, and, if necessary, re-dress the grinding wheel. Thoroughly clean the turbine disc, the rear of the engine, and the adjacent equipment, to remove all traces of swarf and abrasive dust; this should not be done in such a way that there is any risk of abrasive dust being blown into the engine—do **not** use a jet of compressed air. Remove the adhesive tape; or other blanking, from the turbine taking great care to avoid disturbing any grit adhering to it. Ensure that the turbine blades and disc are perfectly clean.
7. Recheck the balance, and, if necessary, repeat the foregoing operations until the balance is satisfactory. The inspection authority must record the amount and direction of any residual unbalance at both the turbine **and the impeller**; making a nil record if perfect balance has been achieved.

REMOVING ENGINE FROM MACHINE

1. Ensure that the balancing machine's bearing pedestals are **LOCKED**.
2. Refit the air-intake cover.

3. Reconnect, or retighten, the fuel pipe unions which were disconnected, or loosened; and, *Ghost 48 Mk. 2*, refit, or retighten, the plugs in the fuel supply pump and in the valve group and circulating pump unit.
4. Uncouple the balancing machine's Cardan shaft from the machine's driving disc.
5. Just take the weight of the engine on the crane; this must be done before the restraining bar is disconnected, as otherwise the complete engine may turn over in the machine.
6. Disconnect the restraining bar from the trunnion on the diffuser casing and swing this bar clear of the engine.
7. *If the engine is to be returned to the dismantling and assembly stand*. Remove the mounting trunnion from the diffuser casing.
8. Return the engine to the transport stand, or to the dismantling and assembly stand; during this operation take great care to ensure that neither the engine nor the balancing machine's Cardan shaft is accidentally damaged.
9. Remove the lifting sling.

REMOVING BALANCING EQUIPMENT FROM ENGINE

1. Unscrew the twelve slave nuts and bolts which secure the rear support bracket to the turbine shroud, and remove the support bracket.
2. Remove the four special nuts and bolts, and disconnect the balancing machine's Cardan shaft from the drive coupling on the turbine disc.
3. Unscrew the two special bolts which secure the drive coupling to the turbine disc, and remove the coupling.
4. Lubricate the turbine disc bolt threads with a thin film of Ragosine L.M. paste; this is best applied by means of a small, good quality brush. Ensuring that each is fitted in its correct, numbered, position, screw the two turbine disc bolts (which were removed whilst preparing the engine, page 5, Op. 4) through the holes in the turbine disc into the threaded holes in the hub shaft flange. Use a suitable torque wrench in conjunction with a $\frac{1}{2}$ in. B.S.F. socket to tighten these bolts, evenly and progressively, to the torque loading specified in chapter 22. Lock these bolt heads.
5. Refit the turbine disc blanking cover, and, if the engine is in a transport stand, reposition the rear support member.
6. Unscrew the eight slave bolts and remove the front support bracket.

Check the engine generally, and, if everything is satisfactory, transfer it to the Dispatch Department, for fitment of the front mounting brackets and for preparation for dispatch as described in chapter 37.

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